

**PROJECT MANUAL FOR:**

# **Lehi Pool Facilities Building Addition and Renovation**

451 East 200 South  
Lehi, Utah 84043

**ARCHITECT:**

EDA Inc. Architects  
9 Exchange Place, Suite #1100  
Salt Lake City, Utah 84111

November 11, 2013



Section 00 0111

Table of Contents

Division 00 -- Procurement and Contracting Requirements

Invitation to Bid

Section 1 – Scope of Work and Bid Pricing

Section 2 – Instructions to Bidders

Section 3 – General Terms and Conditions

Section 4 – Signature Form

Attachment 1 – Performance Bond

Attachment 2 – Schematics Floor Plan

Attachment 3 – Project Specifications

Division 01 -- General Requirements

01 1000 - Summary

01 2000 - Price and Payment Procedures

01 2300 - Alternates

01 2500 - Substitution Procedures

01 3000 - Administrative Requirements

01 3216 - Construction Progress Schedule

01 4000 - Quality Requirements

01 4216 - Definitions

01 5000 - Temporary Facilities and Controls

01 5713 - Temporary Erosion and Sediment Control

01 5813 - Temporary Project Signage

01 6000 - Product Requirements

01 7000 - Execution and Closeout Requirements

01 7419 - Construction Waste Management and Disposal

01 7800 - Closeout Submittals

01 7900 - Demonstration and Training

Division 02 -- Existing Conditions

02 4119 - Selective Demolition

Division 03 -- Concrete

03 1000 - Concrete Forming and Accessories

03 2000 - Concrete Reinforcing

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

03 3000 - Cast-In-Place Concrete

Division 04 -- Masonry

Not Used

Division 05 -- Metals

05 1200 - Structural Steel Framing

05 5000 - Metal Fabrications

05 5213 - Pipe and Tube Railings

Division 06 -- Wood, Plastics, and Composites

06 1000 - Rough Carpentry

06 1733 - Wood I-Joists

06 1800 - Glued-Laminated Construction

06 4100 - Architectural Wood Casework

Division 07 -- Thermal and Moisture Protection

07 1300 - Sheet Waterproofing

07 1900 - Water Repellents

07 2100 - Thermal Insulation

07 2500 - Weather Barriers

07 3113 - Asphalt Shingles

07 4263 - Cement Composite Wall Panels

07 5400 - Thermoplastic Membrane Roofing

07 6200 - Sheet Metal Flashing and Trim

07 9005 - Joint Sealers

Division 08 -- Openings

08 1113 - Hollow Metal Doors and Frames

08 3100 - Access Doors and Panels

08 3313 - Coiling Counter Doors

08 4313 - Aluminum-Framed Storefronts

08 7100 - Door Hardware

08 8000 - Glazing

08 8300 - Mirrors

Division 09 -- Finishes

09 2116 - Gypsum Board Assemblies

09 3000 - Tiling

09 5100 - Acoustical Ceilings

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

09 6500 - Resilient Flooring

09 6723 – Epoxy Resinous Flooring

09 6813 - Tile Carpeting

09 9100 - Painting

Division 10 -- Specialties

10 1400 - Signs

10 2113.13 - Metal Toilet Compartments

10 2113.19 - Phenolic Toilet Compartments

10 2813 - Toilet and Bath Accessories

10 4400 - Fire Protection Specialties

10 5100 - Lockers

10 5126 - Plastic Lockers

Division 11 -- Equipment

Not Used

Division 12 -- Furnishings

Not Used

Division 13 -- Special Construction

Not Used

Division 14 -- Conveying Equipment

Not Used

Division 21 -- Fire Suppression

Not Used

Division 22 -- Plumbing

22 0500 - Common Work Results for Plumbing

22 0513 - Common Motor Requirements for Plumbing Equipment

22 0517 - Sleeves and Sleeve Seals for Plumbing Piping

22 0518 - Escutcheons for Plumbing Piping

22 0519 - Meters and Gages for Plumbing Piping

22 0523 - General-Duty Valves for Plumbing Piping

22 0529 - Hangers and Supports for Plumbing Piping and Equipment

22 0533 - Heat Tracing for Plumbing Piping

22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment

22 0553 - Identification for Plumbing Pipes and Equipment

22 0700 - Plumbing Insulation

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- 22 0719 - Plumbing Piping Insulation
- 22 1116 - Domestic Water Piping
- 22 1119 - Domestic Water Piping Specialties
- 22 1123 - Domestic Water Pumps
- 22 1223 - Facility Indoor Potable-Water Storage Tanks
- 22 1316 - Sanitary Waste and Vent Piping
- 22 1319 - Sanitary Waste Piping Specialties
- 22 1413 - Facility Storm Drainage Piping
- 22 1423 - Storm Drainage Piping Specialties
- 22 4000 - Plumbing Fixtures
- 22 4713 - Drinking Fountains

Division 23 -- Heating, Ventilating, And Air Conditioning

- 23 0100 - Mechanical Requirements
- 23 0500 - Common Work Results for HVAC
- 23 0513 - Common Motor Requirements for HVAC Equipment
- 23 0519 - Meters and Gages for HVAC
- 23 0523 - General-Duty Valves for HVAC Piping
- 23 0529 - Hangers and Supports for HVAC Piping and Equipment
- 23 0548 - Vibration and Seismic Controls for HVAC
- 23 0550 - Operations and Maintenance of HVAC Systems
- 23 0553 - Identification for HVAC Piping and Equipment
- 23 0593 - Testing Adjusting and Balancing for HVAC
- 23 0713 - Duct Insulation
- 23 0800 - Commissioning Mechanical Systems
- 23 0900 - Building Automation System
- 23 0993 - Sequences of Operation
- 23 1123 - Facility Natural Gas Piping
- 23 3001 - Common Duct Requirements
- 23 3113 - Metal Ducts
- 23 3119 - HVAC CASINGS
- 23 3300 - Air Duct Accessories
- 23 3713 - Diffusers, Registers, and Grilles
- 23 5214 - Finned Water-Tube Boilers
- 23 5233 - Finned Water-Tube Boilers

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

23 7413 - Packaged Outdoor Central-Station Air-Handling Units

Division 25 -- Integrated Automation

Not Used

Division 26 -- Electrical

26 0500 - Common Work Results for Electrical

26 0519 - Low-Voltage Electrical Power Conductors and Cables

26 0526 - Grounding and Bonding for Electrical Systems

26 0529 - Hangers and Supports for Electrical Systems

26 0533 - Raceway and Boxes for Electrical Systems

26 0548 - Vibration and Seismic Controls for Electrical Systems

26 0553 - Identification for Electrical Systems

26 0923 - Lighting Control System

26 0924 - Lighting and Control Devices

26 2416 - Panelboards

26 2726 - Wiring Devices

26 2813 - Fuses

26 2913 - Enclosed Controllers

Division 27 -- Communications

Not Used

Division 28 -- Electronic Safety and Security

Not Used

Division 31 -- Earthwork

31 1000 - Site Clearing

31 2000 - Earth Moving

Division 32 -- Exterior Improvements

32 1313 - Concrete Paving

32 3119 - Decorative Iron Fencing and Gates

Division 33 -- Utilities

Not Used

End of Table of Contents





**Pool Facilities Building Renovation  
Bid No. 2013-7**



**Lehi City Corporation  
Leisure Services Department**

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**RESPONSES ARE DUE PRIOR TO:**

**November 26, 2013  
5:00 P.M. MST**

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*Preferred method is to submit electronically to:*

[www.bidsync.com](http://www.bidsync.com)

*Hard-Copy Responses may be mailed or hand-delivered to:*

Lehi City Purchasing Department  
Attn: Alyson Alger  
Bid No. 2013-7  
153 North 100 East  
Lehi, UT 84043

**Lehi City Corporation  
Leisure Services Department**

**Pool Facilities Building Renovation**

REFERENCE NUMBER: Bid No. 2013-7  
BID TITLE: "Pool Facilities Building Renovation"  
BID LOCATION: Lehi City, Utah  
  
SUBMISSION DEADLINE: November 26, 2013, 5 p.m. MST  
SUBMISSION PLACE: Lehi City Purchasing Office  
153 North 100 East  
Lehi, Utah 84043  
  
BID DESCRIPTION: This is a contract for the construction services for the renovation and remodel of the existing 6,500 square foot facilities building with an additional 1,500 square foot addition.  
  
BID CONTACT: Kim Cooper Steve Marchbanks  
Aquatics Section Manager Parks Division Manager  
801-836-1031 801-836-1023  
[kcooper@lehi-ut.gov](mailto:kcooper@lehi-ut.gov) [smarchbanks@lehi-ut.gov](mailto:smarchbanks@lehi-ut.gov)

BIDDERS: Carefully read all instructions, requirements and specifications. Fill out all forms properly and completely. Submit bids with appropriate supplements and/or samples. Please submit sealed bids through Bidsync.com or mail to the Lehi City Purchasing Office address above by the submission deadline. Bids received after November 26, 2013 at 5 p.m. MST will not be considered.

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Additional instructions for submitting bid:

- A. It is the responsibility of the Supplier to "Log In" through BidSync. For assistance contact BidSync at 1-800-990-9339.
- B. Questions regarding this bid should be submitted through BidSync. The Supplier may also contact Kim Cooper and Steve Marchbanks (see "Bid Contact" above).
- C. The recommended method to submit your bid is through BidSync. By using alternate methods of delivery, supplier bears all risks if documents are not received at the Purchasing Office prior to the submission deadline. Supplier should call to verify the purchasing agent has received the hard-copy bid prior to the bid closing.

**Table of Contents**

SECTION 1: SCOPE OF WORK AND BID PRICING ..... 4

SECTION 2: INSTRUCTIONS TO BIDDERS ..... 6

SECTION 3: GENERAL TERMS AND CONDITIONS ..... 10

SECTION 4: SIGNATURE FORM..... 17

ATTACHMENT 1: PERFORMANCE BOND..... 18

ATTACHMENT 2: SCHEMATICS FLOOR PLAN ..... 22

ATTACHMENT 3: PROJECT SPECIFICATIONS ..... 23

## SECTION 1: SCOPE OF WORK AND BID PRICING

### 1.1 SCOPE OF WORK

Lehi City Leisure Services Department is seeking bids from a professional contractor for the renovation and construction of the existing 6,500 square foot Outdoor Pool facilities building with a new 1,500 square foot addition. The addition will provide a family change area, life guard area, possible party room and future splash pad equipment building.

Lehi City has contracted with EDA Architects to complete a full architectural and engineering design for the renovation and construction of the Outdoor Pool facilities building. Contractors will work with EDA Architects to complete the construction according to the approved design. The following attachments provide a detailed description of the project:

- *Attachment 3: Schematics Floor Plan*
- *Attachment 4: Project Specifications*

### 1.2 TIMELINE TO COMPLETION

The Outdoor Pool Facilities Building bid solicitation and renovation will adhere to the following timeline:

<u>Date</u>	<u>Time</u>	<u>Item</u>
November 11, 2013	5 p.m. MST	Lehi City issues the bid solicitation.
November 14, 2013	9 a.m. MST	Pre-bid meeting at the Outdoor Pool.
November 18, 2013	5 p.m. MST	Deadline for Contractors to issue questions.
November 21, 2013	5 p.m. MST	Deadline for the City to issue addenda.
November 26, 2013	5 p.m. MST	Deadline to submit bids to the purchasing agent.
December 10, 2013	5 p.m. MST	Deadline for awarding the contract.
December 16, 2013	N/A	Construction begins (tentative).
May 9, 2014	N/A	Substantial completion of construction.

The construction start date is tentative and dependent on the Contractors proposed timeline. The City requires that substantial construction be completed on the project by the designated date to the point that the facility may open for business without restriction.

Bid documents and specifications for Bid No. 2013-7, "Pool Facilities Building Renovation," can be found online at [lehi-ut.gov/business/rfp](http://lehi-ut.gov/business/rfp) or on BidSync.com.

### 1.3 BID PRICING

The Bidder shall provide all services as described in the Scope of Work above and as necessary to complete the work shown in the attached documents. The total cost for the construction as referenced above is: \$\_\_\_\_\_

The City reserves the right to reject any and all bids and to waive any formality in the bids received, to accept or reject any or all of the items in the bid, and award the contract in whole or in part, if it is

deemed in the City's best interest. The City reserves the right to negotiate any and all elements of the bids, if any such action is deemed in the best interest of the City.

Bids shall be binding upon the Contractor for sixty (60) calendar days from submission deadline. A Bidder may withdraw or modify their bid any time prior to the submission deadline by written request, signed by the same authorized officer or agent who signed the original bid.

**SIGNATURE OF BIDDER**

***By*** \_\_\_\_\_

***Title*** \_\_\_\_\_

***Address*** \_\_\_\_\_

\_\_\_\_\_

***Email*** \_\_\_\_\_

***Date*** \_\_\_\_\_

**ACKNOWLEDGEMENT OF ADDENDUM RECEIVED**

***By*** \_\_\_\_\_

***Date*** \_\_\_\_\_

## **SECTION 2: INSTRUCTIONS TO BIDDERS**

### **2.1 SCOPE OF TERMS & CONDITIONS**

Before submitting a bid, respondents to this bid solicitation (Bidder) shall understand all contract conditions referred to in this document, and any addenda issued before the bid submission date. It shall be the Bidder's responsibility to ensure that the bid includes all addenda issued prior to the bid submission date. By submitting a bid, the Bidder acknowledges and accepts the Terms and Conditions described herein.

### **2.2 MINIMUM QUALIFICATIONS**

The Owner will accept bids from eligible contractors or firms with the ability to meet the following minimum qualifications:

- Five (5) or more years of experience in commercial construction as demonstrated through relevant experience and references.
- Minimum insurance coverage as required in Section 3.9 herein.
- A commitment to complete construction no later than May 9, 2013.
- Strong financial standing as demonstrated by a current, audited financial report.
- Furnish a Performance Bond as indicated in Section 3.18 herein.

### **2.3 BID RESPONSE**

The Bidder must submit a complete and concise response to the Request for Bid (RFB), demonstrating the ability to meet the requirements of this RFB. The contents of the bid submitted by the successful Bidder may become part of any contract awarded as a result of this solicitation. All responses must include the following sections:

#### *LETTER OF TRANSMITTAL*

The Letter of Transmittal must be signed by an authorized representative of the Bidder empowered with the right to bind the Bidder for the amounts estimated and terms proposed. The letter should include the name, address, telephone number and fax number of the person to be contacted, along with others who are authorized to represent the Bidder in dealing with this bid.

#### *COST PROPOSAL*

The response should include a detailed cost proposal allowing cost to be evaluated independently of other criteria. The cost proposal should include a lump-sum estimate for the project.

#### *SUPPLEMENTAL INFORMATION*

The bid response should also include supplementary information to demonstrate the Bidder's experience and qualifications. This information should include:

- Bidder's ability to meet insurance requirements explained in Section 3.9 herein.

- Names and qualifications of personnel assigned to the project.
- Brief description of previous projects similar in scope and size demonstrating the minimum experience required in Section 2.2 herein.
- Professional references.
- Current, audited financial report.
- A detailed proposed timeline demonstrating an ability to complete the project by May 9, 2014.

*SCHEDULE OF VALUES*

The three lowest bidders must submit a Schedule of Values for work over \$50,000 within 24 hours after the bid deadline. The schedule shall be categorized by type of work and list main subcontractors and subcontractor amount. Bidders who fail to submit the Schedule of Values will not be considered for the work described herein.

**2.4 SITE INSPECTION AND REVIEW**

It shall be the Bidder’s responsibility to inspect and review the Outdoor Pool Facilities Building prior to submitting a bid. Bidders interested in reviewing the facility should contact Kim Cooper, Aquatics Section Manager (see Bid Solicitation page for Bid Contact information).

**2.5 PRE-BID MEETING**

A Pre-bid meeting will be held to discuss the construction project and to answer any questions regarding this solicitation (see Section 1.2 for date). **Attendance is mandatory.** The meeting will be held at the Lehi City Outdoor Pool, located at 451 East 200 South in Lehi, at 9 a.m. MST.

**2.6 BID PRICING**

The pricing for all products or services shall be stated on the Bid Form and shall remain firm for the duration of the contract. No price changes, additions, or subsequent qualifications will be honored throughout the duration of the contract except with approved change orders (see *Section 3.21*). Pricing on all transportation, mobilization and other charges shall be prepaid by the contractor and included in the bid prices. The Bidder must indicate any additional charges not mentioned above or forfeit the right to payment for such items.

The Bidder will not be responsible for building permit fees, impact fees, or other City fees; however, the Bidder will be responsible for any taxes associated with the completion of the work. Lehi City is exempt from the payment of federal excise or Utah sales tax and therefore such taxes do not apply to the City (see Section 3.15 and 3.16 herein).

**2.7 BID PREPARATION COSTS**

Lehi City Corporation (Owner) is not liable for any cost incurred by the Bidder associated with the preparation of the bid or the negotiation of a contract for services prior to the issuing of the contract.

## **2.8 SUBSTANTIVE BIDS**

The Bidder certifies that: (a) the Bidder's bid is genuine and is not made in the interest of, or on behalf of, an undisclosed person, firm, or corporation; (b) the Bidder has not directly or indirectly induced or solicited any other Bidder(s) to put in a false bid; (c) the Bidder has not solicited or induced any other person, firm, or corporation to refrain or abstain from proposing a bid; (d) the Bidder has not sought by collusion to obtain for themselves any advantage over any other Bidder(s) or over the Owner; and (e) Bidder shall not violate or cause any person to violate the Utah Municipal Officers and Employees Ethics Act.

## **2.9 ADDENDUM TO THE RFB**

In the event that it becomes necessary to revise this RFB in whole or in part, an addendum will be provided to all Contractors on record as having received this RFB. A statement issued in an addendum shall have the effect of modifying a portion of the bid documents when the statement in the addendum specifies a section, paragraph or text, and states that it is to be so modified. No addenda will be issued after the date listed in Section 1.2 herein.

## **2.10 EVALUATION PROCESS**

All bids in response to this RFB will be evaluated in a manner consistent with Lehi City and Utah State Procurement Code 63g-6a-101, *et seq.* and all applicable rules, regulations, and policies.

In the initial phase of the evaluation process, the evaluation committee will review all bids timely received. First, non-responsive bids (those not conforming to RFB requirements) will be eliminated. Second, the remaining bids will be evaluated in a cursory manner to eliminate from further consideration those bids which in the judgment of the evaluation committee fail to offer sufficient and substantive provisions to warrant further consideration. Each Bidder bears sole responsibility for the items included, or not included, in the response submitted by that Bidder. The Owner reserves the right to disqualify any bid that includes significant deviations or exceptions to the terms, conditions and/or specifications in this RFB.

At the conclusion of this initial evaluation phase, selected bids will be chosen for detailed review and evaluation. The Owner reserves the right to be the sole judge as to the overall acceptability of any bid or to judge the individual merits of specific provisions within competing offers.

## **2.11 EVALUATION CRITERIA**

The Owner will judge the merit of all bids received in accordance with the general evaluation criteria listed below. Failure to provide any of the information requested may result in the bid being removed from further consideration. In determining lowest responsible bidder, the Owner will consider:

1. Cost (lump-sum)
2. Minimum Qualifications (see Section 2.2 herein)
3. Professional Reputation



## **2.12 AWARD OF CONTRACT**

Upon completion of the evaluation process, Owner may negotiate with and award the contract to the Bidder whose bid is determined to be most advantageous to the Owner. AWARD OF CONTRACT MAY BE MADE WITHOUT DISCUSSION AFTER BIDS ARE RECEIVED. The contract will incorporate the provisions of this RFB (including any addenda).

## **2.13 DISCLOSURE OF BID CONTENT**

Under the Government Records Access and Management Act, Section 63-2-101 et seq., Utah Code Ann. (1993 and supp. 1996), as amended ("GRAMA") certain information in the submitted bid may be open for public inspection. If the Bidder desires to have information contained in its bid protected from such disclosure, the Bidder may request such treatment by providing a "written claim of business confidentiality and a concise statement of reasons supporting the claim of business confidentiality" with the bid (GRAMA, Section 63G-2-309). Pricing elements of any bid will not be considered protected. All material contained in and/or submitted with the bid becomes the property of the Owner and may be returned only at the Owner's option.

## **SECTION 3: GENERAL TERMS AND CONDITIONS**

### **3.1 CONTRACT**

The intention of the Contract is to include all labor, material, transportation, and all other action necessary for the accomplishment of the project described herein.

The Contract shall be signed in triplicate by Lehi City Corporation (Owner) and the selected firm or agency that will complete the work (Contractor). The accepted proposal will be retained by the Owner for its files.

### **3.2 THE CONTRACTOR**

It is understood and agreed that the Contractor has satisfied itself as to the character of equipment required under this contract and all other matters which can in any way affect its execution and performance of this contract.

No verbal agreement or conversation with any officer, representative, agent, or employee of the Owner, either before or after the execution of this contract, shall affect or modify the terms or obligations herein contained. Any amendment to the Contract must be in writing, and must be executed by both parties to be valid.

### **3.3 THE OWNER**

The Owner shall have responsibility for the general supervision of the project contemplated by the Contract. The Contractor shall have authority to direct the program of manufacture and delivery to insure the performance of the Contract.

### **3.4 ASSIGNMENT**

Contractor shall not assign any portion of its obligations under the Contract without the prior written consent of Owner. Assignment or subcontracting shall in no way relieve the Contractor of any of its obligations under this Contract.

### **3.5 LAWS AND ORDINANCES**

The laws of the State of Utah shall govern any contract executed between the successful Contractor and Owner. Further, the place of performance and transaction of business shall be deemed to be in the County of Utah, State of Utah, and in the event of litigation, exclusive venue and place of jurisdiction shall be the State of Utah, and more specifically, the district court of Utah County, Utah.

### **3.6 TERMINATION, SUSPENSION OR ABANDONMENT**

**3.6.1** The Owner may terminate this agreement at any time upon seven (7) calendar days' written notice, in the event the services of the Contractor, in the sole judgment of the Owner, are unsatisfactory, because of the Contractor's failure to prosecute the work with diligence or within the time limit specified, or in the event that the Contractor, in the sole judgment of the Owner, has materially breached this Contract; provided, however, that after receiving the Owner's written notice, Contractor shall have five (5) working days (Monday-Friday) in which to cure any such deficiency.

**3.6.2** The Owner reserves the right, at its sole discretion, to suspend or abandon this Agreement at any time upon seven (7) calendar days written notice.

**3.6.3** In the event of termination, suspension or abandonment, without cause, the Owner shall pay the Contractor for services performed according to this agreement up to the time of such termination, suspension, or abandonment. The Contractor shall not be entitled to any additional compensation, award, or damages.

**3.6.4** All work accomplished by the Contractor prior to the date of any termination, suspension, or abandonment shall be recorded, and tangible work documents shall be transferred to and become the sole property of the Owner. If the Owner has terminated the Project without cause, and then requests to resume the Project with the Contractor after more than three (3) months from the date of termination, the Contractor's compensation shall be subject to renegotiation.

### **3.7 ACCEPTANCE OF SERVICES RENDERED**

Owner, through its designated agents and representatives, will be the sole determining judge of whether services rendered under the Contract satisfy the requirements as identified in the Contract.

### **3.8 INDEMNIFICATION**

To the fullest extent permitted by law, the Contractor shall indemnify, defend and hold harmless Owner, and any subsidiary or affiliate of the Owner, and its past, present and future agents, representatives and employees from and against all claims, damages, lawsuits, losses, liabilities, liens, cost, citations, penalties, fines and expenses, including but not limited to attorneys' fees arising out of or resulting from the performance of the work, provided that such claims, damages, losses, liabilities, liens, costs, citations, penalties, fines, or expenses are caused in whole or in part by any negligent, grossly negligent, reckless, or intentional act or omission by the Contractor, any subcontractor, anyone directly or indirectly employed by the Contractor or any subcontractor, or any party for whose acts the Contractor or Owner may be liable, regardless of whether liability is imposed upon such indemnified party. This indemnity obligation is intended to include, but is not limited to, the indemnification of Owner indemnified hereunder for damages apportioned to the Contractor, any subcontractor, or any person or entity directly or indirectly employed by any of them or any person or entity for whose acts any of them may be liable. Such obligation shall not be construed to negate, abridge or otherwise reduce any other right or obligation of indemnity, which may otherwise exist in favor of the Owner. In any and all claims against the Owner, or any subsidiary or affiliate, or any of its past, present or future agents, representatives or employees by any employee of the Contractor, any subcontractor, or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this paragraph shall not be limited in any way by any limitation on the amount or types of damages, compensations or benefits payable by or for the Contractor, or any subcontractor, the worker's or workman's compensation acts, disability benefit acts or other employee-benefit acts.

To the fullest extent by law, the Contractor shall indemnify, defend and hold harmless the Owner and any subsidiary or affiliate, and its past, present and future agents, representatives and employees from

and against all claims, damages, losses and expenses, including but not limited to attorney's fees, directly or indirectly arising out of or based in whole or in part upon:

- A. The Contractor's breach of any covenant or warranty of the Agreement.
- B. Any damage or loss to any property caused in whole or in part by the Contractor any subcontractor, or anyone directly or indirectly employed by any of them, or by any person or entity for whose acts any of them may be liable, except damages or loss attributable solely to acts or omissions of the Owner or its agents or employees and not attributable in any way to the fault or negligence of the Contractor.
- C. The Contractor's failure to comply with any applicable law, regulation, rule, or ordinance.
- D. The indemnity obligations of this section are in addition to the indemnity obligation of the Contractor under the indemnification section.

### **3.9 INSURANCE**

The Contractor shall, at its own expense, provide for the payment of Worker's Compensation benefits to its employees employed on or in connection with the work covered by this RFP, in accordance with applicable laws.

**3.9.1** The Contractor shall at its own expense, carry and maintain Comprehensive General Liability Insurance including but not limited to \$3,000,000.00 per occurrence

**3.9.2** The Contractor shall at its own expense, carry and maintain Automobile Public Liability insurance with Bodily Injury and Death Limits of at least \$250,000 for any one person and \$500,000 for any one occurrence, and Property Damage Limit per occurrences of \$250,000. Such benefits and such coverage as required herein or in any other documents to be considered a part hereof shall not be deemed to limit Contractor's liability under this Contract. It is intended by this section that the limits set forth herein will exceed applicable minimum requirements under Utah law. However, in the event that the foregoing amounts do not satisfy minimum requirements under applicable Utah law, the Contractor must maintain Automobile Public Liability insurance in amounts satisfying applicable Utah law.

**3.9.3** The Contractor shall, at its own expense, carry and maintain professional liability/errors and omissions insurance appropriate to the Contractor's profession, with a minimum coverage of \$3,000,000; with neither Contractor nor listed subcontractors having less than \$500,000 individually. The professional liability/errors and omissions insurance must be project specific with at least a one-year extended reporting period (or longer upon request).

**3.9.3** The Contractor shall likewise require its subcontractors, if any, to provide for such benefits and carry and maintain such insurance at no expense to the Owner.

**3.9.4** Before commencement on the project contemplated herein, and at any time thereafter upon written request by the Owner, the Contractor shall furnish Owner with a copy of certificates of insurance as evidence that policies providing the required coverage's and limits of insurance are in full force and effect.

**3.9.7** All insurance coverage furnished under this Contract, with the exception of Worker's Compensation and Employer's Liability, shall include the Owner, directors, officers, agents, and employees as additional insured with respect to the activities of the Contractor and its subcontractors.

Any certificate or certificates presented as evidence of insurance shall specify the date when such benefits and insurance expire. The Contractor agrees that said benefits and insurance shall be provided and maintained until after the entire work under the Contract has been performed and accepted. The Contractor shall provide Owner at least sixty (60) days advance written notice prior to cancellation, termination, or material alteration of said policies of insurance.

**3.10 EQUAL EMPLOYMENT OPPORTUNITY POLICY**

No Contractor of goods and/or services under this RFP or any contract shall discriminate against any employee, applicant for employment, or recipient of services on the basis of race, religion, color, sex, age, disability, or national origin.

**3.11 RECORD KEEPING AND AUDIT RIGHTS**

Any Contractor providing goods or services under any contract shall maintain accurate accounting records for all goods and services provided thereunder, and shall retain all such records for a period of at least three (3) years following termination of the Contract. Upon 48-hours notice and during normal business hours, the Owner, or any of its duly authorized representatives, shall have access to and the right to audit any records or other documents pertaining to the Contract. The Owner's audit rights shall extend throughout the term of the Contract and for a period of at least three (3) years thereafter.

**3.12 MANAGEMENT REPORTS**

Upon request the Contractor should be able to summarize and concisely report pertinent information to Owner in a timely manner, throughout the duration of any contract resulting from this RFP.

**3.13 FURTHER AGREEMENTS**

In addition to a proposal, Owner may from time to time require Contractor to execute certain additional documents or agreements, including without limitation, a Contract for the purpose of clarifying the intention of the parties with respect to providing the goods or services hereunder.

**3.14 RELATIONSHIP OF THE PARTIES**

In assuming and performing the obligations of any contract, Owner and any Contractor shall each be acting as independent parties and neither shall be considered or represent itself as a joint venture, partner, or employee of the other.

**3.15 TAXES – CONTRACTOR'S RESPONSIBILITY**

Contractor shall be responsible for and pay all taxes which may be levied or incurred against the Contractor in connection with the performance of any services under a Contract, including, but not limited to, taxes levied or incurred against Contractor's income, inventory, property, sales, or other taxes.

**3.16 TAXES - OWNER IS EXEMPT**

The Owner is exempt from the payment of any federal excise or any Utah sales tax (State of Utah Sales Tax Exemption number: Q41296). Exemption certification information appears on all purchase orders issued by Owner and such taxes will not apply to Owner unless otherwise noted. The price must be net, exclusive of taxes. However, when under established trade practice any federal excise tax is included in the list price, Contractor may quote the list price and shall show separately the amount of federal tax, either as a flat sum or as a percentage of the list price, which shall be deducted by Owner.

**3.17 ROYALTIES AND PATENTS**

The Contractor shall pay all applicable royalties and license fees. Contractor shall also defend all suits or claims for infringement of any patent rights and shall hold the Owner harmless from loss on account thereof.

**3.18 PERFORMANCE BOND**

The Contractor will be required to furnish both a Performance and a Payment Bond for the work as required by Owner in Attachment 1 and Attachment 2. The contractor must be eligible for and shall provide a performance bond for 100% of the bid of the project and a payment bond in the amount of \$25,000. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other Bonds as are required by the Contract Documents.

All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

If the surety on any Bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in the State of Utah, Contractor shall within 20 days thereafter substitute another Bond and surety.

**3.19 PAYMENTS**

These terms of payment cover payments to be made at the time of delivery of the project.

Unless otherwise specifically indicated in these contract documents, the terms of payment will be NET, 30 days upon delivery and acceptance of the work. A five percent (5%) retainage will be withheld until final product is reviewed and accepted by the City.

Invoices shall be submitted to:

Lehi City  
Attn: Accounts Payable  
153 North 100 East

**3.20 PAYMENT WITHHELD**

The Owner may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any estimate to such extent as may be necessary to protect itself from loss on account of:

**3.20.1** Defective services not remedied.

**3.20.2** Claims filed or reasonable evidence indicating probable filing of claims.

**3.20.3** Any other violation of or failure to comply with the provisions of this contract.

When the above grounds are removed, payment shall be made for amounts withheld because of them.

Owner reserves the right, in case of Contractor default, to procure the services from other sources while holding the defaulting Contractor responsible for any excess costs occasioned thereby.

**3.21 FAILURE TO MEET DEADLINE**

Unless otherwise noted by City, time is of the essence in the performance of all of the provisions of this Agreement. In the event the Contractor fails to meet any deadline contemplated by this Agreement, the Contractor shall pay the City a penalty of one-hundred dollars (\$100) per day for each day said deadline is unsatisfied. The City may deduct said \$100 per-day penalty from any amounts owed by the City to the Contractor. The penalty provisions of this Section 3.21 shall be in addition to any other remedies, damages, and the like available at law or in equity.

**3.22 ACCEPTANCE AND FINAL PAYMENT**

In a timely manner after the work has been completed and accepted, the Owner will make a final estimate stating that the Contract has been completed and that the work has been accepted by him under the terms and conditions thereof, with qualifications, if any, as stated and the balance found to be due the Contractor according to the terms of payment shall be paid by the Owner, as provided under 3.20 PAYMENTS of this document. Prior to filing a final estimate, Contractor shall file with the Owner a sworn statement that all items of labor entering into the work or services have been paid.

**3.23 CHANGE ORDERS**

All change orders shall be described on a Change Order Request Form, provided by the Owner, and be authorized in writing by Owner prior to proceeding with the work requested.

No payment shall be made to the Contractor for labor involved in correcting errors or omissions attributable in any way to the Contractor or its agents, subcontractors, and the like, which result in the final proposal not in accordance with the Specifications.

**3.24 WARRANTY**

**3.24.1** Contractor expressly warrants the workmanship, materials, and manner of construction provided for and contemplated by this contract and agrees that if the improvement contemplated

therein does not remain in good condition for a period of **one year** from the date of final acceptance by Owner, ordinary wear and tear excepted, because of defects in the workmanship, materials or manner of construction, then and in that event Contractor agrees that any and all repairs necessary to maintain said improvement and each and every part thereof in such good condition shall be made by said Contractor without additional charge or cost to the Owner.

**3.24.2** During the warranty period, Contractor shall make reasonable efforts to correct deficient work. Unless the specifications call for a shorter time, when the deficiency involves safety of the building occupants or patrons; the loss of or damage to property; or renders the building unusable for its intended purpose; Contractor shall respond and begin to correct the work no later than 24 hours after having received notice.

**3.24.3** In the event Contractor does not respond as indicated herein, Owner may elect to complete the work and contact Contractor surety for payment of completed work. Failure to respond to warranty work may be grounds to deny future work for Contractor.



**SECTION 4: SIGNATURE FORM**

Upon acceptance of this bid, the undersigned agrees to complete all required work as described in this bid document and in Attachments 1 and 2 and according to the terms and conditions described herein.

**SIGNATURE OF BIDDER**

*Name* \_\_\_\_\_

*Signature* \_\_\_\_\_

*Title* \_\_\_\_\_

*Address* \_\_\_\_\_

\_\_\_\_\_

*Date* \_\_\_\_\_

**ATTACHMENT 1: PERFORMANCE BOND**

**PERFORMANCE BOND**

(Title 63, Chapter 56, U.C.A. 1953, as Amended)

**KNOW ALL PERSONS BY THESE PRESENTS:**

That \_\_\_\_\_ hereinafter referred to as the "Principal," and \_\_\_\_\_, a corporation organized and existing under the laws of the State of \_\_\_\_\_ authorized to do business in the State of Utah and U.S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of \_\_\_\_\_, hereinafter referred to as the "Surety," are held and firmly bound to the City of Lehi, hereinafter referred to as the "Obligee," in the amount of 100 percent of the bid of the project for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS**, the Principal has entered into a certain written Contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_ 2013, to renovate the existing Outdoor Pool Facilities building and construct a new 1,500 square foot addition to the said building in Lehi, Utah, for Project No. 2013-7, which contract is hereby incorporated by reference herein,

**NOW, THEREFORE**, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents, including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, unless otherwise stated in the contract specifications, and the terms of the Contract as said Contract may be subject to modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of any of the Contract Documents or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of any of the Contract Documents or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

No right of action shall accrue on this bond for the use of any person or corporation other than the Obligee named herein or the heirs, executors, administrators or successors of the Obligee.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties. The parties also agree that this bond will remain in effect until the Obligee certifies, in writing at the completion of the warranty period, that the principal has met the full obligation.

**IN WITNESS WHEREOF**, the said Principal and Surety have signed and sealed this instrument this \_\_ day of \_\_\_\_\_, 2013.

**WITNESS OR ATTESTATION:**

**PRINCIPAL:** \_\_\_\_\_

\_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

(SEAL)

**WITNESS OR ATTESTATION:**

**SURETY:**

\_\_\_\_\_

By: \_\_\_\_\_

Attorney-in-Fact

(SEAL)

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

) ss.

COUNTY OF \_\_\_\_\_)

On this \_\_\_\_ day of \_\_\_\_\_, 2013, personally appeared before me \_\_\_\_\_, whose identity is personally know to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 2013.

My commission expires: \_\_\_\_\_

Resides at: \_\_\_\_\_

\_\_\_\_\_  
NOTARY PUBLIC

**ATTACHMENT 2: PAYMENT BOND**

**PAYMENT BOND**

(Title 63, Chapter 56, U.C.A. 1953, as Amended)

**KNOW ALL PERSONS BY THESE PRESENTS:**

That \_\_\_\_\_ hereinafter referred to as the "Principal," and \_\_\_\_\_, a corporation organized and existing under the laws of the State of \_\_\_\_\_ authorized to do business in the State of Utah and U.S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of \_\_\_\_\_, hereinafter referred to as the "Surety," are held and firmly bound to the City of Lehi, hereinafter referred to as the "Obligee," in the amount of Twenty Five Thousand Dollars (\$25,000.00) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS,** the Principal has entered into a certain written Contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_ 2013, to renovate the existing Outdoor Pool Facilities building and construct a new 1,500 square foot addition to the said building in Lehi, Utah, for Project No. 2013-7, which contract is hereby incorporated by reference herein,

**NOW, THEREFORE,** the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then at the City's sole discretion, this obligation may be terminated, and the bond, exonerated and released; otherwise it shall remain in full force and effect for a period of one year. Also that proof of release of all liens will be required before the bond may be released.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of any of the Contract Documents or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of any of the Contract Documents or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

**PROVIDED, HOWEVER,** that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on the Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

**IN WITNESS WHEREOF**, the said Principal and Surety have signed and sealed this instrument this \_\_ day of \_\_\_\_\_, 2013.

**WITNESS OR ATTESTATION:**

**PRINCIPAL:** \_\_\_\_\_

\_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

(SEAL)

**WITNESS OR ATTESTATION:**

**SURETY:**

\_\_\_\_\_

By: \_\_\_\_\_

Attorney-in-Fact

(SEAL)

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

) ss.

COUNTY OF \_\_\_\_\_)

On this \_\_\_\_ day of \_\_\_\_\_, 2013, personally appeared before me \_\_\_\_\_, whose identity is personally know to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

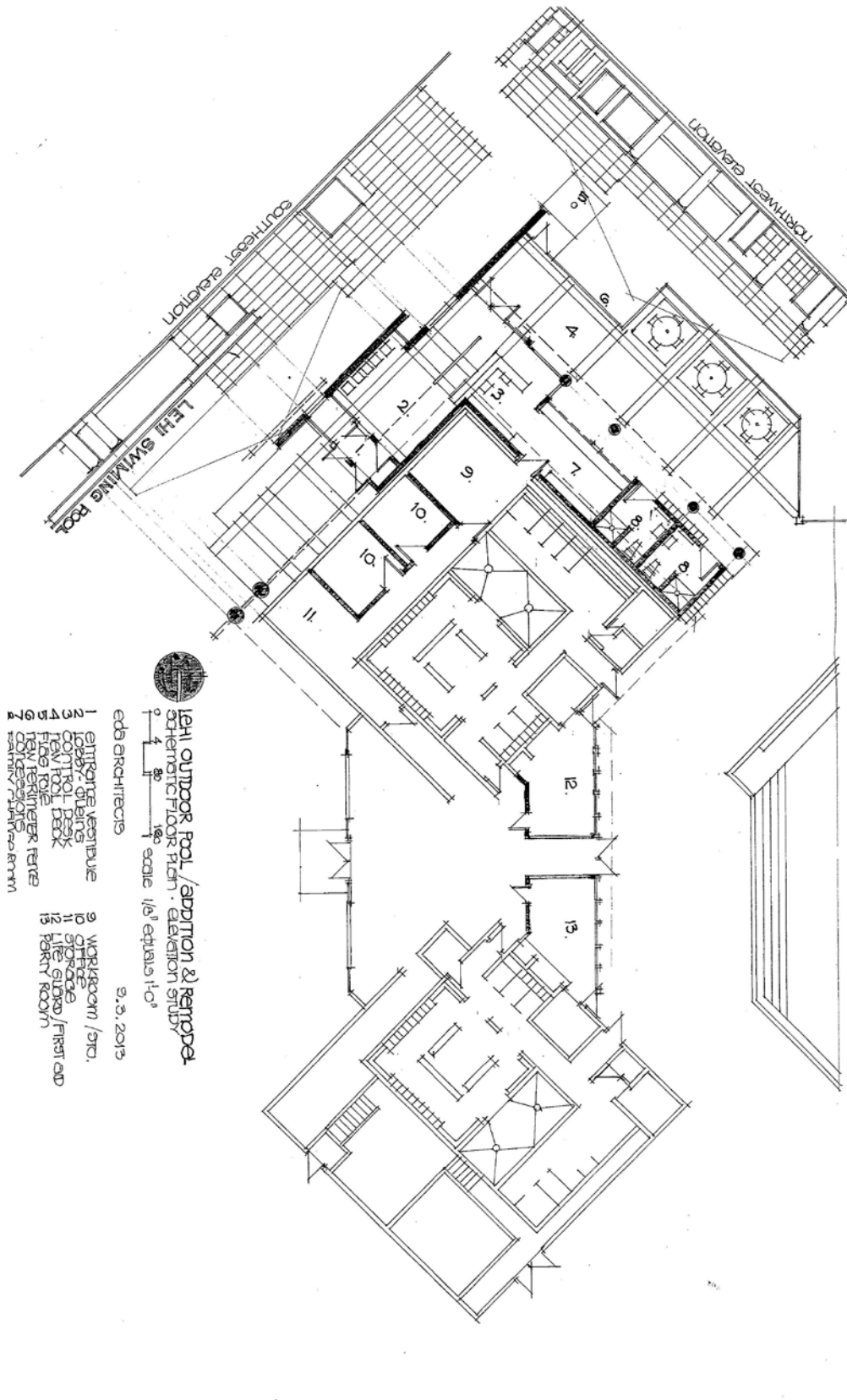
Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 2013.

My commission expires: \_\_\_\_\_

Resides at: \_\_\_\_\_

NOTARY PUBLIC

# ATTACHMENT 3: SCHEMATICS FLOOR PLAN



**ATTACHMENT 4: PROJECT SPECIFICATIONS**





## **DIVISION 01 – GENERAL REQUIREMENTS**

- 01 1000 - Summary
- 01 2000 - Price and Payment Procedures
- 01 2300 - Alternates
- 01 2500 - Substitution Procedures
- 01 3000 - Administrative Requirements
- 01 3216 - Construction Progress Schedule
- 01 4000 - Quality Requirements
- 01 4216 - Definitions
- 01 5000 - Temporary Facilities and Controls
- 01 5713 - Temporary Erosion and Sediment Control
- 01 5813 - Temporary Project Signage
- 01 6000 - Product Requirements
- 01 7000 - Execution and Closeout Requirements
- 01 7419 - Construction Waste Management and Disposal
- 01 7800 - Closeout Submittals
- 01 7900 - Demonstration and Training



## **SECTION 01 1000**

### **SUMMARY**

#### **PART 1 GENERAL**

##### **1.01 PROJECT**

- A. Project Name: Lehi Municipal Pool Building addition and remodeling, 451 East 200 South, Lehi, Utah 84043.
- B. Owner's Name: Lehi City Corporation.
- C. Architect's Name: EDA Architects, 9 Exchange Place (The Boston Building), Suite 1100, Salt Lake City, Utah 84111.

##### **1.02 RELATED DOCUMENTS**

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

##### **1.03 CONTRACT DESCRIPTION**

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 5200 - Agreement Form.

##### **1.04 OWNER OCCUPANCY**

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

##### **1.05 CONTRACTOR USE OF SITE AND PREMISES**

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Provide access to and from site as required by law and by Owner:
  - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.

##### **1.06 SPECIFICATION SECTIONS APPLICABLE TO ALL CONTRACTS**

- A. Unless otherwise noted, all provisions of the sections listed below apply to all contracts. Specific items of work listed under individual contract descriptions constitute exceptions.
- B. Section 01 2000 - Price and Payment Procedures.
- C. Section 01 3000 - Administrative Requirements.
- D. Section 01 3216 - Construction Progress Schedule.
- E. Section 01 4000 - Quality Requirements.
- F. Section 01 4219 - Reference Standards.
- G. Section 01 5000 - Temporary Facilities and Controls.
- H. Section 01 6000 - Product Requirements.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- I. Section 01 7000 - Execution and Closeout Requirements.
- J. Section 01 7800 - Closeout Submittals.

**1.07 CONTRACT NO. - GENERAL CONSTRUCTION**

- A. Division 01 - General Requirements:
  - 1. Specification sections listed above.
  - 2. Section 01 7000 - Execution and Closeout Requirements: Basic project engineering and layout.
  - 3. Section 01 5000: Payment of costs of temporary utilities and services consumed.
  - 4. Section 01 5000: Temporary heating, cooling, and ventilating.
  - 5. Section 01 5000 - Temporary Facilities and Controls: Provide debris receptacles, remove debris from site.
  - 6. Section 01 5000 - Temporary Facilities and Controls: Erosion control structures.
  - 7. Section 01 7000 - Execution and Closeout Requirements: Final cleaning.
- B. Provide all Work except Work specifically assigned to other contractors in this Section.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## **SECTION 01 2000**

### **PRICE AND PAYMENT PROCEDURES**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Price and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

##### **1.02 RELATED REQUIREMENTS**

- A. Document 00 7200 - General Conditions: Additional requirements for progress payments, final payment, changes in the Work.

##### **1.03 SCHEDULE OF VALUES**

- A. Form to be used: American Institute of Architects standard forms.
- B. Electronic media printout including equivalent information may be considered in lieu of standard form specified; submit sample to Architect for approval in writing.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 24 hours after receipt of bids.
- E. Acceptance of Schedule of Values is subject to Architect's review. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment. Provide additional breakdown as requested by the Architect.
- F. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Provide at least one line item for each Specification Section. Identify site mobilization, bonds and insurance, and site demobilization.
- G. Round amounts to nearest whole dollar, total shall equal the Contract Sum.
- H. Include within each line item, a direct proportional amount of Contractor's overhead and profit.
- I. Revise schedule to list approved Change Orders, with each Application For Payment.

##### **1.04 APPLICATIONS FOR PROGRESS PAYMENTS**

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Form to be used: AIA document G702, Application and Certificate for Payment.
- C. Electronic media printout including equivalent information may be considered in lieu of standard form specified; submit sample to Architect for approval in writing.
- D. Forms filled out by hand will not be accepted.
- E. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by Owner.
- F. The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the

period indicated in the Agreement.

- G. For each item, provide a column for listing each of the following:
  - 1. Item Number.
  - 2. Description of work.
  - 3. Scheduled Values.
  - 4. Previous Applications.
  - 5. Work in Place and Stored Materials under this Application.
  - 6. Authorized Change Orders.
  - 7. Total Completed and Stored to Date of Application.
  - 8. Percentage of Completion.
  - 9. Balance to Finish.
  - 10. Retainage.
- H. Execute certification by notarized signature of authorized officer.
- I. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed.
- J. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
- K. Submit three notarized copies of each Application for Payment.
- L. Include the following with the application:
  - 1. Transmittal letter as specified for Submittals in Section 01 3000.
  - 2. Construction progress schedule, revised and current as specified in Section 01 3000.
  - 3. Partial release of Mechanic's Liens from Subcontractors, sub-subcontractors and suppliers and any entity involved in the Work covered by the application, who is lawfully entitled to file a lien.
    - a. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
    - b. When an application shows completion of an item, submit final and full waivers.
    - c. Owner reserves the right to designate which entities involved in the Work must submit waivers.
    - d. Submit waivers of lien on forms executed in a manner acceptable to the Owner.
  - 4. Project record documents as specified in Section 01 7800, for review by Owner which will be returned to the Contractor.
  - 5. Affidavits attesting to off-site stored products.
- M. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.
- N. 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. Construction schedule.
  - 4. Submittal schedule.
  - 5. List of Contractor's and subcontractors staff assignments.
  - 6. Copies of building permit.
  - 7. Copies of authorizations and licenses from authorities having jurisdiction for the performance of the Work.
  - 8. Initial progress report.
  - 9. Report of preconstruction conference.
  - 10. Certificates of insurance.

11. Performance and payment bonds.

- O. 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.

**1.05 MODIFICATION PROCEDURES**

- A. For minor changes not involving an adjustment to the Contract Price or Contract Time, Architect will issue instructions directly to Contractor on AIA Form G710, Architectural Supplemental Instructions.
- B. For some changes, Architect will issue a document, AIA Form G714, Construction Change Directive, signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
1. The document will describe the required changes and will designate method of determining any change in Contract Price or Contract Time.
  2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document, AIA Form G709, Proposal Request, that includes a detailed description of a proposed change with supplementary or revised drawings and specifications if required and a change in Contract Time for executing the change. Contractor shall prepare and submit a fixed price quotation within seven days.
- D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Price and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01 6000.
- E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
  2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
  3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
  4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- F. Substantiation of Costs: Provide full information required for evaluation.
1. Provide following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.
  2. Support each claim for additional costs with additional information:
    - a. Origin and date of claim.
    - b. Dates and times work was performed, and by whom.
    - c. Time records and wage rates paid.
    - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
  3. For Time and Material work, submit itemized account and supporting data after completion

of change, within time limits indicated in the Conditions of the Contract.

- G. Execution of Change Orders: Architect will issue Change Orders for signatures of parties on AIA Document G701, Change Order, as provided in the Conditions of the Contract.
- H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.
- I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- J. Promptly enter changes in Project Record Documents.

#### **1.06 APPLICATION FOR FINAL PAYMENT**

- A. 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.
- B. 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. "Contractor's Affidavit of Payment of Debts and Claims."
  - 5. "Contractor's Affidavit of Release of Liens."
  - 6. "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**



## **SECTION 01 2300**

### **ALTERNATES**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Description of alternates.

##### **1.02 RELATED REQUIREMENTS**

- A. Document 00 2113 - Instructions to Bidders: Instructions for preparation of pricing for alternatives.
- B. Document 00 5200 - Agreement Form: Incorporating monetary value of accepted alternatives.

##### **1.03 ACCEPTANCE OF ALTERNATES**

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each alternate.

##### **1.04 SCHEDULE OF ALTERNATES**

- A. Alternate No. 1: Exterior Monument Sign:
  - 1. Provide all material, equipment and labor for a new exterior monument sign as detailed on the drawings, including column supports, associated steel, letters and lighting.
- B. Alternate No. 2: Asphalt Shingles:
  - 1. Provide all material, equipment and labor to remove all existing asphalt shingles and underlayment and installing new asphalt shingles, underlayment, flashings, vents and associated items for a complete re-roof.
- C. Alternate No. 3: Plastic Lockers:
  - 1. Provide all material, equipment and labor to provide and install new plastic lockers as specified in lieu of metal lockers as specified.
- D. Alternate No. 4: Phenolic Toilet Compartments:
  - 1. Provide all material, equipment and labor to provide and install new phenolic toilet compartments as specified in lieu of baked enamel metal toilet compartments as specified.
- E. Alternate No. 5: Exterior Metal Lockers:
  - 1. Provide all material, equipment and labor to provide and install new exterior metal lockers as specified.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**



## SECTION 01 2500

### SUBSTITUTION PROCEDURES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Sections:
  - 1. Division 01 Section "Alternates" for products selected under an alternate.
  - 2. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
  - 3. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

##### 1.02 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

##### 1.03 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 provided at the end of this Section.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    - 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. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. Certificates and qualification data, where applicable or requested.
    - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.

- j. 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 date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - m. 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 seven 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 seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### **1.04 QUALITY ASSURANCE**

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

#### **1.05 PROCEDURES**

- A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

### **PART 2 - PRODUCTS**

#### **2.01 SUBSTITUTIONS**

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
  - 1. 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:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

B. Substitutions for Convenience: Not allowed, unless otherwise indicated.

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION 01 2500**





## SUBSTITUTION REQUEST

Project: \_\_\_\_\_ Substitution Request Number: \_\_\_\_\_  
\_\_\_\_\_  
From: \_\_\_\_\_  
To: \_\_\_\_\_ Date: \_\_\_\_\_  
\_\_\_\_\_  
A/E Project Number: \_\_\_\_\_  
Re: \_\_\_\_\_ Contract For: \_\_\_\_\_

Specification Title: \_\_\_\_\_ Description: \_\_\_\_\_  
Section: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_

Trade Name: \_\_\_\_\_ Model No.: \_\_\_\_\_

Installer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History:  New product  2-5 years old  5-10 yrs old  More than 10 years old

Differences between proposed substitution and specified product: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: \_\_\_\_\_  
\_\_\_\_\_

Similar Installation:

Project: \_\_\_\_\_ Architect: \_\_\_\_\_

Address: \_\_\_\_\_ Owner: \_\_\_\_\_

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

Proposed substitution affects other parts of Work:  No  Yes; explain \_\_\_\_\_  
\_\_\_\_\_

Savings to Owner for accepting substitution: \_\_\_\_\_ (\$ \_\_\_\_\_).

Proposed substitution changes Contract Time:  No  Yes [Add] [Deduct] \_\_\_\_\_ days.

Supporting Data Attached:  Drawings  Product Data  Samples  Tests  Reports

**SUBSTITUTION  
REQUEST  
(Continued)**

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: \_\_\_\_\_

Signed by: \_\_\_\_\_

Firm: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_

Attachments: \_\_\_\_\_

**A/E's REVIEW AND ACTION**

- Substitution approved - Make submittals in accordance with Specification Section 01330.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

Additional Comments:  Contractor  Subcontractor  Supplier  Manufacturer  A/E  \_\_\_\_\_



## **SECTION 01 3000**

### **ADMINISTRATIVE REQUIREMENTS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Preconstruction meeting.
- B. Subcontractor mobilization meeting.
- C. Progress meetings.
- D. Requests for Information (RFI).
- E. Progress photographs.
- F. Submittals for review, information, and project closeout.
- G. Number of copies of submittals.
- H. Submittal procedures.

##### **1.02 RELATED REQUIREMENTS**

- A. Document 00 7200 - General Conditions: Dates for applications for payment.
- B. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION**

##### **3.01 PRECONSTRUCTION MEETING**

- A. Contractor will schedule a meeting after Award of Contract.
- B. Attendance Required:
  - 1. Owner.
  - 2. Architect.
  - 3. Consultants
  - 4. Contractor.
  - 5. Major subcontractors.
  - 6. Contractor's on-site personnel.
- C. Agenda:
  - 1. Introduction of personnel representing the parties to the Contract including the Owner, Contractor and Architect and their duties.
  - 2. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 3. Scheduling.
  - 4. Long lead items.
  - 5. Procedures for processing field decisions and Change Orders.
  - 6. Procedures for RFIs.
  - 7. Procedures for testing and inspections.
  - 8. Procedures for processing Applications for Payment.
  - 9. Submittal procedures.
  - 10. Distribution of Contract Documents. Coordinate which version of Contract Documents to be used as the construction set.
  - 11. Preparation of Record Drawings.

12. Use of premises and existing building if applicable.
  13. Work restrictions.
  14. Owner's occupancy requirements.
  15. Responsibility for temporary facilities and controls.
  16. Construction waste management and recycling.
  17. Parking availability.
  18. Office, work and storage areas.
  19. First aid.
  20. Security.
  21. Progress cleaning.
  22. Working hours.
- D. Architect will record and distribute copies of the minutes within three days after meeting to Owner, Consultants and Contractor.
- E. Contractor to submit copies of the minutes to subcontractors, sub-subcontractors and other participants and those affected by decisions made.

### **3.02 PREINSTALLATION CONFERENCES**

- A. Conduct a preinstallation conference at the Project site for each construction activity so indicated and those requested by the Contractor, Architect or Owner.
- B. Coordinate preconstruction conference times with Owner and Architect.
- C. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination with other materials and installations that have preceded or will follow shall attend the meeting.
- D. Agenda:
1. The Contract Documents.
  2. Options.
  3. Related RFIs.
  4. Related Change Orders.
  5. Purchases.
  6. Deliveries.
  7. Submittals.
  8. Review of Mockup.
  9. Possible conflicts.
  10. Compatibility problems.
  11. Time schedules.
  12. Weather limitations.
  13. Manufacturer's written recommendations.
  14. Manufacturer's written installation instructions.
  15. Warranty requirements.
  16. Compatibility of materials.
  17. Acceptability of substrates.
  18. Temporary facilities and controls.
  19. Space and access limitations.
  20. Regulations of authorities having jurisdiction.
  21. Testing and inspection requirements.
  22. Installation procedures.
  23. Coordination of other work.
  24. Required performance results.
  25. Protection of adjacent work.
  26. Protection of completed work.
  27. Protection of construction and personnel.

- E. Record minutes of the meeting and distribute two copies to the Architect, participants, those who should have participated and those affected by decisions made within two days of the meeting.
  - 1. Record significant conference discussions, agreements and disagreements, including required corrective measures and actions.
- F. 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 reconvened the conference at earliest feasible date.

### **3.03 PROGRESS MEETINGS**

- A. Contractor shall schedule and administer meetings throughout progress of the Work at minimum weekly intervals.
- B. Contractor to make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Job superintendent, contractors, subcontractors, suppliers, Owner, Architect, and any entity as appropriate to agenda topics for each meeting including those entities involved in planning, coordination or performance of future activities. All participants at the meetings shall be familiar with the Project and authorized to conclude matters relating to the Work.
- D. Agenda:
  - 1. Review minutes of previous meetings.
  - 2. Review of Work progress and construction schedule.
  - 3. Field observations, issues, and decisions.
  - 4. Identification of issues that impede, or may impede, planned progress.
  - 5. Review of submittals schedule and status of submittals.
  - 6. Review of quality and work standards.
  - 7. Review of construction administration documents.
  - 8. Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.04 CONSTRUCTION PROGRESS SCHEDULE - See Section 01 3216**

### **3.05 REQUESTS FOR INFORMATION (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 or Construction Manager.
  - 5. Title of RFI
  - 6. RFI number, numbered sequentially.
  - 7. Specification Section number and title and related paragraphs, as appropriate.

8. Drawing number and detail references, as appropriate.
  9. Field dimensions and conditions, as appropriate.
  10. 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.
  11. Contractor's signature.
  12. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
    - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Hard-Copy RFIs:
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow eleven working days for Architect's response for each RFI. RFIs received after 1:00 PM.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 1 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.
- F. 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.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number with RFI Title. Review log at each Progress Meeting. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. Title of RFI.
  5. RFI number including RFIs that were dropped and not submitted.
  6. RFI description.
  7. Date the RFI was submitted.
  8. Date Architect's response was received.
  9. Retain one of two subparagraphs below. First is for use with AIA Document A201; second is for use with EJCDC Document 1910-8.
  10. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  11. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

### **3.06 PROGRESS PHOTOGRAPHS**

- A. Take new photographs every two weeks and maintain a set of all photographs at the Project site for reference.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of Work, acceptable to Architect. This photographer can be a member of the Contractors staff if acceptable to the Owner and Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
  - 1. Completion of site clearing.
  - 2. Excavations in progress.
  - 3. Foundations in progress and upon completion.
  - 4. Structural framing in progress and upon completion.
  - 5. Enclosure of building, upon completion.
  - 6. Final completion, minimum of twenty photos.
- E. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
  - 1. Delivery Medium: Via email with project record photo CD, when requested by Architect
  - 2. File Naming: Include project identification, date and time of view, and view identification.
  - 3. Photo CD(s): Provide 1 copy including all photos cumulative to date and PDF file(s), with files organized in separate folders by submittal date.

### **3.07 SUBMITTALS - GENERAL**

- A. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Highlight, encircle or otherwise specifically identify deviations from the Contract Documents on submittals.
- C. Make resubmittals in same form and number of copies as initial submittal.
- D. Use only final submittals for construction.

### **3.08 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  - 1. Product data: Collect information into a single submittal for each element of construction and type of product or equipment.
    - a. 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.
    - b. Mark each copy of each submittal to show which products and options are applicable.
    - c. Include the following information as applicable:
      - 1) Manufacturer's written recommendations.
      - 2) Manufacturer's product specifications.
      - 3) Manufacturer's installation instructions.
      - 4) Color charts.
      - 5) Manufacturer's catalog cuts.
      - 6) Wiring diagrams.
      - 7) Standard product operation and maintenance manuals.
      - 8) Compliance with specified reference standards.
      - 9) Testing by recognized testing agency.
      - 10) Application of testing agency labels and seals.
      - 11) Notation of coordination requirements.
    - d. Submit Product Data concurrent with Samples.

2. Shop drawings: Prepare Project-specific information, drawing accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
    - a. Fully illustrate requirements in the Contract Documents. Include the following information as applicable:
      - 1) Dimensions.
      - 2) Identification of products.
      - 3) Fabrication and installation drawings.
      - 4) Roughing-in and setting diagrams.
      - 5) Wiring diagrams showing manufacturer installed and field installed wiring, including power, signal and control wiring.
      - 6) Shopwork manufacturing instructions.
      - 7) Templates and patterns.
      - 8) Schedules.
      - 9) Design calculations.
      - 10) Compliance with specified standards.
      - 11) Notation of coordination requirements.
      - 12) Relationship to adjoining construction clearly indicated.
      - 13) Seal and signature of professional engineer if specified.
  3. Samples for selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures and patterns available.
  4. Samples for verification: Submit samples of size requested, prepared from same material to be used for the Work, cured and finished in a 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 necessarily limited to: 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.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

### **3.09 SUBMITTALS FOR INFORMATION**

- A. When the following are specified in individual sections, submit them for information:
1. Design data.
  2. Certificates.
  3. Test reports.
  4. Inspection reports.
  5. Manufacturer's written installation instructions.
  6. Manufacturer's field reports.
  7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

### **3.10 SUBMITTALS FOR PROJECT CLOSEOUT**

- A. When the following are specified in individual sections, submit them at project closeout:
1. Project record documents.
  2. Operation and maintenance data.
  3. Warranties.
  4. Bonds.

5. Other types as indicated.

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

### **3.11 NUMBER OF COPIES OF SUBMITTALS**

A. Documents for Review:

1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit the number of copies that Contractor requires, plus two copies that will be retained by Architect.
2. Larger Sheets, Not Larger Than 36 x 48 inches: Submit the number of opaque reproductions that Contractor requires, plus two copies that will be retained by Architect.

B. Documents for Information: Submit two copies.

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

D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.

1. After review, produce duplicates.
2. Retained samples will not be returned to Contractor unless specifically so stated.

### **3.12 SUBMITTAL PROCEDURES**

A. Transmit each submittal with AIA Form G810.

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

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

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

E. Deliver submittals to Architect at business address.

F. Schedule submittals to expedite the Project, and coordinate submission of related items.

G. For each submittal for review, allow 21 days excluding delivery time to and from the Contractor.

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

I. Provide space for Contractor and Architect review stamps.

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

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

L. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

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

N. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**3.13 DELEGATED DESIGN**

- A. Where professional design services or certifications by a design professional are specifically required of the Contractor by the Contract Documents, provide products and systems complying with performance and design criteria indicated.
- B. Submit six copies of a statement, signed and sealed by the responsible design professional, licensed in the State the Project is located, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

**END OF SECTION**



## **SECTION 01 3216**

### **CONSTRUCTION PROGRESS SCHEDULE**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Preliminary schedule.
- B. Construction progress schedule, with network analysis diagrams and reports.

##### **1.02 SUBMITTALS**

- A. Within 10 days after date established in Notice to Proceed, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule at the first project meeting of each month.

##### **1.03 QUALITY ASSURANCE**

- A. Contractor's Administrative Personnel: 2 years minimum experience in using and monitoring CPM schedules on comparable projects.

##### **1.04 SCHEDULE FORMAT**

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Diagram Sheet Size: Maximum 22 x 17 inches or width required.
- C. Scale and Spacing: To allow for notations and revisions.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION**

##### **3.01 PRELIMINARY SCHEDULE**

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

##### **3.02 CONTENT**

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- C. Provide legend for symbols and abbreviations used.

##### **3.03 NETWORK ANALYSIS**

- A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method.
- B. Illustrate order and interdependence of activities and sequence of work; how start of a given

activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.

- C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
  - 1. Preceding and following event numbers.
  - 2. Activity description.
  - 3. Estimated duration of activity, in maximum 15 day intervals.
  - 4. Earliest start date.
  - 5. Earliest finish date.
  - 6. Actual start date.
  - 7. Actual finish date.
  - 8. Total and free float; float time shall accrue to Owner and to Owner's benefit.
  - 9. Percentage of activity completed.
- D. Required Reports: List activities in sorts or groups:
  - 1. Supply reports as requested by the Architect or Owner.

### **3.04 REVIEW AND EVALUATION OF SCHEDULE**

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

### **3.05 UPDATING SCHEDULE**

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Update diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

### **3.06 DISTRIBUTION OF SCHEDULE**

- A. Distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

**END OF SECTION**

## **SECTION 01 4000**

### **QUALITY REQUIREMENTS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. References and standards.
- B. Quality assurance submittals.
- C. Mock-ups.
- D. Control of installation.
- E. Tolerances.
- F. Testing and inspection services.
- G. Manufacturers' field services.

##### **1.02 RELATED REQUIREMENTS**

- A. Document 00 7200 - General Conditions: Inspections and approvals required by public authorities.
- B. Section 01 3000 - Administrative Requirements: Submittal procedures.
- C. Section 01 4216 - Definitions.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008.
- B. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2007a.
- C. ASTM C 1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2007.
- D. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2004a.
- E. ASTM E 329 - Standard Specification for Agencies Engaged Construction Inspection and/or Testing; 2007a.
- F. ASTM E 543 - Standard Specification for Agencies Performing Nondestructive Testing; 2008.

##### **1.04 CONFLICTING REQUIREMENTS**

- A. General: If compliance with one 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 the Architect for a decision before proceeding.
- B. Minimum Quality or Quantity Levels: The quality or quantity level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quality or quantity 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.

## 1.05 SUBMITTALS

- A. Testing Agency Qualifications:
  - 1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test/inspection.
    - h. Date of test/inspection.
    - i. Results of test/inspection.
    - j. Conformance with Contract Documents.
    - k. When requested by Architect, provide interpretation of results.
  - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
  - 1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Permits, Licenses and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records and similar documents established for compliance with standards and regulations bearing on performance of the Work.

## 1.06 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except

where a specific date is established by applicable code.

- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

#### **1.07 TESTING AND INSPECTION AGENCIES**

- A. Owner will employ and pay for services of an independent testing agency to perform specified testing.
- B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing and inspection. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction.
  - 1. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
- C. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform specified testing.
- D. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- E. Contractor Employed Agency:
  - 1. Testing agency: Comply with requirements of ASTM E 329, ASTM E 543, ASTM C 1021, ASTM C 1077, and ASTM C 1093.
  - 2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
  - 3. Laboratory: Authorized to operate in Utah.
  - 4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
  - 5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

#### **1.08 SPECIAL TESTS AND INSPECTIONS**

- A. Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction.
- B. Responsibilities of testing agency or special inspector:
  - 1. Verify that manufacturer maintains detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.
  - 2. Notify Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  - 3. Submit a certified written report of each test, inspection and similar quality control service to Architect with a copy to Contractor and authorities having jurisdiction.
  - 4. Submit a final report of special tests and inspections at Substantial Completion which includes a list of unresolved deficiencies.
  - 5. Interpret test and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  - 6. Retest and reinspect corrective work.

- C. Contractor shall be responsible for all coordination between the testing agency or special inspector and the Work.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 CONTROL OF INSTALLATION**

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

### **3.02 MOCK-UPS**

- A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be a comparison standard for the remaining Work.
- D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, remove mock-up and clear area when directed to do so.

### **3.03 TOLERANCES**

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

### **3.04 TESTING AND INSPECTION**

- A. See individual specification sections for testing required.
- B. Testing Agency Duties:
  1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  2. Perform specified sampling and testing of products in accordance with specified standards.
  3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.

5. Perform additional tests and inspections required by Architect.
  6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  2. Agency may not approve or accept any portion of the Work.
  3. Agency may not assume any duties of Contractor.
  4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
  2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
  3. 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 testings and inspecting.
    - a. Schedule times for tests, inspections, obtaining of samples, and similar activities.
  4. Provide incidental labor and facilities:
    - a. To provide access to Work to be tested/inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    - c. To facilitate tests/inspections.
    - d. To provide storage and curing of test samples.
  5. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
  6. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  7. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

### **3.05 REPAIR AND PROTECTION**

- A. Contractor to protect construction exposed by or for quality control service activities.
- B. Repair and protection are Contractor's responsibility regardless of the assignment of responsibility for quality control services.

### **3.06 MANUFACTURERS' FIELD SERVICES**

- A. When specified in individual specification sections, engage material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and other requirements as applicable, and to initiate instructions when necessary. Report results in writing to the Architect.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations.
  1. Observer subject to approval of Architect.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**3.07 DEFECT ASSESSMENT**

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

**END OF SECTION**



**SECTION 01 4216**

**DEFINITIONS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Other definitions are included in individual specification sections.

**1.02 DEFINITIONS**

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Provide: To furnish and install.
- E. Supply: Same as Furnish.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**



## **SECTION 01 5000**

### **TEMPORARY FACILITIES AND CONTROLS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Field offices.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 01 5813 - Temporary Project Signage.

##### **1.03 TEMPORARY UTILITIES**

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. Use trigger-operated nozzles for water hoses, to avoid waste of water.
- C. Temporary heating, cooling, ventilation or humidity control: provide climate control required by construction activities for curing or drying of completed installation 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.
- D. 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.
- E. Electrical Power Service: Provide electrical power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- F. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

##### **1.04 TELECOMMUNICATIONS SERVICES**

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
  - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
  - 2. Telephone Land Lines: One line, minimum; one handset per line with speaker phone capability.

#### **1.05 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

#### **1.06 BARRIERS**

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

#### **1.07 FENCING**

- A. Construction: Commercial grade chain link fence.
- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

#### **1.08 SECURITY**

- A. Provide security and facilities to protect Work, and Owner's operations from unauthorized entry, vandalism, or theft.

#### **1.09 VEHICULAR ACCESS AND PARKING**

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

#### **1.10 WASTE REMOVAL**

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

#### **1.11 PROJECT SIGNS - See Section 01 5813**

#### **1.12 FIELD OFFICES**

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

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Provide space for Project meetings, with table and chairs to accommodate 8 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

**1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

**1.14 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. 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 1 Section "Closeout Procedures."

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**



## **SECTION 01 5713**

### **TEMPORARY EROSION AND SEDIMENT CONTROL**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

##### **1.02 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
  - 1. Include:
    - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
    - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
    - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
    - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
    - e. Other information required by law.
    - f. Format required by law is acceptable, provided any additional information specified is also included.
  - 2. Obtain the approval of the Plan by authorities having jurisdiction.
  - 3. Obtain the approval of the Plan by Owner.
- C. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

**END OF SECTION**





## **SECTION 01 5813**

### **TEMPORARY PROJECT SIGNAGE**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Project identification sign.

##### **1.02 QUALITY ASSURANCE**

- A. Design sign and structure to withstand 50 miles/hr wind velocity.
- B. Sign Painter: Experienced as a professional sign painter for minimum three years.
- C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

##### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

#### **PART 2 PRODUCTS**

##### **2.01 SIGN MATERIALS**

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.
- C. Rough Hardware: Galvanized.
- D. Paint and Primers: Exterior quality, two coats; sign background of color as selected.
- E. Lettering: Exterior quality paint, colors as selected.

##### **2.02 PROJECT IDENTIFICATION SIGN**

- A. One painted sign, 32 sq ft area, bottom 6 feet above ground.
- B. Content:
  - 1. Project number, title, logo and name of Owner as indicated on Contract Documents.
  - 2. Names and titles of authorities.
  - 3. Names and titles of Architect and Consultants.
  - 4. Name of Prime Contractor and major Subcontractors.
- C. Graphic Design, Colors, Style of Lettering: Designated by Architect.

#### **PART 3 EXECUTION**

##### **3.01 INSTALLATION**

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Erect at location of high public visibility adjacent to main entrance to site. Coordinate location with the Architect.
- C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- D. Install sign surface plumb and level, with butt joints. Anchor securely.
- E. Paint exposed surfaces of sign, supports, and framing.

**3.02 MAINTENANCE**

- A. Maintain signs and supports clean, repair deterioration and damage.

**3.03 REMOVAL**

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

**END OF SECTION**

## **SECTION 01 6000**

### **PRODUCT REQUIREMENTS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Maintenance materials, including extra materials, spare parts, tools, and software.

##### **1.02 RELATED REQUIREMENTS**

- A. Document 00 2113 - Instructions to Bidders: Product options and substitution procedures prior to bid date.

##### **1.03 SUBMITTALS**

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

#### **PART 2 PRODUCTS**

##### **2.01 EXISTING PRODUCTS**

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- D. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.

##### **2.02 NEW PRODUCTS**

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. Do not use products having any of the following characteristics:
  - 1. Made using or containing CFC's or HCFC's.
- C. Where all other criteria are met, Contractor shall give preference to products that:

1. Are extracted, harvested, and/or manufactured closer to the location of the project.
2. Have longer documented life span under normal use.
3. Result in less construction waste.
4. Are made of vegetable materials that are rapidly renewable.

D. Urea-Formaldehyde Prohibition:

1. Specific Product Categories: Comply with limitations specified elsewhere.

### **2.03 PRODUCT OPTIONS**

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

### **2.04 MAINTENANCE MATERIALS**

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

## **PART 3 EXECUTION**

### **3.01 TRANSPORTATION AND HANDLING**

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

### **3.02 STORAGE AND PROTECTION**

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- G. Prevent contact with material that may cause corrosion, discoloration, or staining.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**END OF SECTION**



## **SECTION 01 7000**

### **EXECUTION AND CLOSEOUT REQUIREMENTS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- D. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, except payment procedures.
- I. General requirements for maintenance service.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittals procedures.
- B. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
- C. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
- D. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.
- E. Section 07 8400 - Firestopping.
- F. Individual Product Specification Sections:
  - 1. Advance notification to other sections of openings required in work of those sections.

##### **1.03 REFERENCE STANDARDS**

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2004.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. On request, submit documentation verifying accuracy of survey work.
  - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
  - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.

6. Include in request:
  - a. Identification of Project.
  - b. Location and description of affected work.
  - c. Necessity for cutting or alteration.
  - d. Description of proposed work and products to be used.
  - e. Effect on work of Owner or separate Contractor.
  - f. Written permission of affected separate Contractor.
  - g. Date and time work will be executed.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

### **1.05 QUALIFICATIONS**

- A. For survey work, employ a land surveyor registered in Utah and acceptable to Architect. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.
- B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in Utah.

### **1.06 PROJECT CONDITIONS**

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
  1. Minimize amount of bare soil exposed at one time.
  2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
  3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
  4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- I. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.
- J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.



## **1.07 COORDINATION**

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

## **PART 2 PRODUCTS**

### **2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### **3.02 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### **3.03 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.04 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Control datum for survey is that established by Owner provided survey.
- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- H. Utilize recognized engineering survey practices.
- I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, ground floor elevations.
- K. Periodically verify layouts by same means.
- L. Maintain a complete and accurate log of control and survey work as it progresses.
- M. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

### **3.05 GENERAL INSTALLATION REQUIREMENTS**

- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. Install products as specified in individual sections, in accordance with manufacturer's written installation instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

### **3.06 CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
  - 1. Complete the work.
  - 2. Fit products together to integrate with other work.
  - 3. Provide openings for penetration of mechanical, electrical, and other services.
  - 4. Match work that has been cut to adjacent work.
  - 5. Repair areas adjacent to cuts to required condition.
  - 6. Repair new work damaged by subsequent work.
  - 7. Remove samples of installed work for testing when requested.
  - 8. Remove and replace defective and non-conforming work.
- C. Execute cutting and patching including excavation and fill to complete the work, to uncover work in order to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit products together to integrate with other work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- J. Patching:
  - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  - 2. Match color, texture, and appearance.

- 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
- K. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- L. Make neat transitions. Patch work to match adjacent work in texture and appearance. Where new work abuts or aligns with existing, perform a smooth and even transition.

### **3.07 PROGRESS CLEANING**

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### **3.08 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

### **3.09 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized

representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

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

### **3.10 DEMONSTRATION AND INSTRUCTION**

- A. See Section 01 7900 - Demonstration and Training.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- C. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

### **3.11 ADJUSTING**

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

### **3.12 FINAL CLEANING**

- A. Execute final cleaning prior to Substantial Completion.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Replace filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.13 CLOSEOUT PROCEDURES**

- A. SUBSTANTIAL COMPLETION
  - 1. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
    - a. 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.
    - b. Advise Owner of pending insurance changeover requirements.
    - c. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
    - d. 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.
    - e. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
    - f. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
    - g. Make final changeover of permanent locks and deliver keys to Owner. Advise

- Owner's personnel of changeover in security provisions.
  - h. Complete startup testing of systems.
  - i. Submit test/adjust/balance records.
  - j. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  - k. Advise Owner of changeover in heat and other utilities.
  - l. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  - m. Complete final cleaning requirements, including touchup painting.
  - n. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
2. 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.
- a. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
  - b. Results of completed inspection will form the basis of requirements for final completion.
- B. FINAL COMPLETION
1. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
- a. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
  - b. 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.
  - c. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  - d. Submit pest-control final inspection report and warranty.
  - e. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
2. 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.
- a. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
- C. LIST OF INCOMPLETE ITEMS (PUNCH LIST)
1. Organization 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.
- a. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
  - b. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  - c. Include the following information at the top of each page:
    - 1) Project name.
    - 2) Date.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- 3) Name of Architect.
  - 4) Name of Contractor.
  - 5) Page number.
- d. Submit list of incomplete items in the following format:
- 1) Three paper copies of product schedule or list, unless otherwise indicated.  
Architect will return two copies.

### **3.14 MAINTENANCE**

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Furnish service and maintenance of components indicated in specification sections during the warranty period.
- D. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- E. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- F. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

**END OF SECTION**





## SECTION 01 7419

### CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

#### PART 1 GENERAL

##### 1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
  - 1. Aluminum and plastic beverage containers.
  - 2. Corrugated cardboard.
  - 3. Wood pallets.
  - 4. Clean dimensional wood: May be used as blocking or furring.
  - 5. Land clearing debris, including brush, branches, logs, and stumps: See Section 31 1000 for use options.
  - 6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
  - 7. Carpet, carpet cushion, carpet tile, and carpet remnants: DuPont (<http://flooring.dupont.com>) and Interface ([www.interfaceinc.com](http://www.interfaceinc.com)) conduct reclamation programs.
- E. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- F. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.
- G. Methods of trash/waste disposal that are not acceptable are:
  - 1. Burning on the project site.
  - 2. Burying on the project site.
  - 3. Dumping or burying on other property, public or private.
  - 4. Other illegal dumping or burying.
- H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. Section 01 5000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- C. Section 01 6000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

- D. Section 01 7000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.
- E. Section 31 1000 - Site Clearing: Handling and disposal of land clearing debris.

### **1.03 DEFINITIONS**

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.
- C. Waste Management Plan: Include the following information:
  - 1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.

2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
  3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
  4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
  5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
  6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
- D. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
  2. Submit Report on a form acceptable to Owner.
  3. Landfill Disposal: Include the following information:
    - a. Identification of material.
    - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
    - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  4. Incinerator Disposal: Include the following information:
    - a. Identification of material.
    - b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
    - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  5. Recycled and Salvaged Materials: Include the following information for each:
    - a. Identification of material, including those retrieved by installer for use on other projects.
    - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
    - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
    - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
  6. Material Reused on Project: Include the following information for each:
    - a. Identification of material and how it was used in the project.
    - b. Amount, in tons or cubic yards.
    - c. Include weight tickets as evidence of quantity.
  7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

## **PART 2 PRODUCTS**

### **2.01 PRODUCT SUBSTITUTIONS**

- A. See Section 01 6000 - Product Requirements for substitution submission procedures.
- B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 6000:
  - 1. Relative amount of waste produced, compared to specified product.
  - 2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Price.
  - 3. Proposed disposal method for waste product.
  - 4. Markets for recycled waste product.

## **PART 3 EXECUTION**

### **3.01 WASTE MANAGEMENT PROCEDURES**

- A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 01 7000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

### **3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION**

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
  - 1. Pre-bid meeting.
  - 2. Pre-construction meeting.
  - 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
  - 1. Provide containers as required.
  - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
  - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

**END OF SECTION**



## SECTION 01 7800

### CLOSEOUT SUBMITTALS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

##### 1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
  - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
  - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
  - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
  - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
  - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
  - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
  - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

#### PART 2 PRODUCTS - NOT USED

#### PART 3 EXECUTION

##### 3.01 PROJECT RECORD DOCUMENTS

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

- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
  - 1. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Field changes of dimension and detail.
  - 2. Details not on original Contract drawings.

### **3.02 OPERATION AND MAINTENANCE DATA**

- A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

### **3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

### **3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS**

- A. For Each Item of Equipment and Each System:
  - 1. Description of unit or system, and component parts.
  - 2. Identify function, normal operating characteristics, and limiting conditions.
  - 3. Include performance curves, with engineering data and tests.
  - 4. Complete nomenclature and model number of replaceable parts.
- B. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- C. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- D. Provide servicing and lubrication schedule, and list of lubricants required.
- E. Include manufacturer's printed operation and maintenance instructions.
- F. Include sequence of operation by controls manufacturer.
- G. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.



- H. Provide control diagrams by controls manufacturer as installed.
- I. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- J. Include test and balancing reports.
- K. Additional Requirements: As specified in individual product specification sections.

### **3.05 OPERATION AND MAINTENANCE MANUALS**

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. Prepare data in the form of an instructional manual.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
- I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
  - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
  - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
    - a. Significant design criteria.
    - b. List of equipment.
    - c. Parts list for each component.
    - d. Operating instructions.
    - e. Maintenance instructions for equipment and systems.
    - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
  - 3. Part 3: Project documents and certificates, including the following:
    - a. Shop drawings and product data.

### **3.06 WARRANTIES AND BONDS**

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

**END OF SECTION**

## SECTION 01 7900

### DEMONSTRATION AND TRAINING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
  - 1. All software-operated systems.
  - 2. HVAC systems and equipment.
  - 3. Plumbing equipment.
  - 4. Electrical systems and equipment.
  - 5. Conveying systems.
  - 6. Landscape irrigation.
  - 7. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
  - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
  - 2. Finishes, including flooring, wall finishes, ceiling finishes.
  - 3. Fixtures and fittings.
  - 4. Items specified in individual product Sections.

##### 1.02 RELATED REQUIREMENTS

- A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

##### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
  - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
  - 2. Submit one copy to the Commissioning Authority, not to be returned.
  - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
  - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
  - 1. Submit to Commissioning Authority for review and inclusion in overall training plan.
  - 2. Submit not less than four weeks prior to start of training.
  - 3. Revise and resubmit until acceptable.
  - 4. Provide an overall schedule showing all training sessions.
  - 5. Include at least the following for each training session:
    - a. Identification, date, time, and duration.
    - b. Description of products and/or systems to be covered.
    - c. Name of firm and person conducting training; include qualifications.
    - d. Intended audience, such as job description.
    - e. Objectives of training and suggested methods of ensuring adequate training.
    - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
    - g. Media to be used, such as slides, hand-outs, etc.
    - h. Training equipment required, such as projector, projection screen, etc., to be provided

by Contractor.

- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
  - 1. Include applicable portion of O&M manuals.
  - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
  - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
  - 1. Identification of each training session, date, time, and duration.
  - 2. Sign-in sheet showing names and job titles of attendees.
  - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
  - 4. Include Commissioning Authority's formal acceptance of training session.

#### **1.04 QUALITY ASSURANCE**

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

### **PART 2 PRODUCTS - NOT USED**

### **PART 3 EXECUTION**

#### **3.01 DEMONSTRATION - GENERAL**

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
  - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

#### **3.02 TRAINING - GENERAL**

- A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.
- B. Conduct training on-site unless otherwise indicated.
- C. Owner will provide classroom and seating at no cost to Contractor.
- D. Do not start training until Functional Testing is complete, unless otherwise specified or approved

by the Commissioning Authority.

- E. Provide training in minimum two hour segments.
- F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
  - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
  - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
  - 3. Typical uses of the O&M manuals.
- I. Product- and System-Specific Training:
  - 1. Review the applicable O&M manuals.
  - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
  - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
  - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
  - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
  - 6. Discuss common troubleshooting problems and solutions.
  - 7. Discuss any peculiarities of equipment installation or operation.
  - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
  - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  - 10. Review spare parts and tools required to be furnished by Contractor.
  - 11. Review spare parts suppliers and sources and procurement procedures.
- J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

**END OF SECTION**



**DIVISION 02 – EXISTING CONDITIONS**

02 4119 - Selective Demolition





## **SECTION 02 4119**

### **SELECTIVE DEMOLITION**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

##### **1.2 DEFINITIONS**

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

##### **1.3 PREINSTALLATION MEETINGS**

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

##### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For refrigerant recovery technician.
- B. Predemolition Photographs or Video: Submit before Work begins.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

### **1.5 CLOSEOUT SUBMITTALS**

- A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

### **1.6 QUALITY ASSURANCE**

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

### **1.7 FIELD CONDITIONS**

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

### **1.8 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- D. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

### **3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS**

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off indicated utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
  - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
  - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

### **3.3 PREPARATION**

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

### **3.4 SELECTIVE DEMOLITION, GENERAL**

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 EXISTING WALLS TO REMAIN

- A. Clean existing finished walls to remain.

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them.

1. Do not allow demolished materials to accumulate on-site.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### **3.7 CLEANING**

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

**END OF SECTION 02 4119**

**DIVISION 03 – CONCRETE**

03 1000 - Concrete Forming and Accessories

03 2000 - Concrete Reinforcing

03 3000 - Cast-In-Place Concrete





## **SECTION 03 1000**

### **CONCRETE FORMING AND ACCESSORIES**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 03 2000 - Concrete Reinforcing.
- B. Section 03 3000 - Cast-in-Place Concrete.

##### **1.03 REFERENCE STANDARDS**

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; American Concrete Institute; 2006.
- B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute; 2005.
- C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute; 2008.
- D. ACI 347 - Guide to Formwork for Concrete; American Concrete Institute; 2004.
- E. ASME A17.1 - Safety Code for Elevators and Escalators; The American Society of Mechanical Engineers; 2004.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on void form materials and installation requirements.
- C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.

##### **1.05 QUALITY ASSURANCE**

- A. Perform work of this section in accordance with Public Works standards of the State of Utah.
- B. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in Utah.

##### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver void forms and installation instructions in manufacturer's packaging.
- B. Store void forms off ground in ventilated and protected manner to prevent deterioration from moisture.

## **PART 2 PRODUCTS**

### **2.01 FORMWORK - GENERAL**

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.
- C. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
- D. Comply with relevant portions of ACI 347, ACI 301, and ACI 318.

### **2.02 WOOD FORM MATERIALS**

- A. Form Materials: At the discretion of the Contractor.

### **2.03 PREFABRICATED FORMS**

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inches thick..

### **2.04 FORMWORK ACCESSORIES**

- A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, 3/4 inch back break dimension, free of defects that could leave holes larger than 1 inch in concrete surface.
- B. Form Release Agent: Colorless mineral oil that will not stain concrete.
- C. Corners: Filleted, rigid plastic type; 3/4 x 3/4 inch size; maximum possible lengths.
- D. Dovetail Anchor Slot: Galvanized steel, 22 gage thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- E. Flashing Reglets: Galvanized steel, 22 gage thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

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

### **3.02 EARTH FORMS**

- A. Earth forms are not permitted.

### **3.03 ERECTION - FORMWORK**

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to

overstressing by construction loads.

- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members that are not indicated on drawings.
- F. Provide fillet strips on external corners of beams, joists, and columns.
- G. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- H. Coordinate this section with other sections of work that require attachment of components to formwork.
- I. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

### **3.04 APPLICATION - FORM RELEASE AGENT**

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

### **3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS**

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

### **3.06 FORM CLEANING**

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
  - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
  - 2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

### **3.07 FORMWORK TOLERANCES**

- A. Construct formwork to maintain tolerances required by ACI 117.

- B. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

### **3.08 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.
- C. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.

### **3.09 FORM REMOVAL**

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

**END OF SECTION**

## **SECTION 03 2000**

### **CONCRETE REINFORCING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

##### **1.02 RELATED REQUIREMENTS**

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

##### **1.03 REFERENCE STANDARDS**

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- B. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 2004.
- C. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2007.
- D. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement; 2006.
- E. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2006.
- F. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; American Welding Society; 2005.
- G. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; 2001.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
  - 1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in Utah.
- C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

##### **1.05 QUALITY ASSURANCE**

- A. Perform work of this section in accordance with ACI 301.
- B. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.

#### **PART 2 PRODUCTS**

##### **2.01 REINFORCEMENT**

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

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Reinforcing Steel Mat: ASTM A704/A704M, using ASTM A 615/A 615M, Grade 40 (280) steel bars or rods, unfinished.
- C. Steel Welded Wire Reinforcement: ASTM A 884/A 884M, deformed, Class A epoxy coated type.
  - 1. Flat Sheets.
  - 2. Mesh Size and Wire Gage: As indicated on drawings.
- D. Reinforcement Accessories:
  - 1. Tie Wire: Annealed, minimum 16 gage.
  - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
  - 3. Provide stainless steel or galvanized components for placement within 1-1/2 inches of weathering surfaces.

## **2.02 FABRICATION**

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Welding of reinforcement is permitted only with the specific approval of Architect or as shown in the structural drawings. Perform welding in accordance with AWS D1.4.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress.
  - 1. Review locations of splices with Architect.

## **PART 3 EXECUTION**

### **3.01 PLACEMENT**

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Conform to applicable code for concrete cover over reinforcement.

### **3.02 FIELD QUALITY CONTROL**

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

**END OF SECTION**

## **SECTION 03 3000**

### **CAST-IN-PLACE CONCRETE**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Floors and slabs on grade.
- B. Joint devices associated with concrete work.
- C. Miscellaneous concrete elements, including equipment pads, light pole bases, flagpole bases, thrust blocks, and manholes.
- D. Concrete curing.

##### **1.02 RELATED DOCUMENTS**

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

##### **1.03 RELATED REQUIREMENTS**

- A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 2000 - Concrete Reinforcing.
- C. Section 07 9005 - Joint Sealers.

##### **1.04 REFERENCE STANDARDS**

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (errata 2007).
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- E. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 1999.
- F. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 1988 (Reapproved 2002).
- G. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001.
- H. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2008.
- I. ASTM C 33 - Standard Specification for Concrete Aggregates; 2007.
- J. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2005.
- K. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2007.
- L. ASTM C 143/C 143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2005a.

- M. ASTM C 150 - Standard Specification for Portland Cement; 2007.
- N. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.
- O. ASTM C 173/C 173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2007.
- P. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2006.
- Q. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2007.
- R. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 2008.
- S. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2005.
- T. ASTM C 685/C 685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2007.
- U. ASTM C 979 - Standard Specification for Pigments for Integrally Colored Concrete; 2005.
- V. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 1999.
- W. ASTM C 1107/C 1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2007a.
- X. ASTM C 1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2005.
- Y. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements.
- C. Design Mixtures: For each concrete pavement mixture. Include alternative mixture designs when characteristics of materials, Project conditions, installation details, weather, test results, or other circumstances warrants adjustments.
- D. Samples for Pigment Color Selection: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.
- E. Samples: Submit samples of underslab vapor retarder to be used.
- F. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.
- G. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

#### **1.06 QUALITY ASSURANCE**

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.



## **PART 2 PRODUCTS**

### **2.01 FORMWORK**

- A. Comply with requirements of Section 03 1000.

### **2.02 REINFORCEMENT**

- A. Comply with requirements of Section 03 2000.

### **2.03 CONCRETE MATERIALS**

- A. Cement: ASTM C 150, Type I - Normal portland type.
- B. Fine and Coarse Aggregates: ASTM C 33.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Calcined Pozzolan: ASTM C618, Class N.
- E. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
- F. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979.
  - 1. Concentration: Base dosage rates on weight of portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.
  - 2. Packaging: If pigments are to be added to mix at site, furnish pigments in premeasured disintegrating bags to minimize job site waste.
  - 3. Color(s): As indicated on drawings.
  - 4. Manufacturers:
    - a. Butterfield Color: [www.butterfieldcolor.com](http://www.butterfieldcolor.com).
    - b. Davis Colors: [www.daviscolors.com](http://www.daviscolors.com).
    - c. Lambert Corporation: [www.lambertusa.com](http://www.lambertusa.com).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Water: Clean and not detrimental to concrete.

### **2.04 CHEMICAL ADMIXTURES**

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C260.
- C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- G. Accelerating Admixture: ASTM C494/C494M Type C.
- H. Retarding Admixture: ASTM C494/C494M Type B.
- I. Water Reducing Admixture: ASTM C494/C494M Type A.

### **2.05 ACCESSORY MATERIALS**

- A. Non-Shrink Grout: ASTM C 1107/C 1107M; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
  - 1. Minimum Compressive Strength at 48 Hours: 2,400 psi.
  - 2. Minimum Compressive Strength at 28 Days: 4,000 psi.

- B. Moisture-Retaining Cover: ASTM C 171; regular curing paper, white curing paper, clear polyethylene, white polyethylene, or white burlap-polyethylene sheet.
- C. Liquid Curing Compound: ASTM C 309, Type 1, clear or translucent.

## **2.06 BONDING AND JOINTING PRODUCTS**

- A. Latex Bonding Agent: Non-dispersible acrylic latex, complying with ASTM C 1059 Type II.
- B. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
- C. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D 1751, 1/4 inch thick and 4 inches deep; tongue and groove profile.
- D. Sealant and Primer: As specified in Section 07 9005.

## **2.07 CONCRETE MIX DESIGN**

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
  - 1. Replace as much portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.
- B. Concrete Strength: Refer to structural drawings for required concrete strengths for each particular concrete element. Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
  - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- D. Normal Weight Concrete:
  - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
  - 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
  - 3. Water-Cement Ratio: Follow requirements in Chapter 4 of ACI 318-08 according to the exposure categories specified in the structural notes.
  - 4. Total Air Content: Follow requirements in Chapter 4 of ACI 318-08 according to the exposure categories specified in the structural notes.
  - 5. Maximum Slump: Follow requirements in Chapter 4 of ACI 318-08 according to the exposure categories specified in the structural notes.
  - 6. Maximum Aggregate Size: 3/4 inch.

## **2.08 MIXING**

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
  - 1. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
- B. Transit Mixers: Comply with ASTM C94/C94M.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

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

### **3.02 PREPARATION**

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- C. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
  - 1. Use latex bonding agent only for non-load-bearing applications.

### **3.03 PLACING CONCRETE**

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

### **3.04 CONCRETE FINISHING**

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
  - 1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
- D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
  - 1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and terrazzo with full bed setting system.
  - 2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 301.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, thin set quarry tile, and thin set ceramic tile.
  - 3. Other Surfaces to Be Left Exposed: "Steel trowel" as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
- E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

### **3.05 CURING AND PROTECTION**

- A. Comply with requirements of ACI 308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
  - 1. Normal concrete: Not less than 7 days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:
  - 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to

flooring manufacturer's satisfaction.

2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
3. Final Curing: Begin after initial curing but before surface is dry.
  - a. Moisture-Retaining Cover: Seal in place with waterproof tape or adhesive.
  - b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

### **3.06 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure four concrete test cylinders. Obtain test samples for every 75 cu yd or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

### **3.07 DEFECTIVE CONCRETE**

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

**END OF SECTION**

**DIVISION 04 – MASONRY**

Not Used



**DIVISION 05 – METALS**

05 1200 - Structural Steel Framing

05 5000 - Metal Fabrications

05 5213 - Pipe and Tube Railings





## **SECTION 05 1200**

### **STRUCTURAL STEEL FRAMING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Structural steel framing members, support members, sag rods, and struts.
- B. Base plates, shear stud connectors and expansion joint plates.
- C. Grouting under base plates.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

##### **1.03 REFERENCE STANDARDS**

- A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.; 2005.
- B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2005.
- C. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts; 2004.
- D. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- E. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.
- F. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2007.
- G. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2007a.
- H. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2007.
- I. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2007.
- J. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2006a.
- K. ASTM C 1107/C 1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2007a.
- L. ASTM E 94 - Standard Guide for Radiographic Examination; 2004.
- M. ASTM E 164 - Standard Practice for Ultrasonic Contact Examination of Weldments; 2003.
- N. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination; 2002.
- O. ASTM E 709 - Standard Guide for Magnetic Particle Examination; 2001.
- P. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2007.
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2006 and Errata.

##### **1.04 SUBMITTALS**

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

- B. Shop Drawings:
  - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
  - 2. Connections not detailed.
  - 3. Indicate cambers and loads.
  - 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

### **1.05 QUALITY ASSURANCE**

- A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."
- B. Fabricator: Company specializing in performing the work of this section with minimum ten years of documented experience.
- C. Erector: Company specializing in performing the work of this section with minimum ten years of documented experience.
- D. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Utah.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Cold-Formed Structural Tubing: ASTM A500, Grade B.
- D. Pipe: ASTM A53/A53M, Grade B, Finish black.
- E. Shear Stud Connectors: Made from ASTM A 108 Grade 1015 bars.
- F. Sag Rods: ASTM A 36/A 36M.
- G. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, medium carbon, galvanized.
- H. Welding Materials: AWS D1.1; type required for materials being welded.
- I. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107/C1107M and capable of developing a minimum compressive strength of 4,000 psi at 28 days.
- J. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

### **2.02 FABRICATION**

- A. Shop fabricate to greatest extent possible.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors.
- D. Develop required camber for members.

### **2.03 FINISH**

- A. Prepare structural component surfaces in accordance with SSPC SP 3, "Power Tool Cleaning".
- B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted.

### **2.04 SOURCE QUALITY CONTROL**

- A. Provide shop testing and analysis of structural steel.
- B. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing at least 50 percent of bolts at each connection.
- C. Welded Connections: Visually inspect all shop-welded connections and test at least 50 percent of welds using one of the following:
  - 1. Radiographic testing performed in accordance with ASTM E94.
  - 2. Ultrasonic testing performed in accordance with ASTM E164.
  - 3. Liquid penetrant inspection performed in accordance with ASTM E165.
  - 4. Magnetic particle inspection performed in accordance with ASTM E709.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

### **3.02 ERECTION**

- A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".
- B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components indicated on shop drawings.
- D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- E. Do not field cut or alter structural members without approval of Architect.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

### **3.03 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

### **3.04 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing at least 50 percent of bolts at each connection.
- C. Welded Connections: Visually inspect all field-welded connections and test at least 50 percent of welds using one of the following:
  - 1. Radiographic testing performed in accordance with ASTM E94.
  - 2. Ultrasonic testing performed in accordance with ASTM E164.
  - 3. Liquid penetrant inspection performed in accordance with ASTM E165.
  - 4. Magnetic particle inspection performed in accordance with ASTM E709.

**END OF SECTION**

## **SECTION 05 5000**

### **METAL FABRICATIONS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Shop fabricated steel and aluminum items.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 05 52 13 - Pipe and Tube Railings.
- C. Section 09 90 00 - Painting and Coating: Paint finish.

##### **1.03 REFERENCE STANDARDS**

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.
- B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2002.
- C. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
- D. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.
- E. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- F. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2003 (Reapproved 2007).
- H. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2007a.
- I. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2007.
- J. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2007.
- K. ASTM B 26/B 26M - Standard Specification for Aluminum-Alloy Sand Castings; 2005.
- L. ASTM B 85 - Standard Specification for Aluminum-Alloy Die Castings; 2003.
- M. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.
- N. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2007.
- O. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2004.
- P. ASTM B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric); 2005.
- Q. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire;

2003.

- R. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric); 2003.
- S. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2006.
- T. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2007.
- U. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2007.
- V. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2006 and Errata.
- W. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; American Welding Society; 2003, and Errata 2004.
- X. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).
- Y. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).
- Z. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

#### **PART 2 PRODUCTS**

##### **2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.
- C. Plates: ASTM A 283.
- D. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- E. Slotted Channel Framing: ASTM A 653, Grade 33.
- F. Slotted Channel Fittings: ASTM A1011/A1011M.
- G. Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.
- H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

- J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

## **2.02 MATERIALS - ALUMINUM**

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210 (ASTM B210M), 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211 (ASTM B211M), 6061 alloy, T6 temper.
- E. Aluminum-Alloy Sand Castings: ASTM B26.
- F. Aluminum-Alloy Die Castings: ASTM B85.
- G. Bolts, Nuts, and Washers: Stainless steel.
- H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

## **2.03 FABRICATION**

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

## **2.04 FABRICATED ITEMS**

- A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
  - 1. Side Rails: 3/8 x 2 inches members spaced at 20 inches.
  - 2. Rungs: one inch diameter solid round bar spaced 12 inches on center.
  - 3. Space rungs 7 inches from wall surface.
- B. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- C. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of masonry; galvanized finish.
- D. Lintels: As detailed; galvanized finish.
- E. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

## **2.05 FINISHES - STEEL**

- A. Prime paint all steel items.
  - 1. Exceptions: Galvanize items to be embedded in concrete or masonry.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.
- E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M

requirements.

- F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

## **2.06 FINISHES - ALUMINUM**

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

## **2.07 FABRICATION TOLERANCES**

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

### **3.02 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

### **3.03 INSTALLATION**

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

### **3.04 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

**END OF SECTION**



## SECTION 05 5213

### PIPE AND TUBE RAILINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.
- C. Free-standing railings.

##### 1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 092116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.
- C. Section 099000 - Painting and Coating: Paint finish.

##### 1.03 REFERENCE STANDARDS

- A. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.
- B. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- C. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2007.
- D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
- E. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
- F. SSPC-Paint 15 - Steel Joist Shop Paint; The Society for Protective Coatings; 1999 (Ed. 2004).
- G. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); The Society for Protective Coatings; 2002 (Ed. 2004).

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  - 1. Steel: 72 percent of minimum yield strength.
  - 2. Stainless Steel: 60 percent of minimum yield strength.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:

- a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
  - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

### **1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## **PART 2 PRODUCTS**

### **2.01 RAILINGS - GENERAL REQUIREMENTS**

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
- B. Design railing assembly, wall rails, and attachments to resist lateral force of 75 lbs at any point without damage or permanent set. Test in accordance with ASTM E 935.
- C. Allow for expansion and contraction of members and building movement without damage to connections or members.
- D. Dimensions: See drawings for configurations and heights.
  1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
  2. Intermediate Rails: 1-1/2 inches diameter, round.
  3. Posts: 1-1/2 inches diameter, round.
  4. Balusters: 1/2 inch square solid bar.
- E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
  1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
  2. For anchorage to stud walls, provide backing plates, for bolting anchors.
- F. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

### **2.02 STEEL RAILING SYSTEM**

- A. Steel Tube: ASTM A 500, Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

- D. Exposed Fasteners: No exposed bolts or screws.
- E. Galvanizing: In accordance with requirements of ASTM A123/A123M.
  - 1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

### **2.03 STAINLESS STEEL**

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
- C. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Perforated Metal: Stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, Type 304, 0.062 inch (1.59 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.
- E. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 580/A 580M, Type 304.

### **2.04 FABRICATION**

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
  - 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
  - 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
  - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

### **3.02 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Anchor railings securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

#### **3.04 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

**END OF SECTION**

**DIVISION 06 – WOOD, PLASTICS, and COMPOSITES**

06 1000 - Rough Carpentry

06 1733 - Wood I-Joists

06 1800 - Glued-Laminated Construction

06 4100 - Architectural Wood Casework



**SECTION 06 1000**

**ROUGH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Structural dimension lumber framing.
- B. Non-structural dimension lumber framing.
- C. Rough opening framing for doors, windows, and roof openings.
- D. Engineered wood products.
- E. Sheathing.
- F. Roof-mounted curbs.
- G. Roofing nailers.
- H. Preservative treated wood materials.
- I. Miscellaneous framing and sheathing.
- J. Communications and electrical room mounting boards.
- K. Concealed wood blocking, nailers, and supports.
- L. Water-resistive barrier over wall sheathing.

**1.02 RELATED REQUIREMENTS**

- A. Section 05 1200 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- B. Section 05 5000 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.
- C. Section 06 1753 - Shop-Fabricated Wood Trusses.
- D. Section 06 1733 - Wood I-Joists.
- E. Section 06 1800 - Glued-Laminated Construction.
- F. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
- G. Section 07 6200 - Sheet Metal Flashing and Trim: Sill flashings.
- H. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.

**1.03 REFERENCE STANDARDS**

- A. AFPA (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; American Forest and Paper Association; 2001.
- B. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- C. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007
- D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008.

- E. AWPA C2 - Lumber, Timber, Bridge Ties and Mine Ties -- Preservative Treatment by Pressure Processes; American Wood Protection Association; 2003.
- F. AWPA C9 - Plywood -- Preservative Treatment by Pressure Processes; American Wood Protection Association; 2003.
- G. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood-Protection Association; 2007.
- H. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.
- I. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; West Coast Lumber Inspection Bureau; 2004, and supplements.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. Species: Douglas Fir-Larch, unless otherwise indicated, and as scheduled in the General Structural Notes.
  - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
  - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee ([www.alsc.org](http://www.alsc.org)) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

#### **2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS**

- A. Grading Agency: West Coast Lumber Inspection Bureau (WCLIB).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Stud Framing (2 by 2 through 2 by 6 ):
  - 1. Species: Douglas Fir-Larch.
  - 2. Grade: No. 2.
- E. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16 ):
  - 1. Species: Douglas Fir-Larch.
  - 2. Grade: No. 2 & Btr.



- F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.
  - 2. Boards: Standard or No. 3.

### **2.03 EXPOSED DIMENSION LUMBER**

- A. Grading Agency: West Coast Lumber Inspection Bureau (WCLIB).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16 ):
  - 1. Species and Grades: As indicated on the drawings for various locations.

### **2.04 TIMBERS FOR CONCEALED APPLICATIONS**

- A. Grading Agency: West Coast Lumber Inspection Bureau (WCLIB).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry (23 percent maximum).
- D. Beams and Posts 5 inches and over in thickness:
  - 1. Species: Douglas Fir-Larch.
  - 2. Grade: No. 1.

### **2.05 ENGINEERED WOOD PRODUCTS**

- A. Engineered Wood Products, General: Products shall contain no urea formaldehyde.
- B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- C. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
  - 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. Boise Cascade Corporation.
    - b. Georgia-Pacific.
    - c. Louisiana-Pacific Corporation.
    - d. Weyerhaeuser Company.
  - 2. Extreme Fiber Stress in Bending, Edgewise: As scheduled in the General Structural Notes for 12-inch nominal- (286-mm actual-) depth members.
  - 3. Modulus of Elasticity, Edgewise: As scheduled in the General Structural Notes.
- D. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
  - 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. **Louisiana-Pacific Corporation.**
    - b. **Weyerhaeuser Company.**
  - 2. Extreme Fiber Stress in Bending, Edgewise: As scheduled in the General Structural Notes for **12-inch nominal- (286-mm actual-)** depth members.
  - 3. Modulus of Elasticity, Edgewise: As scheduled in the General Structural Notes.

- E. Laminated Strand Lumber, including the following:
  - 1. LSL Grade: In accordance with the Structural General Notes.
    - a. Material: Strands arranged parallel to the finished product's length.
    - b. Adhesive: MDI, bonded and cured under pressure and heat.
    - c. Thickness: As scheduled.
    - d. Plies: 1 to 4.
    - e. Depth: As scheduled.
    - f. Water Resistant Coating: Provide proprietary edge and end seal coating.

## 2.06 CONSTRUCTION PANELS

- A. Roof Sheathing: APA PRP-108/APA PRPR-108, Form B455, Structural I Rated Sheathing, Exterior Exposure Class, and as follows:
  - 1. Span Rating: See General Structural Notes.
  - 2. Thickness: As scheduled in the General Structural Notes.
- B. Wall Sheathing: APA PRP-108/APA PRP-108, Form B455 Structural I Rated Sheathing, Exterior Exposure Class, and as follows:
  - 1. Span Rating: See General Structural Notes.
  - 2. Thickness: As scheduled in the General Structural Notes.
- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

## 2.07 ACCESSORIES

- A. Fasteners and Anchors:
  - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
  - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing per ASTM A653/A653M.
- C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
  - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing per ASTM A653/A653M.
- D. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
- E. Sill Flashing: As specified in Section 07 62 00.
- F. Subfloor Glue: Waterproof, water base, air cure type, cartridge dispensed.
- G. Water-Resistive Barrier: As specified in Section 07 25 00.

## 2.08 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
  - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Preservative Treatment:
  - 1. Preservative Pressure Treatment of Lumber Above Grade: AWPA Use Category UC3B, Commodity Specification A (Treatment C2) using waterborne preservative to 0.25 lb/cu ft

retention.

- a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
  - b. Treat lumber exposed to weather.
  - c. Treat lumber in contact with roofing, flashing, or waterproofing.
  - d. Treat lumber in contact with masonry or concrete.
  - e. Treat lumber in other locations as indicated.
2. Preservative Pressure Treatment of Plywood Above Grade: AWPAC Use Category UC2 and UC3B, Commodity Specification F (Treatment C9) using waterborne preservative to 0.25 lb/cu ft retention.
- a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
  - b. Treat plywood in contact with roofing, flashing, or waterproofing.
  - c. Treat plywood in contact with masonry or concrete.
  - d. Treat plywood in other locations as indicated.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.
- B. Coordinate installation of rough carpentry members specified in other sections.

#### **3.02 INSTALLATION - GENERAL**

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

#### **3.03 FRAMING INSTALLATION**

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AFPA Wood Frame Construction Manual.
- E. Install horizontal spanning members with crown edge up and not less than 3 inches of bearing at each end.
- F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- G. Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.
- H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

#### **3.04 BLOCKING, NAILERS, AND SUPPORTS**

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures,

specialty items, and trim.

- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- E. Specifically, provide the following non-structural framing and blocking:
  - 1. Cabinets and shelf supports.
  - 2. Wall brackets.
  - 3. Handrails.
  - 4. Grab bars.
  - 5. Towel and bath accessories.
  - 6. Wall-mounted door stops.
  - 7. Chalkboards and marker boards.
  - 8. Wall paneling and trim.
  - 9. Joints of rigid wall coverings that occur between studs.

### **3.05 ROOF-RELATED CARPENTRY**

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

### **3.06 INSTALLATION OF CONSTRUCTION PANELS**

- A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
  - 1. At long edges provide solid edge blocking where joints occur between roof framing members.
  - 2. Nail panels to framing; staples are not permitted.
- B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
  - 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.
- C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
  - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
  - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
  - 3. Install adjacent boards without gaps.
  - 4. Size and Location: As indicated on drawings.

### **3.07 SITE APPLIED WOOD TREATMENT**

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

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451 East 200 South  
Lehi, Utah 84043

- B. Allow preservative to dry prior to erecting members.

### **3.08 TOLERANCES**

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

### **3.09 CLEANING**

- A. Waste Disposal: Comply with the requirements of Section 01 74 19.
  - 1. Comply with applicable regulations.
  - 2. Do not burn scrap on project site.
  - 3. Do not burn scraps that have been pressure treated.
  - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

**END OF SECTION**



## **SECTION 06 1733**

### **WOOD I-JOISTS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Wood I-joists for roof framing.
- B. Bridging, bracing, and anchorage.
- C. Framing for openings.
- D. Preservative treatment of wood.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Installation requirements for miscellaneous framing.
- B. Section 06 1000 - Rough Carpentry: Material requirements for blocking, plates, and miscellaneous framing.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM D 5055 - Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists; 2007.
- B. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood-Preservers' Association; 2007.
- C. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2004.

##### **1.04 DESIGN REQUIREMENTS**

- A. Refer to General Structural Notes.

##### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's literature describing materials, dimensions, allowable spans and spacings, bearing and anchor details, bridging and bracing requirements, and installation instructions; identify independent inspection agency.
- C. Shop Drawings: Indicate sizes and spacing of joists, bracing and bridging, bearing stiffeners, holes to be cut (if any), and framed openings between joists.
- D. Certificate: Certification by joist manufacturer that products delivered are of the same design and construction as those evaluated by the independent inspection agency.

##### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

##### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in manufacturer's original packaging with manufacturer's name and product identification intact and legible.
- B. Protect products from damage due to weather and breakage.
- C. Protect joists from warping or other distortion by stacking in upright position, braced to resist

movement, with air circulation under coverings and around stacks.

- D. Handle individual joists in the upright position.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Wood I-Joists:
1. Boise Cascade Corporation: [www.bc.com](http://www.bc.com).
  2. Louisiana-Pacific Corp: [www.lpcorp.com](http://www.lpcorp.com).
  3. iLevel by Weyerhaeuser: [www.ilevel.com](http://www.ilevel.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.02 MATERIALS**

- A. Wood I-Joists: Solid lumber top and bottom flanges and oriented strand board (OSB) webs bonded together with structural adhesive, with published span rating to meet project requirements.
1. Span Rating: Established and monitored in accordance with ASTM D5055 by independent inspection agency.
  2. Oriented Strand Board: Comply with PS 2.
  3. Adhesive: Tested for wet/exterior service in accordance with ASTM D2559.
  4. Depth: As indicated on drawings.
  5. Fabrication Tolerances:
    - a. Flange Width: Plus/minus 1/32 inch.
    - b. Flange Thickness: Minus 1/16 inch.
    - c. Joist Depth: Plus 0, minus 1/8 inch.
  6. Marking: Mark each piece with depth, joist spacing, and allowable span for joist spacing.
  7. Provide bearing stiffeners if required by span rating or joist hanger manufacturer.
- B. Wood-Based Components:
1. Wood fabricated from old growth timber is not permitted.
- C. Joist Bridging: Type, size and spacing recommended by joist manufacturer.
- D. Wood Blocking, Plates, and Miscellaneous Framing: As specified in Section 06 10 00.
- E. Fasteners: Electrogalvanized steel, type to suit application.
- F. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.
1. Manufacturer: Provide products by same manufacturer as I-joists.
  2. Material: All-veneer product or product made from any combination solid lumber, wood strands, and veneers.
  3. Thickness: Minimum 1 inch (25 mm).
  4. Provide performance-rated product complying with APA PRR-401, rim board grade, factory marked with APA trademark indicating thickness, grade, and compliance with APA standard.

### **2.03 WOOD TREATMENT**

- A. Factory-Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.



### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that supports and openings are ready to receive joists.
- B. Verify that field measurements are as indicated on shop drawings.

#### **3.02 PREPARATION**

- A. Coordinate placement of bearing items.

#### **3.03 ERECTION**

- A. Install joists in accordance with manufacturer's instructions.
- B. Set structural members level and plumb, in correct position.
- C. Make provisions for erection loads and for sufficient temporary bracing to maintain structure plumb and in true alignment until completion of erection and installation of permanent bracing.
- D. Do not field cut or alter structural members without approval of Architect.
- E. Install permanent bridging and bracing.
- F. Install headers and supports to frame openings required.
- G. Frame openings between joists with lumber in accordance with Section 06 10 00.
- H. Coordinate installation of sheathing/decking with work of this section.

#### **3.04 SITE APPLIED WOOD TREATMENT**

- A. Apply preservative treatment in accordance with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

#### **3.05 TOLERANCES**

- A. Framing Members: 1/2 inch maximum, from true position.

**END OF SECTION**



## **SECTION 06 1800**

### **GLUED-LAMINATED CONSTRUCTION**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Glue laminated wood beams.
- B. Preservative treatment of wood.
- C. Steel hardware and attachment brackets.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 09 9000 - Painting and Coating: Field Finishing.

##### **1.03 REFERENCE STANDARDS**

- A. AITC A190.1 - American National Standard for Wood Products - Structural Glued Laminated Timber; American Institute of Timber Construction; 2007.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2009.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2009a.
- F. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2009.
- G. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2007a.
- H. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts [Metric]; 2007.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- J. RIS (GR) - Standard Specifications for Grades of California Redwood Lumber; Redwood Inspection Service; 2000.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials, application technique and resultant performance information.
- C. Shop Drawings: Indicate framing system, sizes and spacing of members, loads and cambers, bearing and anchor details, bridging and bracing, framed openings.
  - 1. Submit design calculations.

##### **1.05 QUALITY ASSURANCE**

- A. Designer Qualifications: Design structural members under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Utah.
- B. Manufacturer/Fabricator Qualifications: Company specializing in manufacture of glue laminated structural units with three years of documented experience, and certified by AITC in accordance

with AITC A190.1.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect members to AITC requirements for individually wrapped.
- B. Leave individual wrapping in place until finishing occurs.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Glued-Laminated Structural Units:
  - 1. Sentinel Structures, Inc: [www.sentinelstructures.com](http://www.sentinelstructures.com).
  - 2. Unit Structures: [www.unitstructures.com](http://www.unitstructures.com).
  - 3. Western Wood Structures, Inc: [www.westernwoodstructures.com](http://www.westernwoodstructures.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 GLUED-LAMINATED UNITS**

- A. Glued-Laminated Units: Fabricate in accordance with AITC 117 Architectural grade.
  - 1. Verify dimensions and site conditions prior to fabrication.
  - 2. Cut and fit members accurately to length to achieve tight joint fit.
  - 3. Fabricate member with camber built in.
  - 4. Do not splice or join members in locations other than those indicated without permission.
  - 5. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.
  - 6. Welding: Perform welding in accordance with AWS D1.1.
  - 7. After end trimming, seal with penetrating sealer in accordance with AITC requirements.
- B. Performance Criteria:
  - 1. Conform to applicable code for loads, seismic zoning, and other load criteria.

### **2.03 MATERIALS**

- A. Lumber: Softwood lumber conforming to RIS grading rules with 12 percent maximum moisture content before fabrication. Design for the values in accordance with the Structural General Notes.
- B. Steel Connections and Brackets: ASTM A36/A36M weldable quality, galvanize per ASTM A123/A123M.
- C. Hardware: ASTM A325 (ASTM A325M) Type 1 high strength heavy hex bolts and ASTM A563 (ASTM A563M) nuts, hot-dip galvanized to meet requirements of ASTM A153/A153M, matching washers.
- D. Bearing Plate Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

### **2.04 WOOD TREATMENT**

- A. Surface-Applied Wood Preservative: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.
- B. Shop treat wood materials in accordance with manufacturer's instructions.

### **2.05 FABRICATION**

- A. Fabricate glue laminated structural members in accordance with AITC Industrial grade.
- B. Welding: Perform welding in accordance with AWS D1.1.

- C. Verify dimensions and site conditions prior to fabrication.
- D. Cut and fit members accurately to length to achieve tight joint fit.
- E. Fabricate member with camber built in, as indicated.
- F. Do not splice or join members in locations other than those indicated without permission.
- G. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.
- H. After end trimming, seal with penetrating sealer in accordance with AITC requirements.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that supports are ready to receive units.
- B. Verify sufficient end bearing area.

#### **3.02 PREPARATION**

- A. Coordinate placement of bearing items.

#### **3.03 ERECTION**

- A. Lift members using protective straps to prevent visible damage.
- B. Set structural members level and plumb, in correct positions or sloped where indicated.
- C. Provide temporary bracing and anchorage to hold members in place until permanently secured.
- D. Fit members together accurately without trimming, cutting, splicing, or other unauthorized modification.
- E. Swab and seal the interior wood surfaces of field drilled holes in members with primer.

#### **3.04 TOLERANCES**

- A. Framing Members: 1/2 inch (12 mm) maximum from true position.

**END OF SECTION**



## **SECTION 06 4100**

### **ARCHITECTURAL WOOD CASEWORK**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Cabinet hardware.
- D. Factory finishing.
- E. Preparation for installing utilities.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 12 3600 - Countertops.
- B. Section 08 8000 - Glazing: Glass for casework.

##### **1.03 REFERENCE STANDARDS**

- A. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2002.
- B. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.
- C. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.9).
- D. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.
- E. NHLA G-101 - Rules for the Measurement & Inspection of Hardwood & Cypress; National Hardwood Lumber Association; 2007.
- F. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

##### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

##### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
- E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

### **1.06 QUALITY ASSURANCE**

- A. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Premium quality, unless other quality is indicated for specific items.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Quality Certification: Provide inspection and quality certification of completed custom cabinets in accordance with AWI/AWMAC Quality Certification Program.

### **1.07 MOCK-UP**

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Protect units from moisture damage.

### **1.09 FIELD CONDITIONS**

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

## **PART 2 PRODUCTS**

### **2.01 WOOD-BASED COMPONENTS**

- A. Wood fabricated from old growth timber is not permitted.

### **2.02 LUMBER MATERIALS**

- A. Softwood Lumber: NIST PS 20; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade I/Premium; average moisture content of 5-10 percent; species as recommended by manufacturer.
- B. Hardwood Lumber: NHLA; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade I/Premium; average moisture content of 5-10 percent; species as recommended by manufacturer.
- C. Hardboard: AHA A135.4

### **2.03 PANEL MATERIALS**

- A. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with moisture resistant adhesive to suit application; sanded faces; thickness as required.

### **2.04 LAMINATE MATERIALS**

- A. Manufacturers:
  - 1. Formica Corporation: [www.formica.com](http://www.formica.com).
  - 2. Panolam Industries International, Inc\Nevamar: [www.nevamar.com](http://www.nevamar.com).
  - 3. Wilsonart International, Inc: [www.wilsonart.com](http://www.wilsonart.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific



applications.

- C. Provide specific types as scheduled.
  - 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
  - 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
  - 3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
  - 4. Post-Formed Vertical Surfaces: VGP, 0.028 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
  - 5. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
  - 6. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

## **2.05 COUNTERTOPS**

- A. Countertops: Specified in Section 12 3600.
- B. Plastic Laminate Countertops: Medium density fiberboard substrate covered with HPDL, conventionally fabricated and self-edge banded. Refer to Section 12 3600.
- C. Stainless Steel Countertops: ASTM A666 Type 304 stainless steel sheet; 16 gage, 0.06 inch (1.5 mm) nominal sheet thickness.
  - 1. Finish: 4B satin brushed finish.
  - 2. Edge and Backsplash Sink Details: As indicated on drawings.
  - 3. Exposed Edge Shape in Sink Areas: Marine edge with return; edge raised 3/16 inch (5 mm) above counter with 45 degree transition, minimum 1 inch (25 mm) flat rim; 1-1/2 inch (38 mm) high turndown, 1/2 inch (12 mm) return to face of case; reinforced with hardwood or steel.
  - 4. Back and End Splashes: Same material; welded 1/4 inch (6 mm) radius coved joint to countertop; square top edge with 1 inch (25 mm) wide top surface and minimum 1/2 inch (12 mm) turndown;
  - 5. Splash Dimensions: 4 inch (100 mm) high by 1 inch (25 mm) thick, unless otherwise indicated.

## **2.06 ACCESSORIES**

- A. Adhesive: Type recommended by AWI/AWMAC to suit application.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel, or chrome-plated finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

## **2.07 HARDWARE**

- A. Hardware: BHMA A156.9, types as scheduled for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.

- C. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
- D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- E. Catches: Magnetic.
- F. Drawer Slides:
  - 1. Type: Full extension.
  - 2. Static Load Capacity: Heavy Duty grade.
  - 3. Mounting: Side mounted.
  - 4. Stops: Integral type.
  - 5. Features: Provide self closing/stay closed type.
- G. Hinges: European style concealed self-closing type, BHMA No. BHMA A156.9, B01602, minimum 100 degrees of opening, steel with polished finish.

## **2.08 FABRICATION**

- A. Cabinet Style: Flush overlay.
- B. Cabinet Doors and Drawer Fronts: Flush style.
- C. Drawer Construction Technique: Dovetail joints.
- D. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- E. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- F. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- G. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
  - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
  - 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- H. Mechanically fasten back splash to countertops with steel brackets at 16 inches on center.
- I. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- J. Shop glaze glass materials using the Interior Dry method specified in Section 08 80 00.
- K. Stainless Steel: Fabricate tops up to 144 inches (3657 mm) long in one piece including nosings and back and end splashes; accurately fitted mechanical field joints in lengths over that dimension are permitted.
  - 1. Weld joints; grind smooth and polish to match.
  - 2. Provide stainless steel hat channel stiffeners, welded or soldered to underside, where indicated on drawings.
  - 3. Provide wall clips for support of back/end splash turndowns.
  - 4. Sound Deadening: Apply water resistant, fire resistant sound deadening mastic to entire bottom surface.

## **2.09 FACTORY FINISHING**

- A. Sand work smooth and set exposed nails and screws.
- B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.

- C. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- D. Finish work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Section 1500, Nitrocellulose Lacquer, Transparent.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

#### **3.02 INSTALLATION**

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure cabinets to floor using appropriate angles and anchorages.
- F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.
- G. Attach stainless steel countertops using stainless steel fasteners and clips.

#### **3.03 TOLERANCES**

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

#### **3.04 ADJUSTING**

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

#### **3.05 CLEANING**

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.
- B. Clean countertops surfaces thoroughly.

#### **3.06 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**



## **DIVISION 07 – THERMAL AND MOISTURE PROTECTION**

- 07 1300 - Sheet Waterproofing
- 07 1900 - Water Repellents
- 07 2100 - Thermal Insulation
- 07 2500 - Weather Barriers
- 07 3113 - Asphalt Shingles
- 07 4263 - Cement Composite Wall Panels
- 07 5400 - Thermoplastic Membrane Roofing
- 07 6200 - Sheet Metal Flashing and Trim
- 07 9005 - Joint Sealers



## **SECTION 07 1300**

### **SHEET WATERPROOFING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Sheet membrane waterproofing.
- B. Cant strips and other accessories.
- C. Drainage panels and Protection boards.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 07 9005 - Joint Sealers: Sealant for joints in substrates.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension; 2006a.
- B. ASTM D 570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2005).
- C. ASTM E 96/E 96M - Standard Test Methods For Water Vapor Transmission of Materials; 2005.
- D. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

##### **1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual for indicated system.
- B. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with three years experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

##### **1.06 FIELD CONDITIONS**

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

## 1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
- C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable Laminated Composite Manufacturers:
  - 1. Grace Construction Products; Product Bituthene 3000: [www.na.graceconstruction.com](http://www.na.graceconstruction.com).
  - 2. W.R. Meadows, Inc: [www.wrmeadows.com](http://www.wrmeadows.com).
  - 3. American Hydrotech, Inc.; VM 75.
  - 4. American Permaquik Inc.; PQ 7100.
  - 5. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
  - 6. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 MEMBRANE MATERIALS

- A. Sheet Waterproofing - General: Laminated composite membrane, adhesive bonded.
- B. Composite Laminate Membrane: Comprised of 0.056 inch (56-mil) thickness of rubberized asphalt and a 0.004 inch (4-mil) thickness of polyethylene film with release liner on adhesive side; 0.060 inch (60-mil) total thickness.
  - 1. Sheet Width: 36 inch, minimum.
  - 2. Tensile Strength: 325 psi, measured in accordance with ASTM D 412.
  - 3. Ultimate Elongation: 300 percent, measured in accordance with ASTM D 412.
  - 4. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D 570, 24 hour immersion.
  - 5. Water Vapor Permeability: 0.05 perm inch, measured in accordance with ASTM E 96/E 96M.
- C. Seaming Materials: As recommended by membrane manufacturer.
- D. Membrane Sealant: As recommended by membrane manufacturer.
- E. Termination Bars: Aluminum; compatible with membrane and adhesives.
- F. Surface Conditioner: Type compatible with membrane.
- G. Adhesives: As recommended by membrane manufacturer.
- H. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

### 2.03 ACCESSORIES

- A. Protection Board: 1/8 inch thick biodegradable hardboard.
- B. Drainage Panel: 1/4 inch thick formed plastic, hollowed sandwich.
- C. Cant Strips: Premolded composition material.
- D. Flexible Flashings: Type recommended by membrane manufacturer.
- E. Counterflashings: Galvanized steel sheet, as recommended by membrane manufacturer.



### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify conditions before starting work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify that items that penetrate surfaces to receive waterproofing are securely installed.

#### **3.02 PREPARATION**

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Seal cracks and joints with sealant using depth to width ratio as recommended by sealant manufacturer.
- E. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer. Protect conditioner from rain or frost until dry.

#### **3.03 INSTALLATION - MEMBRANE**

- A. Install membrane waterproofing in accordance with manufacturer's instructions.
- B. Roll out membrane. Minimize wrinkles and bubbles.
- C. Self-Adhering Membrane: Remove release paper layer. Roll out on substrate with a mechanical roller to encourage full contact bond.
- D. Overlap edges and ends and seal by method recommended by manufacturer, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- F. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams.
- G. Install flexible flashings. Seal items penetrating through membrane with flexible flashings. Seal watertight to membrane.
- H. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface for first ply and 6 inches at subsequent plies laid in shingle fashion.
- I. Seal membrane and flashings to adjoining surfaces. Install termination bar at all edges. Install counterflashing over all exposed edges.

#### **3.04 INSTALLATION - DRAINAGE PANEL and PROTECTION BOARD**

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.
- B. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.
- C. Adhere protection board to substrate with compatible adhesive.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**3.05 PROTECTION**

- A. Do not permit traffic over unprotected or uncovered membrane.

**END OF SECTION**

## **SECTION 07 1900**

### **WATER REPELLENTS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Water repellents applied to exterior and interior masonry surfaces.

##### **1.02 REFERENCE STANDARDS**

- A. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005.
- B. ASTM D 5095 - Standard Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes, and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments; 1991 (Reapproved 2007).

##### **1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Owner.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Field Reports: Report whether manufacturer's "best practices" are being followed; if not, state corrective recommendations. Email report to Architect the same day as inspection occurs; mail report on manufacturer's letterhead to Architect within 2 days after inspection.

##### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.
- C. Owner reserves the right to provide continuous independent inspection of surface preparation and application of water repellent.

##### **1.06 TEST PANELS**

- A. Field Samples: Select multiple representative surfaces for each substrate to receive water repellents. Apply water repellent to each substrate, with either partial or full coverage as directed and in accordance with provisions in this Section. Comply with application requirements of this Section.
  - 1. Obtain Architect's approval of field samples before applying water repellents.

2. Maintain field samples during construction in an undisturbed condition as a standard for judging the completed Work.
- B. Clean test panel area following substrate manufacturer's guidelines and recommended products for cleaning.
- C. After substrate has dried, rilm tube testing shall be done by manufactures representative, to determine coverage rates.
- D. Before full-scale application, review manufacturer's product data sheets to determine the suitability of each product for the specific surfaces. Apply each water repellent to test panels to determine number of applications, coverage rates, compatibility, effectiveness, surface preparation, application procedures, and desired results.
- E. Apply water repellents to test panels in accordance with manufacturer's written instructions. Allow 48 hours or until test panels are thoroughly dry before evaluating final appearance and results. A final rilm tube test shall be done to determine if desired finish has been accomplished. Do not begin full-scale application until test panels are inspected and approved by the Architect and the Manufacturer.
- F. Test Panel Requirements:
  1. Size: Minimum 4 feet by 4 feet each.
  2. Locations: As determined by the Architect.
  3. Number: As required to completely test each water repellent with each type of substrate to be protected.

#### **1.07 MOCK-UP**

- A. Prepare a representative surface 36 by 36 inch in size using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.
- B. For proposed substitutions, prepare side-by-side mock-ups of specified and substitute products.
- C. Locate where directed.
- D. Mockup may remain as part of the Work.

#### **1.08 FIELD CONDITIONS**

- A. Protect liquid materials from freezing.
- B. Do not apply water repellent when ambient temperature is lower than 50 degrees F or higher than 100 degrees F.
- C. Do not apply water repellents when wind velocity is higher than 20 mph.

#### **1.09 WARRANTY**

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty, executed by the applicator and water repellent manufacturer, covering materials and labor, agreeing to repair or replace materials that fail to provide water repellency within the specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1/16 inch (1.5 mm) wide, fire, vandalism, or abuse by maintenance equipment.

1. Warranty Period: 5 years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Water Repellent: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
  1. Applications: Vertical surfaces and non-traffic horizontal surfaces.
  2. Number of Coats: Two.
  3. VOC Content: Less than 600 g/L, when tested in accordance with ASTM D3690 or D 5095.
  4. Moisture Absorption When Applied to Masonry: 2 percent, maximum, when tested in accordance with ASTM C140 using masonry sample completely coated with water repellent.
  5. Maintains dry appearance when wetted.
  6. Products: Solvent-based siloxane, silane, or blend that reacts chemically with concrete and masonry; minimum 40 percent nonvolatile content by weight.
    - a. BASF Construction Chemicals; Hydrozo Clear 40 VOC.
    - b. Dayton Superior Corporation; Conspec Silane 40.
    - c. Pecora Corporation; KlereSeal 940-S VOC.
    - d. PROSOCO, Inc; Sure Klean Weather Seal SL40 <600.
    - e. Tnemec Co., Inc; Prime-A-Pell Plus V662.
    - f. W.R. Meadows, Deck-O-Shield.
    - g. Substitutions: See Section 01 6000 - Product Requirements.
- B. Graffiti Coating System: Apply Tex-Cote Sacrificial Graffiti-Gard Clear System, or approved equal, on concrete masonry and concrete surfaces over water repellent system.
  1. Apply one (1) uniform pinhole free, continuous flood coat (apply at rate of 150-200 Sq. Ft. Per Gallon over masonry block or 200-250 Sq. Ft. Per Gallon over masonry brick) over entire surface. Runs or sags shall be immediately brushed out to even the coat.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify conditions before starting work.
- B. Verify joint sealants are installed and cured.
- C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

### **3.02 PREPARATION**

- A. Protection of Adjacent Work:
  1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
  2. Protect adjacent surfaces not intended to receive water repellent.
- B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.
- C. Do not start work until masonry mortar substrate is cured a minimum of 60 days.
- D. Remove loose particles and foreign matter.
- E. Remove oil and foreign substances with a chemical solvent that will not affect water repellent.
- F. Scrub and rinse surfaces with water and let dry.
- G. Allow surfaces to dry completely to degree recommended by water repellent manufacturer

before starting coating work.

### **3.03 APPLICATION**

- A. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.
- B. Apply at rate recommended by manufacturer, continuously over entire surface.
- C. Apply two coats, minimum.
- D. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.
- E. Provide manufacturer's field service representative to inspect preparation and application work continuously during entire application period to ensure that manufacturer's "best practices" for preparation and application are being followed.

**END OF SECTION**

## **SECTION 07 2100**

### **THERMAL INSULATION**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Board insulation at perimeter foundation wall, and exterior wall behind all wall finish as shown.
- B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 2500 - Weather Barriers: Separate air barrier and vapor retarder materials.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2007.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2006.
- C. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2007.
- D. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2006.
- E. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008.
- F. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2004.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

##### **1.05 FIELD CONDITIONS**

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

#### **PART 2 PRODUCTS**

##### **2.01 APPLICATIONS**

- A. Insulation at Perimeter of Foundation: Expanded polystyrene board.
- B. Insulation on Inside of Concrete and Masonry Exterior Walls: Glass fiber board.
- C. Insulation in Metal Framed Walls: Batt insulation with separate vapor retarder.

- D. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

## 2.02 BOARD INSULATION MATERIALS

- A. Expanded Polystyrene Board Insulation: ASTM C 578; with the following characteristics:
1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  3. Board Size: 48 x 96 inch.
  4. Board Thickness: 2 inches.
  5. Board Edges: Square.
  6. Water Absorption: 4 percent by volume, maximum, when tested in accordance with ASTM D2842.
  7. Board Density: 1.35 lb/cu ft.
  8. Compressive Resistance: 15 psi.
  9. Thermal Conductivity (k factor) at 25 degrees F: 0.22.
  10. Manufacturers:
    - a. AFM Corp: [www.r-control.com](http://www.r-control.com).
    - b. Diversifoam Products: [www.diversifoam.com](http://www.diversifoam.com).
    - c. Grace Construction Products: [www.na.graceconstruction.com](http://www.na.graceconstruction.com).
  11. Substitutions: See Section 01 6000 - Product Requirements.
- B. Unfaced, Glass-Fiber Board Insulation: ASTM C 612, Type IA; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84, passing ASTM E 136 for combustion characteristics.
1. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

## 2.03 BATT INSULATION MATERIALS

- A. Batt Insulation: ASTM C 665; preformed batt; friction fit, conforming to the following:
1. Material: Glass or mineral fiber.
  2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E 84.
  3. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E 84.
  4. Combustibility: Non-combustible, when tested in accordance with ASTM E 136, except for facing, if any.
  5. Formaldehyde Content: Zero.
  6. Facing: Unfaced.
  7. Manufacturers:
    - a. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
    - b. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
    - c. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
  8. Substitutions: See Section 01 6000 - Product Requirements.

## 2.04 ACCESSORIES

- A. Sheet Vapor Retarder: Specified in Section 07 2500.
- B. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
- C. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- D. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- E. Protection Board for Below Grade Insulation: Cementitious, 1/4 inch thick.
- F. Adhesive: Type recommended by insulation manufacturer for application.



## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

### **3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER**

- A. Install boards horizontally on foundation perimeter.
  - 1. Place boards to maximize adhesive contact.
  - 2. Install in running bond pattern.
  - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Immediately following application of board insulation, place protective boards over exposed insulation surfaces.
  - 1. Apply adhesive in five continuous beads per board length.
  - 2. Install boards horizontally from base of foundation to top of insulation.
  - 3. Butt boards tightly, with joints staggered from insulation joints.

### **3.03 BOARD INSTALLATION AT EXTERIOR WALLS**

- A. Install boards vertically on walls between stud framing.
  - 1. Place boards to maximize adhesive contact.
  - 2. Butt edges and ends tightly to adjacent boards and to protrusions.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor retarder and air seal.
- D. Tape insulation board joints.

### **3.04 BATT INSTALLATION**

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Retain insulation batts in place with wire mesh secured to framing members.
- F. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
- G. Tape seal tears or cuts in vapor retarder.
- H. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.
- I. Coordinate work of this section with requirements for vapor retarder specified in Section 07 2500.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**3.05 PROTECTION**

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION**

## SECTION 07 2500

### VAPOR RETARDERS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air-tight or vapor retardant.
- B. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor-resistant and air-tight.

##### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-In-Place Concrete: Vapor retarder under concrete slabs on grade.
- B. Section 05 4000 - Cold-Formed Metal Framing: Water-resistive barrier under exterior cladding.

##### 1.03 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, vapor retarders, or water-resistive barriers.
- B. Air Barrier: Air-tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
- C. Vapor Retarder: Air-tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
  - 1. Water Vapor Permeance: For purposes of conversion,  $57.2 \text{ ng}/(\text{Pa s sq m}) = 1 \text{ perm}$ .

##### 1.04 REFERENCE STANDARDS

- A. ASTM D 1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2001.
- B. ASTM D 4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2002.
- C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008.
- D. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.
- E. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2003.

##### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Manufacturer's Installation Instructions: Indicate preparation.

##### 1.06 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

## **PART 2 PRODUCTS**

### **2.01 WEATHER BARRIER ASSEMBLIES**

- A. Air Barrier:
  - 1. On outside surface of sheathing of exterior walls use air barrier sheet, mechanically fastened type.
- B. Interior Vapor Retarder:
  - 1. On inside face of studs of exterior walls, under cladding, use mechanically fastened vapor retarder sheet.

### **2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)**

- A. Air Barrier Sheet, Mechanically Fastened:
  - 1. Air Permeance: 0.001 cubic feet per square foot, at 75 Pa., when tested in accordance with ASTM E 2178.
  - 2. Water Vapor Permeance: 28 perms, minimum, when tested in accordance with ASTM E96 Method B.
  - 3. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for minimum of 9 months weather exposure.
  - 4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 50 or less, Class A when tested in accordance with ASTM E 84.
  - 5. Products:
    - a. DuPont Company; Tyvek CommercialWrap: [www.dupont.com](http://www.dupont.com).
    - b. Fiberweb, Inc; Typar MetroWrap: [www.typar.com](http://www.typar.com).
    - c. VaproShield, LLC; WrapShield: [www.vaproshield.com](http://www.vaproshield.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.

### **2.03 VAPOR RETARDER MATERIALS**

- A. Vapor Retarder Sheet: ASTM D4397 polyethylene film reinforced with glass fiber square mesh, clear.
  - 1. Water Vapor Permeance: As required by referenced standard for thickness specified.
- B. Vapor Retarder Tape: Bright aluminum self adhering type, mesh reinforced, 2 inches wide, compatible with sheet material.

### **2.04 SEALANTS**

- A. Butyl Sealant: as specified in Section 07 9005.
- B. Sealant Backers: As specified in Section 07 9005.
- C. Primers, Cleaners, and Other Sealant Materials: As recommended by sealant manufacturer, appropriate to application, and compatible with adjacent materials.

### **2.05 ADHESIVES**

- A. Mastic Adhesive: Compatible with sheet seal and substrate, thick mastic of uniform knife grade consistency.
- B. Non-Curing Adhesive: Compatible with sheet seal and substrate, permanently non-curing.

### **2.06 ACCESSORIES**

- A. Self-Adhesive Sheet Flashing: ASTM D 1970.
- B. Thinners and Cleaners: As recommended by material manufacturer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces and conditions are ready to accept the work of this section.

### **3.02 PREPARATION**

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

### **3.03 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air-tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Vapor Retarders: Install continuous air-tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- D. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
- E. Mechanically Fastened Sheets - On Exterior:
  - 1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
  - 2. Overlap seams as recommended by manufacturer but at least 6 inches.
  - 3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
  - 4. Attach to framed construction with fasteners extending through sheathing into framing. Space fasteners at 12 to 18 inches on center along each framing member supporting sheathing.
  - 5. Attach to masonry construction using mechanical fasteners spaced at 12 to 18 inches on center vertically and maximum 24 inches on center horizontally.
  - 6. For applications specified to be air-tight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.
  - 7. Where stud framing rests on concrete or masonry, extend lower edge of sheet at least 4 inches below bottom of framing and seal to foundation with sealant.
  - 8. Install air barrier and vapor retarder UNDER jamb flashings.
  - 9. Install head flashings under weather barrier.
  - 10. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.
- F. Mechanically Fastened Sheets - Vapor Retarder On Interior:
  - 1. When insulation is to be installed in assembly, install vapor retarder over insulation.
  - 2. Anchor to metal framing using seam tape, adhering at least one-half of tape width to substrate.
  - 3. Seal seams, laps, perimeter edges, penetrations, tears, and cuts with self-adhesive tape, making air-tight seal.
  - 4. Locate laps at a framing member; at laps fasten one sheet to framing member then tape overlapping sheet to first sheet.
  - 5. Seal entire perimeter to structure, window and door frames, and other penetrations.
  - 6. Where conduit, pipes, wires, ducts, outlet boxes, and other items are installed in insulation cavity, pass vapor retarder sheet behind item but over insulation and maintain air-tight seal.

- G. Openings and Penetrations in Exterior Weather Barriers:
1. Install self-adhesive flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
  2. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using self-adhesive flashing at least 9 inches wide, covering entire depth of framing.
  3. At head of openings, install self-adhesive flashing under weather barrier extending at least 4 inches beyond face of jambs; seal weather barrier to flashing.
  4. Service and Other Penetrations: Form self-adhesive flashing around penetrating item and seal to weather barrier surface.

**3.04 FIELD QUALITY CONTROL**

- A. Do not cover installed weather barriers until required inspections have been completed.

**3.05 PROTECTION**

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

**END OF SECTION**

**SECTION 07 3113**

**ASPHALT SHINGLES**

**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. Asphalt shingles.
  - 2. Underlayment.
- B. Related Sections:
  - 1. Section 07 6200 "Sheet Metal Flashing and Trim" for metal roof penetration flashings, counterflashings and flashings.

**1.3 DEFINITION**

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples for Selection: For each type of asphalt shingle and ridge vent indicated.
  - 1. Include similar Samples of trim and accessories involving color selection.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for asphalt shingles.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Research/Evaluation Reports: For each type of asphalt shingle required, from the ICC.
- D. Warranties: Sample of special warranties.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each type of asphalt shingle to include in maintenance manuals.

#### **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. Asphalt Shingles: 100 sq. ft (9.3 sq. m) of each type, in unbroken bundles.

#### **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
  - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108 or UL 790, for application and roof slopes indicated.
- C. Preinstallation Conference: Conduct conference at Project site.

#### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Store roofing materials in a dry, well-ventilated, weathertight location according to asphalt shingle manufacturer's written instructions. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.
  - 1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.
- B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.



## **1.10 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not deliver or install asphalt shingles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.

## **1.11 WARRANTY**

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Manufacturing defects.
    - b. Structural failures including failure of asphalt shingles to self-seal after a reasonable time.
  2. Material Warranty Period: 40 years from date of Substantial Completion, prorated, with first five years nonprorated.
  3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds up to 80 mph (36 m/s) for five years from date of Substantial Completion.
  4. Workmanship Warranty Period: 10 years from date of Substantial Completion.
- B. Special Project Warranty: Roofing Installer's Warranty, or warranty form at end of this Section, signed by roofing Installer, covering the Work of this Section, in which roofing Installer agrees to repair or replace components of asphalt shingle roofing 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 GLASS-FIBER-REINFORCED ASPHALT SHINGLES**

- A. Multitab-Strip Asphalt Shingles: ASTM D 3462, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
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:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- a. Atlas Roofing Corporation.
  - b. CertainTeed Corporation.
  - c. GAF Materials Corporation.
  - d. Owens Corning.
  - e. TAMKO Roofing Products, Inc.
2. Tab Arrangement: Five tabs, randomly spaced.
  3. Cutout Shape: Tapered.
  4. Butt Edge: Stagger cut.
  5. Strip Size: Manufacturer's standard.
  6. Algae Resistance: Granules treated to resist algae discoloration.
  7. Color and Blends: As selected by Architect from manufacturer's full range.
- B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

## 2.2 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226, Type I, asphalt-saturated organic felts, nonperforated.
- B. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40-mil- (1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied.
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. Carlisle Coatings & Waterproofing, Inc.
    - b. Grace, W. R. & Co. - Conn.
    - c. Henry Company.
    - d. Johns Manville.
    - e. Owens Corning.
    - f. Protecto Wrap Company.

## 2.3 RIDGE VENTS

- A. Rigid Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent with nonwoven geotextile filter strips and external deflector baffles; for use under ridge shingles.
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. Air Vent, Inc.; a Gibraltar Industries company.
    - b. GAF Materials Corporation.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- c. Owens Corning.
- d. RGM Products, Inc.
- e. Trimline Building Products.

## 2.4 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.
- B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum **0.120-inch- (3-mm-)** diameter, barbed shank, sharp-pointed, with a minimum **3/8-inch- (9.5-mm-)** diameter flat head and of sufficient length to penetrate **3/4 inch (19 mm)** into solid wood decking or extend at least **1/8 inch (3 mm)** through OSB or plywood sheathing.
  - 1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, **1-inch (25-mm)** minimum diameter.

## 2.5 METAL FLASHING AND TRIM

- A. General: Comply with requirements in Section 07 6200 "Sheet Metal Flashing and Trim."
  - 1. Sheet Metal: Zinc-tin alloy-coated steel.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.
  - 1. Open-Valley Flashings: Fabricate in lengths not exceeding **10 feet (3 m)** with **1-inch- (25-mm-)** high, inverted-V profile at center of valley and equal flange widths of **12 inches (300 mm)**.
  - 2. Drip Edges: Fabricate in lengths not exceeding **10 feet (3 m)** with **2-inch (50-mm)** roof-deck flange and **1-1/2-inch (38-mm)** fascia flange with **3/8-inch (9.6-mm)** drip at lower edge.
- C. Vent Pipe Flashings: ASTM B 749, Type L51121, at least **1/16 inch (1.6 mm)** thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least **4 inches (100 mm)** from pipe onto roof.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and penetrations through asphalt shingles.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 UNDERLAYMENT INSTALLATION**

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of **2 inches (50 mm)** over underlying course. Lap ends a minimum of **4 inches (100 mm)**. Stagger end laps between succeeding courses at least **72 inches (1830 mm)**. Fasten with felt underlayment nails.
  - 1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than **3 inches (75 mm)** in direction to shed water. Lap ends of felt not less than **6 inches (150 mm)** over self-adhering sheet underlayment.
  - 2. Install fasteners at no more than **36 inch (900 mm)** o.c.
- C. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below, lapped in direction to shed water. Lap sides not less than **3-1/2 inches (89 mm)**. Lap ends not less than **6 inches (150 mm)** staggered **24 inches (600 mm)** between courses. Roll laps with roller. Cover underlayment within seven days.
  - 1. Eaves: Extend from edges of eaves **36 inches (914 mm)** beyond interior face of exterior wall.
  - 2. Rakes: Extend from edges of rake **36 inches (914 mm)** beyond interior face of exterior wall.
  - 3. Valleys: Extend from lowest to highest point **18 inches (450 mm)** on each side.
  - 4. Hips: Extend **18 inches (450 mm)** on each side.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

5. Ridges: Extend **36 inches (914 mm)** on each side without obstructing continuous ridge vent slot.

D. Metal-Flashed, Open-Valley Underlayment: Install two layers of **36-inch- (914-mm-)** wide felt underlayment centered in valley. Stagger end laps between layers at least **72 inches (1830 mm)**. Lap ends of each layer at least **12 inches (300 mm)** in direction to shed water, and seal with asphalt roofing cement. Fasten each layer to roof deck with felt underlayment nails.

1. Lap roof-deck felt underlayment over first layer of valley felt underlayment at least **6 inches (150 mm)**.

### **3.3 METAL FLASHING INSTALLATION**

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 07 6200 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Open-Valley Flashings: Install centered in valleys, lapping ends at least **8 inches (200 mm)** in direction to shed water. Fasten upper end of each length to roof deck beneath overlap.

1. Secure hemmed flange edges into metal cleats spaced **12 inches (300 mm)** apart and fastened to roof deck.

2. Adhere **9-inch- (225-mm-)** wide strip of self-adhering sheet to metal flanges and to self-adhering sheet underlayment.

C. Eave Drip Edges: Install eave drip edge flashings below underlayment and fasten to roof sheathing.

D. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

### **3.4 ASPHALT SHINGLE INSTALLATION**

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removed with self-sealing strip face up at roof edge.

1. Extend asphalt shingles **3/4 inch (19 mm)** over fasciae at eaves and rakes.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Fasten asphalt shingle strips with a minimum of five roofing nails located according to manufacturer's written instructions.
  - 1. Where roof slope is less than 4:12, seal asphalt shingles with asphalt roofing cement spots.
  - 2. When ambient temperature during installation is below 50 deg F (10 deg C), seal asphalt shingles with asphalt roofing cement spots.
- E. Open Valleys: Cut and fit asphalt shingles at open valleys, trimming upper concealed corners of shingle strips. Maintain uniform width of exposed open valley from highest to lowest point.
  - 1. Set valley edge of asphalt shingles in a 3-inch- (75-mm-) wide bed of asphalt roofing cement.
  - 2. Do not nail asphalt shingles to metal open-valley flashings.
- F. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- G. Ridge and Hip Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.
  - 1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.
- H. Install asphalt shingles, underlayment and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

### 3.5 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
  - 1. Owner: <Insert name of Owner>.
  - 2. Address: <Insert address>.
  - 3. Building Name/Type: <Insert information>.
  - 4. Address: <Insert address>.
  - 5. Area of Work: <Insert information>.
  - 6. Acceptance Date: <Insert date>.
  - 7. Warranty Period: <Insert time>.
  - 8. Expiration Date: <Insert date>.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
    - a. Lightning;
    - b. Peak gust wind speed exceeding <Insert wind speed> mph (m/sec);
    - c. Fire;
    - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    - f. Vapor condensation on bottom of roofing; and
    - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
  2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
  4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
  5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
  6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
  7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

- E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.
1. Authorized Signature: <Insert signature>.
  2. Name: <Insert name>.
  3. Title: <Insert title>.

**END OF SECTION 07 3113**



## SECTION 07 4263

### CEMENT COMPOSITE WALL PANELS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section includes fiber-cement composite wall panels.
- B. Related Sections:
  - 1. Section 07 6200 "Sheet Metal Flashing and Trim" for field-formed flashings and other sheet metal work not part of fiber-cement composite wall panel assemblies.

##### 1.03 DEFINITION

- A. Fiber-Cement Composite Wall Panel Assembly: Fiber-cement composite wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight/rainscreen wall system.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. General Performance: Fiber-cement composite wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Design fiber-cement composite wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Performance: Provide fiber-cement composite wall panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
  - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
    - a. Uniform pressure as indicated on Drawings.
  - 2. Deflection Limits: Fiber-cement composite wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/175 of the span at the perimeter and 1/60 of the span anywhere in the panel.
- 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.

##### 1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of fiber-cement composite wall panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of fiber-cement composite wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among

factory-, shop-, and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):
  - a. Flashing and trim.
  - b. Anchorage systems.
- C. Samples for Initial Selection: For each type of fiber-cement composite wall panel indicated with factory-applied color finishes.
  1. Include similar Samples of trim and accessories involving color selection.
  2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  1. Fiber-Cement Composite Wall Panels: Minimum 12 x 12 inches (300 x 300 mm). Include fasteners, closures, and other fiber-cement composite wall panel accessories.
  2. Trim and Closures: 12 inches (300 mm) long. Include fasteners and other exposed accessories.
  3. Accessories: 12-inch- (300-mm-) long Samples for each type of accessory.
  4. Exposed Gaskets: 12 inches (300 mm) long.
  5. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of fiber-cement composite wall panels adjacent to joint sealants.
- E. Delegated-Deferred-Design Submittal: For fiber-cement composite wall panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### **1.06 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Exterior elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Wall panels and attachments.
  2. Stud framing.
  3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
  4. Penetrations of wall by pipes and utilities.
- B. Qualification Data: For professional engineer and for installer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- D. Field quality-control reports.
- E. Warranties: Samples of special warranties.

#### **1.07 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For fiber-cement wall panels to include in maintenance manuals.

#### **1.08 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of fiber-cement composite wall panel from single source from single manufacturer.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. Fire-Resistance Ratings: Where indicated, provide fiber-cement composite wall panels identical

to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall panel as shown on Drawings; approximately 8 feet long x 6 feet high by full thickness, including supports, attachments, and accessories.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, fiber-cement composite wall panel Installer, fiber-cement composite wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects fiber-cement composite wall panels including installers of doors, windows, and louvers.
  2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  3. Review methods and procedures related to fiber-cement composite wall panel installation, including manufacturer's written instructions.
  4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  5. Review flashings, special details, wall penetrations, openings, and condition of other construction that will affect fiber-cement composite wall panels.
  6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  7. Review temporary protection requirements for fiber-cement composite wall panel assembly during and after installation.
  8. Review wall panel observation and repair procedures after fiber-cement composite wall panel installation.

#### **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver components, sheets, fiber-cement composite wall panels, and other manufactured items so as not to be damaged or deformed. Package fiber-cement composite wall panels for protection during transportation and handling.
- B. Unload, store, and erect fiber-cement composite wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Store fiber-cement composite wall panels vertically, covered with suitable weathertight and ventilated covering. Store fiber-cement composite wall panels to ensure dryness, with positive slope for drainage of water. Do not store fiber-cement composite wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F (49 deg C).
- D. Retain any strippable protective covering on fiber-cement composite wall panel for period of panel installation.

#### **1.10 PROJECT CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather

conditions permit assembly of fiber-cement composite wall panels to be performed according to manufacturer's written instructions and warranty requirements.

- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before fiber-cement composite wall panel fabrication and indicate measurements on Shop Drawings.

### **1.11 COORDINATION**

- A. Coordinate fiber-cement composite wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

### **1.12 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fiber-cement composite wall panel assemblies that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including rupturing, cracking, or puncturing.
    - b. Deterioration of materials beyond normal weathering.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 PANEL MATERIALS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Swisspearl; Swisspearl CARAT or a comparable product.
- B. General: Fiber-cement panels, noncombustible with a flame-spread index of 25 or less and meeting the manufacturer's published physical properties.
- B. Panel Finish:
  - 1. Provide stain finish as recommended by the manufacturer, color to match Architect's sample.
- C. Panel Sealants:
  - 1. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in fiber-cement composite wall panels and remain weathertight; and as recommended in writing by panel manufacturer.

### **2.02 MISCELLANEOUS METAL FRAMING**

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

### **2.03 MISCELLANEOUS MATERIALS**

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of fiber-cement composite wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

## **2.04 ACCESSORIES**

- A. Wall Panel Accessories: Provide components required for a complete fiber-cement composite wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of fiber-cement composite wall panels unless otherwise indicated.
- B. Flashing and Trim: Formed from 0.018-inch- (0.46-mm-) minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers.

## **2.05 FABRICATION**

- A. General: Fabricate and finish fiber-cement composite wall panels and accessories at the factory to greatest extent possible, 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. Fiber-Cement Composite Wall Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of material.
  - 1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
  - 2. Fabricate panels with sharply cut edges.
  - 3. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape as recommended by panel manufacturer.
  - 4. Dimensional Tolerances:
    - a. Panel Bow: 0.8 percent maximum of panel length or width.
    - b. Squareness: 0.25 inch (5 mm) maximum.
- C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by fiber-cement composite wall panel manufacturer.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, fiber-cement composite wall panel supports, and other conditions affecting performance of the Work.
  - 1. Examine wall framing to verify that studs and other structural panel support members and

- anchorage have been installed within alignment tolerances required by fiber-cement composite wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by fiber-cement composite wall panel manufacturer.
  3. Verify that weather membrane has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating fiber-cement composite wall panels to verify actual locations of penetrations relative to seam locations of panels before panel installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Miscellaneous Framing: Install miscellaneous wall panel support members and anchorage according to ASTM C 754 and fiber-cement composite wall panel manufacturer's written instructions.

### **3.03 FIBER-CEMENT COMPOSITE WALL PANEL INSTALLATION**

- A. General: Install fiber-cement composite wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Commence fiber-cement composite wall panel installation and install minimum of 100 sq. ft. (9.27 sq. m) in presence of factory-authorized representative.
  2. Shim or otherwise plumb substrates receiving fiber-cement composite wall panels.
  3. Flash and seal fiber-cement composite wall panels at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
  4. Install flashing and trim as fiber-cement composite wall panel work proceeds.
  5. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of fiber-cement composite wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.
1. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."
- C. Attachment System Installation, General: Install attachment system required to support fiber-cement composite wall panels and to provide a complete weathertight wall system, including tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
  2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.
- D. Rainscreen-Principle Installation: Provide manufacturer's standard pressure-equalized, rainscreen-principle system with vertical channel that provides support and complete secondary drainage system, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach wall panels by engaging

horizontal support pins into notches in vertical channels and into flanges of wall panels. Leave horizontal and vertical joints with open reveal.

1. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
2. Do not apply sealants to joints unless otherwise indicated on Drawings.

### **3.04 ACCESSORY INSTALLATION**

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
  1. Install components required for a complete fiber-cement composite wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. 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.

### **3.05 ERECTION TOLERANCES**

- A. Installation Tolerances: Shim and align fiber-cement composite wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

### **3.06 CLEANING**

- A. Remove temporary protective coverings and strippable films, if any, as fiber-cement composite wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of fiber-cement composite wall panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.
- B. After fiber-cement composite wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace fiber-cement composite wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 07 4263**





## **SECTION 07 5400**

### **THERMOPLASTIC MEMBRANE ROOFING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Mechanically attached system with thermoplastic roofing membrane.
- B. Insulation, flat and tapered.
- C. Vapor retarder.
- D. Deck sheathing.
- E. Roofing stack boots, roofing expansion joints, and walkway pads.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 07 6200 - Sheet Metal Flashing and Trim: Counterflashings, reglets,.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2007.
- B. ASTM C 728 - Standard Specification for Perlite Thermal Insulation Board; 2005.
- C. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2007.
- D. ASTM D 6878 - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing; 2006a.
- E. FM DS 1-28 - Wind Design; Factory Mutual Research Corporation; 2007.
- F. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.

##### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene one week before starting work of this section.
  - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

##### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Specimen Warranty: For approval.
- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, and mechanical fastener layout.
- D. Samples for Verification: Submit two samples 6 x 6 inches in size illustrating insulation.
- E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's

name and registered with manufacturer.

#### **1.06 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing the work of this section:
  - 1. With minimum five years documented experience.
  - 2. Approved by membrane manufacturer.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Store products in weather protected environment, clear of ground and moisture.
- C. Protect foam insulation from direct exposure to sunlight.

#### **1.08 WARRANTY**

- A. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 5 years after installation.
- B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
  - 1. Warranty Term: 20 years.
  - 2. For repair and replacement include costs of both material and labor in warranty.
  - 3. Exceptions NOT Permitted:
    - a. Damage due to roof traffic.
    - b. Damage due to wind of speed greater than 56 mph but less than 90 mph.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Thermoplastic Polyolefin Membrane Materials:
  - 1. Carlisle SynTec; [www.carlisle-syntec.com](http://www.carlisle-syntec.com).
  - 2. Firestone Building Products Co; [www.firestonebpc.com](http://www.firestonebpc.com).
  - 3. GenFlex Roofing Systems; [www.genflex.com](http://www.genflex.com).
  - 4. Johns Manville.
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation:
  - 1. Atlas Roofing Corporation: [www.atlasroofing.com](http://www.atlasroofing.com).
  - 2. GAF Materials Corporation: [www.gaf.com](http://www.gaf.com).
  - 3. Dow Chemical Co: [www.dow.com](http://www.dow.com).
  - 4. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 ROOFING - UNBALLASTED APPLICATIONS**

- A. Thermoplastic Membrane Roofing: One ply membrane, mechanically fastened, over insulation.
- B. Acceptable Insulation Types - Constant Thickness Application: Any of the types specified.
  - 1. Minimum 2 layers of polyisocyanurate board.
  - 2. Bottom layer of polyisocyanurate board covered with single layer of polyisocyanurate board.
- C. Acceptable Insulation Types - Tapered Application: Any of the types specified.
  - 1. Tapered perlite or extruded polystyrene board.
  - 2. Tapered perlite or extruded polystyrene board covered with uniform thickness polyisocyanurate board.

3. Uniform thickness polyisocyanurate board covered with tapered extruded polystyrene, or perlite board.

### **2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS**

- A. Membrane:
  1. Material: Thermoplastic polyolefin (TPO) complying with ASTM D6878.
  2. Reinforcing: Internal fabric.
  3. Thickness: 0.060 inch, minimum.
  4. Sheet Width: Factory fabricated into largest sheets possible.
  5. Color: White.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Membrane Fasteners:
- D. Vapor Retarder: Polyethylene film, ASTM D 4397, 6 mils (0.15mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5ng/Pa x s x sq. m).
  1. Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.
  2. Adhesive: Manufacturer's standard lap adhesive, FM Approvals approved for vapor retarder application.
- E. Flexible Flashing Material: Same material as membrane.

### **2.04 INSULATION**

- A. Perlite Board Insulation: Expanded perlite mineral aggregate, ASTM C728, with the following characteristics:
  1. Tapered Board: Slope as indicated; minimum thickness 1/2 inch; fabricate of fewest layers possible.
- B. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type I, aluminum foil both faces; Class 1, non-reinforced foam core and with the following characteristics:
  1. Compressive Strength: 16 psi
  2. Board Size: 48 x 96 inch.
  3. Board Thickness: 2 inch.
  4. Board Edges: Square.
  5. Manufacturers:
    - a. Atlas Roofing Corporation: [www.atlasroofing.com](http://www.atlasroofing.com).
    - b. Dow Chemical Co: [www.dow.com](http://www.dow.com).
    - c. GAF Materials Corporation: [www.gaf.com](http://www.gaf.com).
  6. Substitutions: See Section 016000 - Product Requirements.
- C. Extruded Polystyrene Board Insulation: ASTM C 578, Type X; Extruded expanded polystyrene board with natural skin surfaces, with drainage channels one face; with the following characteristics:
  1. Board Size: 48 x 96 inch.
  2. Tapered Board: Slope as indicated; minimum thickness 1/2 in; fabricate of fewest layers possible.
  3. Board Edges: Square.
  4. Compressive Resistance: 25 psi.
  5. Board Density: 1.6 lb/cu ft.
  6. Water Absorption, maximum: 0.3 percent, volume.

## **2.05 ACCESSORIES**

- A. Prefabricated Roofing Expansion Joint Flashing: Sheet butyl over closed-cell foam backing seamed to galvanized steel flanges.
- B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- C. Sheathing Joint Tape: Paper type, 3 inch wide, self adhering.
- D. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.
- E. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
  - 1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
- F. Membrane Adhesive: As recommended by membrane manufacturer.
- G. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
- H. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- I. Insulation Adhesive: As recommended by insulation manufacturer.
- J. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.
- K. Insulation Perimeter Restraint: Stainless steel edge device configured to restrain insulation boards in position and provide top flashing over ballast.
- L. Sealants: As recommended by membrane manufacturer.
- M. Walkway Pads: Type as recommended by membrane manufacturer; size as indicated.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION - GENERAL**

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.
- B. Do not apply roofing membrane during unsuitable weather.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- F. At insulation depths exceeding 12 inches it is acceptable to use "Insta Stik" Quick Set commercial roofing adhesive installed / applied to meet FM I-90 requirements.

### **3.02 EXAMINATION**

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped

and suitable for installation of roof system.

- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

### **3.03 METAL DECK PREPARATION**

- A. Install preformed sound absorbing glass fiber insulation strips supplied by Section 053100 in acoustic deck flutes. Install in accordance with manufacturer's instructions.
- B. Install deck sheathing on metal deck:
  - 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
  - 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
  - 3. Tape joints.
  - 4. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.
    - a. Over entire roof area, fasten sheathing using 6 fasteners with washers per sheathing board.
    - b. At roof perimeter to a distance of 4 ft in from edges, fasten sheathing using 6 fasteners with washers per board.

### **3.04 VAPOR RETARDER AND INSULATION - UNDER MEMBRANE**

- A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
  - 1. Extend vapor retarder under cant strips and blocking to deck edge.
  - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
- C. Attachment of Insulation:
  - 1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
- D. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.
- E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- F. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
- G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- H. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
- I. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.
- J. Do not apply more insulation than can be covered with membrane in same day.

### **3.05 MEMBRANE APPLICATION**

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.

- C. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- D. Mechanical Attachment: Apply membrane and mechanical attachment devices in accordance with manufacturer's instructions.
- E. At intersections with vertical surfaces:
  - 1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
  - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Install roofing expansion joints where indicated. Make joints watertight.
  - 1. Install prefabricated joint components in accordance with manufacturer's instructions.
- H. Coordinate installation of roof drains and sumps and related flashings.

### **3.06 FINISHING UNBALLASTED SURFACES**

- A. Install walkway pads. Space pad joints to permit drainage.

### **3.07 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.
- B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

### **3.08 CLEANING**

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

### **3.09 PROTECTION**

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

**END OF SECTION**

## **SECTION 07 6200**

### **SHEET METAL FLASHING AND TRIM**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and other items indicated in Schedule.
- B. Reglets and accessories.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 07 5400 - Thermoplastic Membrane Roofing: Roofing system.

##### **1.03 REFERENCE STANDARDS**

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2002.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2005.
- C. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.
- D. ASTM B 32 - Standard Specification for Solder Metal; 2004.
- E. ASTM B 370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2003.
- F. ASTM B 749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products; 2003.
- G. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007.
- H. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

##### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene one week before starting work of this section.

##### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples 6 x 6 inch in size illustrating metal finish color.

##### **1.06 QUALITY ASSURANCE**

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.

##### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

- B. Prevent contact with materials that could cause discoloration or staining.

## **PART 2 PRODUCTS**

### **2.01 SHEET MATERIALS**

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch thick base metal.
- B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch thick base metal, shop pre-coated with modified silicone coating.
  - 1. Modified Silicone Polyester Coating (Concealed Locations): Pigmented Organic Coating System, AAMA 2603; baked enamel finish system; color as selected from manufacturer's standard colors.
  - 2. PVDF (Polyvinylidene Fluoride) Coating (Exposed Locations): Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as scheduled.
- C. Lead: ASTM B749, 2.5 lb/sq ft thick.
- D. Copper: ASTM B370, cold rolled 16 oz/sq ft thick; natural finish.

### **2.02 ACCESSORIES**

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Underlayment: Polyethylene, 6 mils.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
  - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
  - 3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
- D. Slip Sheet: Rosin sized building paper.
- E. Primer: Zinc chromate type.
- F. Protective Backing Paint: Zinc molybdate alkyd.
- G. Sealant: Typespecified in Section 079005.
- H. Plastic Cement: ASTM D4586, Type I.
- I. Reglets: Surface mounted type, galvanized steel; face and ends covered with plastic tape.
- J. Solder: ASTM B32; Sn50 (50/50) type.

### **2.03 FABRICATION**

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with standing seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.



- E. Tin edges of copper sheet to be soldered. Solder shop formed metal joints. After soldering, remove flux. Wipe and wash solder joints clean. Weather seal joints.
- F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- H. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.
- I. Fabricate snow guards as detailed.

## **2.04 GUTTER AND DOWNSPOUT FABRICATION**

- A. Gutters: SMACNA Architectural Sheet Metal Manual, Rectangular profile.
- B. Downspouts: Rectangular profile.
- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 5 years in accordance with SMACNA Architectural Sheet Metal Manual.
- D. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from material matching adjacent wall panels or surfaces.
- E. Accessories: Profiled to suit gutters and downspouts.
  - 1. Anchorage Devices: In accordance with SMACNA requirements.
  - 2. Gutter Supports: Brackets.
  - 3. Downspout Supports: Brackets.
- F. Downspout Boots: Steel.
- G. Seal metal joints.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

### **3.02 PREPARATION**

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

### **3.03 INSTALLATION**

- A. Insert flashings into reglets to form tight fit. Secure in place with plastic wedges. Seal flashings into reglets with sealant.
- B. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.

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451 East 200 South  
Lehi, Utah 84043

- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- F. Secure gutters and downspouts in place using concealed fasteners.
- G. Slope gutters 1/4 inch per foot minimum.
- H. Connect downspouts to downspout boots. Grout connection watertight.

**END OF SECTION**

## SECTION 07 9005

### JOINT SEALERS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
  - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
    - a. Construction joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry and cast stone units.
    - c. Joints between metal panels.
    - d. Joints between different materials listed above.
    - e. Perimeter joints between materials listed above and frames of doors and windows.
    - f. Control and expansion joints in ceilings and other overhead surfaces.
    - g. Other joints as indicated.
  - 2. Exterior joints in the following horizontal traffic surfaces:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
    - b. Joints between different materials listed above.
    - c. Other joints as indicated.
  - 3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints of exterior openings where indicated.
    - c. Tile control and expansion joints.
    - d. Vertical joints on exposed surfaces of walls and partitions.
    - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
    - f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - g. Other joints as indicated.
  - 4. Interior joints in the following horizontal traffic surfaces:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Control and expansion joints in tile flooring.
    - c. Other joints as indicated.

##### 1.02 REFERENCE STANDARDS

- A. ASTM C 834 - Standard Specification for Latex Sealants; 2005.
- B. ASTM C 919 - Standard Practice for Use of Sealants in Acoustical Applications; 2002.
- C. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2005.
- D. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2005a.
- E. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).

##### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with other sections referencing this section.

##### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. Samples: Submit two samples, 4 inches long in size illustrating sealant colors for selection.

- D. Manufacturer's Installation Instructions: Indicate special procedures.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years experience.

#### **1.07 PRECONSTRUCTION TESTING**

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Use ASTM 1087 or manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint substrates.
  2. Submit number of pieces of each kind of material required by manufacturer for complete testing. Include at a minimum, joint substrates, shims, joint sealant backings, secondary seals and miscellaneous materials.
  3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  4. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  5. Testing will not be required if joint sealant manufacturers submit joint preparation data that are based on previous testing, not older than 36 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- B. Preconstruction Field Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints as directed by Architect.
  2. Conduct field tests for each kind of sealant and joint substrate indicated.
  3. Coordinate with Architect the dates and times when test joints will be installed.
  4. Arrange for joint sealant manufacturer's technical representative to be present for all tests.
    - a. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM 1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along on side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  6. Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### **1.08 MOCK-UP**

- A. Provide mock-up of sealant joints in conjunction with window under provisions of Section 01 4000.
- B. Construct mock-up with specified sealant types and with other components noted.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

### **1.09 FIELD CONDITIONS**

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

### **1.10 COORDINATION**

- A. Coordinate the work with all sections referencing this section.

### **1.11 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a 20 year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.
- D. Provide all testing required by the manufacturer to qualify for the warranty specified.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Silicone Sealants:
  - 1. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com](http://www.momentive.com).
  - 2. Tremco Inc. : [www.tremcosealants.com](http://www.tremcosealants.com)
  - 3. Dow Corning Corp.; [www.dowcorning.com](http://www.dowcorning.com)
  - 4. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 5. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Polyurethane Sealants:
  - 1. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 2. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 3. Sika
  - 4. Tremco
  - 5. Substitutions: See Section 016000 - Product Requirements.
- C. Acrylic Sealants:
  - 1. DAP Products Inc; Product 230
  - 2. OSI Pro-Series; Product: PC-158
  - 3. Tremco, Inc
  - 4. Pecora Corp.
  - 5. Substitutions: See Section 016000 - Product Requirements.
- D. Butyl Sealants:
  - 1. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 2. Manus Products Inc.
  - 3. ADCO
  - 4. Tremco
  - 5. Substitutions: See Section 016000 - Product Requirements.
- E. Acrylic Emulsion Latex Sealants:
  - 1. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 2. BASF Construction Chemicals-Building Systems: [www.chemrex.com](http://www.chemrex.com).
  - 3. Tremco
  - 4. OSI
  - 5. Substitutions: See Section 016000 - Product Requirements.

## 2.02 SEALANTS

- A. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25, Uses M, G, and A; single component.
  - 1. Color: Standard colors matching finished surfaces.
  - 2. Applications: Use for:
    - a. Control, expansion, and soft joints in masonry.
    - b. Joints between concrete and other materials.
    - c. Joints between metal frames and other materials.
    - d. Other exterior joints for which no other sealant is indicated.
- B. Exterior Expansion Joint Sealer: Precompressed foam sealer; urethane with water-repellent;
  - 1. Color: Black.
  - 2. Size as required to provide weathertight seal when installed.
  - 3. Provide product recommended by manufacturer for traffic-bearing use.
  - 4. Applications: Use for:
    - a. Exterior wall expansion joints.
- C. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
  - 1. Applications: Use for:
    - a. Concealed sealant bead in sheet metal work.
    - b. Concealed sealant bead in siding overlaps.
- D. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
  - 1. Color: Standard colors matching finished surfaces.
  - 2. Applications: Use for:
    - a. Interior wall and ceiling control joints.
    - b. Joints between door and window frames and wall surfaces.
    - c. Other interior joints for which no other type of sealant is indicated.
- E. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
  - 1. Applications: Use for:
    - a. Joints between plumbing fixtures and floor and wall surfaces.
    - b. Joints between kitchen and bath countertops and wall surfaces.
- F. Acoustical Sealant: Acrylic sealant; ASTM C 920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.
  - 1. Applications: Use for concealed locations only:
    - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
- G. Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C920, Grade P, Class 25, Uses T, M and A; single component.
  - 1. Approved by manufacturer for wide joints up to 1-1/2 inches.
  - 2. Color: Standard colors matching finished surfaces.
  - 3. Applications: Use for:
    - a. Expansion joints in floors.
- H. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C920, Class 25, Uses T, I, M and A; single component.
  - 1. Color: Gray.
  - 2. Applications: Use for:
    - a. Joints in sidewalks and vehicular paving.
- I. Silicone Sealant: ASTM C920, Grade NS, Class 25, Uses NT, A, G, M, O; single component,

solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding.

1. Color: Standard colors matching finished surfaces.
2. Movement Capability: Plus and minus 25 percent.
3. Service Temperature Range: -65 to 180 degrees F.
4. Shore A Hardness Range: 15 to 35.
5. Applications: Use for:
  - a. Exterior horizontal and vertical joints.

### **2.03 ACCESSORIES**

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

### **3.02 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

### **3.03 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.
- I. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- J. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.
- K. Seal abutting joint at all dissimilar materials.

#### **3.04 FIELD QUALITY CONTROL**

- A. Field Adhesion Testing: Field test joint sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Provide all testing required by the manufacturer to qualify for the warranty specified.

#### **3.05 CLEANING**

- A. Clean adjacent soiled surfaces as work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

#### **3.06 PROTECTION**

- A. Protect sealants until cured.

**END OF SECTION**



## **DIVISION 08 – OPENINGS**

08 1113 - Hollow Metal Doors and Frames

08 3100 - Access Doors and Panels

08 3313 - Coiling Counter Doors

08 4313 - Aluminum-Framed Storefronts

08 7100 - Door Hardware

08 8000 - Glazing

08 8300 - Mirrors



## SECTION 08 1113

### HOLLOW METAL DOORS AND FRAMES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.
- B. Steel frames for wood doors.
- C. Fire-rated steel doors and frames.
- D. Thermally insulated steel doors at all exterior locations.
- E. Steel glazing frames.
- F. Accessories, including glazing, louvers, and matching panels.

##### 1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware.
- B. Section 088000 - Glazing: Glass for doors and borrowed lites.
- C. Section 099000 - Painting and Coating: Field painting.

##### 1.03 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2004).
- D. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.
- E. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2006.
- F. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.
- G. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association; 2007.
- H. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; 1998.

##### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Steel Doors and Frames:
  - 1. Assa Abloy Ceco, Curries, or Fleming: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Windsor Republic Doors: [www.republicdoor.com](http://www.republicdoor.com).
  - 3. Steelcraft: [www.steelcraft.com](http://www.steelcraft.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 DOORS AND FRAMES**

- A. Requirements for All Doors and Frames:
  - 1. Accessibility: Comply with ANSI/ICC A117.1.
  - 2. Door Top Closures: Flush with top of faces and edges.
  - 3. Door Edge Profile: Beveled on both edges.
  - 4. Door Texture: Smooth faces.
  - 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
  - 6. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
  - 7. Galvanizing for Units in Wet Areas: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.
  - 8. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

### **2.03 STEEL DOORS**

- A. Exterior Doors:
  - 1. Grade: ANSI A250.8 Level 4, physical performance Level A, Model 2, seamless.
  - 2. Core: Polystyrene foam.
  - 3. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
  - 4. Texture: Smooth faces.
  - 5. Weatherstripping: Separate, see Section 087100.
  - 6. Finish: Factory primed, for field finishing.

- B. Interior Doors, Non-Fire-Rated:
  - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
  - 2. Core: Cardboard honeycomb.
  - 3. Thickness: 1-3/4 inches.
  - 4. Texture: Smooth faces.
  - 5. Finish: Factory primed, for field finishing.
- C. Interior Doors, Fire-Rated:
  - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
  - 2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
    - a. Rate of Temperature Rise Across Door Thickness: 250 F degrees.
    - b. Provide units listed and labeled by UL.
    - c. Attach fire rating label to each fire rated unit.
  - 3. Core: Mineral fiberboard.
  - 4. Texture: Smooth faces.
  - 5. Finish: Factory primed, for field finishing.
- D. Panels: Same construction, performance, and finish as doors.

## 2.04 STEEL FRAMES

- A. General:
  - 1. Comply with the requirements of grade specified for corresponding door, except:
    - a. ANSI A250.8 Level 3 Doors: 14 gage frames.
    - b. ANSI A250.8 Level 4 Doors: 12 gage frames.
    - c. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 16 gage
  - 2. Finish: Same as for door.
  - 3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
  - 4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
  - 5. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
- B. Exterior Door Frames: Fully welded.
  - 1. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
  - 2. Finish: Factory primed, for field finishing.
  - 3. Weatherstripping: Separate, see Section 08 7100.
- C. Interior Door Frames, Non-Fire-Rated: Fully welded type.
  - 1. Finish: Factory primed, for field finishing.
- D. Interior Door Frames, Fire-Rated: Fully welded type.
  - 1. Fire Rating: Same as door, labeled.
  - 2. Finish: Factory primed, for field finishing.
- E. Mullions for Pairs of Doors: Fixed, except where removable is indicated, of profile similar to jambs.
- F. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

## 2.05 ACCESSORY MATERIALS

- A. Louvers: Roll formed steel with overlapping frame; factory-painted finish, color as selected;

factory-installed.

1. In Fire-Rated Doors: UL-listed fusible link louver, same rating as door.
  2. Style: Sightproof inverted Y blade.
  3. Fasteners: Concealed fasteners.
- B. Glazing: As specified in Section 08 8000 for 90 minute rated glazing, factory installed.
- C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- D. Astragals for Double Doors: Specified in Section 08 7100.
1. Exterior Doors: Steel, Z-shaped.
  2. Fire-Rated Doors: Steel, shape as required to accomplish fire rating.
- E. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- F. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- G. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

## **2.06 FINISH MATERIALS**

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

### **3.02 PREPARATION**

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

### **3.03 INSTALLATION**

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. In addition, install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Coordinate installation of hardware.
- F. Coordinate installation of glazing.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

### **3.04 TOLERANCES**

- A. Clearances Between Door and Frame: As specified in ANSI A250.8.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

### **3.05 ADJUSTING**

A. Adjust for smooth and balanced door movement.

**END OF SECTION**





## **SECTION 08 3100**

### **ACCESS DOORS AND PANELS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Access door and frame units, fire-rated and non-fire-rated, in wall locations.
- B. Access door and frame units, non-fire-rated, in ceiling locations.
- C. Access door and frame units at locations as shown on the drawings.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 09 9000 - Painting and Coating: Field paint finish.

##### **1.03 REFERENCE STANDARDS**

- A. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- B. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of all access door units.
- D. Manufacturer's Installation Instructions: Indicate installation requirements.
- E. Project Record Documents: Record actual locations of all access units.

#### **PART 2 PRODUCTS**

##### **2.01 MANUFACTURERS**

- A. Access Doors:
  - 1. Acudor Products Inc: [www.acudor.com](http://www.acudor.com).
  - 2. Karp Associates, Inc: [www.karpinc.com](http://www.karpinc.com).
  - 3. Milcor Inc: [www.milcorinc.com](http://www.milcorinc.com).
  - 4. Substitutions: See Section 016000 - Product Requirements.

##### **2.02 ACCESS DOORS AND PANELS**

- A. All Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
- B. Floor Units: Design to support live load of 100 lb/sq ft with deflection not to exceed 1/180 of span.
- C. Units in Fire Rated Assemblies: Fire rating equivalent to the fire rated assembly in which they are to be installed.
  - 1. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.
  - 2. Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated doors.

## **2.03 WALL AND CEILING UNITS**

- A. Door and Frame Units: Formed steel.
  - 1. Frames and flanges: 0.058 inch steel.
  - 2. Door panels: 0.070 inch single thickness steel sheet.
  - 3. Door panels: 0.070 inch double sheet with integral non-combustible insulation filler at fire-rated locations.
  - 4. Size: As indicated or as required.
  - 5. Hardware:
    - a. Hinge: 175 degree stainless steel piano hinge with removable pin.
    - b. Lock: Cylinder lock with latch, two keys for each unit.
  - 6. Galvanized, hot dipped finish.
  - 7. Prime coat with alkyd primer.
  
- B. Door and Frame Units: Formed stainless steel.
  - 1. Frames and flanges: 0.058 inch steel.
  - 2. Door panels: 0.070 inch single thickness steel sheet.
  - 3. Door panels: 0.070 inch double sheet with integral non-combustible insulation filler at fire-rated locations.
  - 4. Size: As indicated or as required.
  - 5. Hardware:
    - a. Hinge: 175 degree stainless steel piano hinge with removable pin.
    - b. Lock: Cylinder lock with latch, two keys for each unit.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that rough openings are correctly sized and located.

### **3.02 INSTALLATION**

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.

**END OF SECTION**

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**SECTION 08 3313**  
**COILING COUNTER DOORS**

**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. Counter doors.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of coiling counter door and accessory.

- 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Include rated capacities, operating characteristics, and furnished accessories.

- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

- 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.

- C. Samples for Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Include similar Samples of accessories involving color selection.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

#### 1.6 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.
  1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.

#### 2.2 COUNTER DOOR ASSEMBLY

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
  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. [Cookson Company.](#)
    - b. [Cornell Iron Works, Inc.](#)
    - c. [McKeon Rolling Steel Door Company, Inc.](#)
    - d. [Overhead Door Corporation.](#)
    - e. [Raynor.](#)
    - f. [Wayne-Dalton Corp.](#)
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Curtain R-Value: 5.0 deg F x h x sq. ft./Btu (0.881 K x sq. m/W).
- D. Door Curtain Material: Aluminum.
- E. Door Curtain Slats: Flat profile slats of 3-inch (76-mm) center-to-center height.
  - 1. Insulated-Slat Interior Facing: Metal.
  - 2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- F. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated aluminum extrusion and finished to match door.
- G. 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.
- H. Hood: Aluminum.
  - 1. Shape: Round.
  - 2. Mounting: Face of wall.
- I. Sill Configuration: No sill.
- J. Locking Devices: Equip door with locking device assembly.
  - 1. Locking Device Assembly: Cremona type, both jamb sides locking bars, operable from inside and outside with cylinders.
- K. Manual Door Operator: Push-up operation/Chain-hoist operator.
- L. Curtain Accessories: Equip door with weatherseals, and push/pull handles.
- M. Door Finish:
  - 1. Aluminum Finish: Clear anodized.

## 2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- 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:
  - 1. Aluminum Door Curtain Slats: ASTM B 209 (ASTM B 209M) sheet or ASTM B 221 (ASTM B 221M) extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch (1.27 mm); and as required.
  - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

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.

1. Removable Posts and Jamb Guides: Manufacturer's standard.

## 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. Aluminum: 0.040-inch- (1.02-mm-) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.

## 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: Cylinders standard with manufacturer and keyed to building keying system.

2. Keys: Three for each cylinder.

## 2.6 CURTAIN ACCESSORIES

A. Weatherseals: Equip door with weather-stripping gaskets fitted to entire perimeter of door for air-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.

2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.

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.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

## 2.7 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than **0.03 in./ft. (2.5 mm/m)** of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. 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)**.
- C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum **25-lbf (111-N)** force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

## 2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.10 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- 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.
- B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

#### 3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

#### 3.4 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 08 3313**



## SECTION 08 4313

### ALUMINUM-FRAMED STOREFRONTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of metal.
- C. Aluminum doors and frames.
- D. Weatherstripping.
- E. Door hardware.
- F. Perimeter sealant.

##### 1.02 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Steel attachment members.
- B. Section 07 9005 - Joint Sealers: Perimeter sealant and back-up materials.
- C. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.
- D. Section 08 8000 - Glazing: Glass and glazing accessories.
- E. Section 08 4413 - Glazed Aluminum Curtain Walls.

##### 1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2004.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.
- C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2005.
- D. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2008.
- E. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.
- F. ASTM B 209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2007.
- G. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2008.
- H. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2007.
- I. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.
- J. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002 (Reapproved 2010).
- K. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type

I and Type II; Society for Protective Coatings; 1997 (Ed. 2004).

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting four weeks before starting work of this section to review equipment, staging, and preceding activities; require attendance by all affected installers.

#### 1.05 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
  - 1. Wind Load Criteria: See Structural Drawings.
  - 2. Member Deflection: Limit member deflection to 1/175 in any direction, with full recovery of glazing materials.
- B. Seismic Loads: See Structural Drawings.
- C. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- D. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area, measured at a reference differential pressure across assembly of 6.24 psf (300 Pa) as measured in accordance with ASTM E 283.
- E. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 8psf as defined in AAMA 501.
- F. Energy Performance: Certify and label total system energy performance according to NFRC as follows:
  - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
- G. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- H. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
- I. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
- J. Design system to eliminate noises caused by wind and thermal movement, to prevent vibration harmonics, and to prevent "stack effect" in internal spaces.

#### 1.06 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical wall areas as shown on Drawings.
  - 2. Testing shall be performed on mockups according to requirements in "Field Quality Control" and "Commissioning" Articles.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.07 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required. Show plans, sections, elevations and details of adjoining materials.
- D. Hardware Schedule: for aluminum doors, submit hardware schedule and indicate operating hardware types, functions, quantities, and locations. Provide product data for each piece of hardware specified, coordinated with cylinders provided by others.
- E. Samples: Submit two samples 4 x 6 inches in size illustrating finished aluminum surface, glass, glazing materials.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### **1.08 QUALITY ASSURANCE**

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at Utah.
- B. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum ten years of documented experience.

#### **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

#### **1.10 FIELD CONDITIONS**

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C) unless specifically reviewed and accepted by the sealant manufacturer and the General Contractor. Maintain this minimum temperature during and 48 hours after installation.

#### **1.11 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide ten year manufacturer warranty against degradation of exterior finish. Include provision for replacement of units with fading, chalking, or flaking.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Basis of Design: Kawneer; Product Trifab VG 451/451T.
- B. Other Acceptable Manufacturers:
  - 1. United States Aluminum Corp: [www.usalum.com](http://www.usalum.com).
  - 2. Vistawall Architectural Products: [www.vistawall.com](http://www.vistawall.com).
  - 3. Tubelite Inc..
  - 4. Arcadia, Inc.
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 COMPONENTS**

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  - 1. Glass Location: Center plane at brick veneer locations and front plane at exterior zinc panel locations.
  - 2. Framing members for interior applications need not be thermally broken.
  - 3. Glazing stops: Flush. Provide inside glazed framing, typical.
  - 4. Cross-Section: 2 x 4-1/2 inches nominal dimension.
  - 5. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
  - 6. High Performance Sill: provide extruded high performance sill flashing at all frame sills.
  - 7. Thermal Snap-in filler: Provide thermal snap-in filler at all jamb and head conditions.
  - 8. Perimeter strapping: Provide continuous 16 guage, galvanized, steel strap at all perimeter surfaces if required to attach. Frames to structural studs.
- B. Doors: Glazed aluminum, see Door Schedule for Locations
  - 1. Basis of Design: Kawneer 500 Heavy Wall Entrance Doors.
  - 2. Thickness: 2 inches (50 mm).
  - 3. Wall thickness: .188 inches
  - 4. Top Rail: 6 inches (152 mm) wide.
  - 5. Vertical Stiles: 5 inches (128 mm) wide.
  - 6. Bottom Rail: 10 inches (254 mm) wide.
  - 7. Glazing Stops: Square.
  - 8. Finish: Same as storefront or curtain wall framing.
  - 9. Glass: 1-inch insulated. Type as shown on drawings.

### **2.03 MATERIALS**

- A. Extruded Aluminum: ASTM B 221 (ASTM B 221M).
- B. Sheet Aluminum: ASTM B 209 (ASTM B209M).
  - 1. Break Metal: Where indicated, provide minimum 0.080 inch aluminum break metal, formed to profile indicated or as required, finished to match adjacent storefront or curtain wall system.
- C. Structural Steel Sections: ASTM A 36/A 36M; shop primed.
- D. Fasteners: Stainless steel.
- E. Exposed Flashings and Break Metal: .080 inch (2.03 mm) thick aluminum sheet minimum unless noted differently on drawings, finish to match framing members.
- F. Concealed Flashings: 0.018 inch (0.5 mm) thick aluminum of type recommended by manufacturer.
- G. Concealed Flashings: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

- H. Perimeter Sealant: Type silicone specified in Section 07 9005.
- I. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos: formulated for 30-mil thickness per coat.
- J. Glass: As specified in Section 08 8000.
- K. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- L. Glazing Accessories: As specified in Section 08 8000.
- M. Shop and Touch-Up Primer for Steel Components: SSPC-Paint 25, zinc oxide, alkyd, linseed oil primer.

#### **2.04 FINISHES**

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

#### **2.05 HARDWARE**

- A. Door Hardware: As specified in Section 08 7100 and specified in this Section. Aluminum door installer to provide all hardware on aluminum doors.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- C. Sill Sweep Strips: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on a mounting strip.
- D. Thresholds: Raised thresholds, beveled with a slope of not more than 1:2, with a maximum height of 1/2 inch. Mill finish.

#### **2.06 FABRICATION**

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware and door operators.
- G. Reinforce framing members for imposed loads.
- H. Factory install door hardware whenever possible.
- I. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
  - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

### **3.02 INSTALLATION**

- A. Install wall system in accordance with manufacturer's written installation instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Insulated Composite Panels: Glaze into storefront system according to manufacturer's written installation instructions.
- K. Set thresholds in bed of mastic and secure.
- L. Install hardware using templates provided.
  - 1. See Section 08 7100 for hardware installation requirements.
- M. Install glass and infill panels in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- N. Install perimeter sealant in accordance with Section 07 9005.
- O. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### **3.03 TOLERANCES**

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 1/16 inches per 10 ft (1.5 mm/3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

### **3.04 ADJUSTING**

- A. Adjust operating hardware for smooth operation.

### **3.05 CLEANING**

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

### **3.06 PROTECTION**

- A. Protect installed products from damage during subsequent construction.

**END OF SECTION**

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

## SECTION 08 7100

### DOOR HARDWARE

#### 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 commercial door hardware for the following:
  - 1. Swinging doors.
  - 2. Sliding doors.
  - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Automatic operators.
  - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
  - 1. Division 08 Section "Door Hardware Schedule".
  - 2. Division 08 Section "Hollow Metal Doors and Frames".
  - 3. Division 08 Section "Interior Aluminum Doors and Frames".
  - 4. Division 08 Section "Automatic Door Operators".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 80 - Fire Doors and Windows.
  - 4. NFPA 101 - Life Safety Code.
  - 5. NFPA 105 - Installation of Smoke Door Assemblies.
  - 6. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

### 1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

- a. Type, style, function, size, label, hand, and finish of each door hardware item.
- b. Manufacturer of each item.
- c. Fastenings and other pertinent information.
- d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
- e. Explanation of abbreviations, symbols, and codes contained in schedule.
- f. Mounting locations for door hardware.
- g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.
  2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.
- F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.
1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
    - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
    - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
      - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
      - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
    - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
  3. NFPA 101: Comply with the following for means of egress doors:
    - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
    - b. Thresholds: Not more than 1/2 inch high.
  4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

- a. Test Pressure: Positive pressure labeling.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
  2. Plans for existing and future key system expansion.
  3. Requirements for key control storage and software.
  4. Installation of permanent keys, cylinder cores and software.
  5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  3. Review sequence of operation narratives for each unique access controlled opening.
  4. Review and finalize construction schedule and verify availability of materials.
  5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

#### 1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

#### 1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Ten years for mortise locks and latches.
  - 2. Seven years for heavy duty cylindrical (bored) locks and latches.
  - 3. Twenty five years for manual surface door closers.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

## 1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
  - 1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
    - a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
  - B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

### 2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
  - 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
    - a. Two Hinges: For doors with heights up to 60 inches.
    - b. Three Hinges: For doors with heights 61 to 90 inches.
    - c. Four Hinges: For doors with heights 91 to 120 inches.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
  2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
  3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
  4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
    - a. Non-removable 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 the following applications:
      - 1) Out-swinging exterior doors.
      - 2) Out-swinging access controlled doors.
      - 3) Out-swinging lockable doors.
  5. Acceptable Manufacturers:
    - a. Hager Companies (HA).
    - b. McKinney Products (MK).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.
  1. Acceptable Manufacturers:
    - a. McKinney Products (MK).
    - b. Pemko Manufacturing (PE).

## 2.3 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
1. Acceptable Manufacturers:
- a. Rockwood Manufacturing (RO).
  - b. Trimco (TC).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with square corners and beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
- a. Acceptable Manufacturers:
- 1) Rockwood Manufacturing (RO).
  - 2) Trimco (TC).

## 2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
1. Acceptable Manufacturers:
- a. Corbin Russwin Hardware (RU).

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Cylinders: Original manufacturer cylinders complying with the following:
  - 1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
  - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
  - 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  - 5. Keyway: Manufacturer's Standard.
- D. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:
  - 1. Master Key System: Cylinders are operated by a change key and a master key.
- E. Key Quantity: Provide the following minimum number of keys:
  - 1. Top Master Key: One (1)
  - 2. Change Keys per Cylinder: Two (2)
  - 3. Construction Keys (where required): Ten (10)
- F. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

## 2.5 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.
  - 1. Acceptable Manufacturers:
    - a. Corbin Russwin Hardware (RU) – ML2000 Series.
- B. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified cylindrical (bored) locksets furnished in the functions as specified in the Hardware Sets. Lock chassis fabricated of heavy gauge steel, zinc dichromate plated, with through-bolted application. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt. Locks are to be non-handed and fully field reversible.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Acceptable Manufacturers:
  - a. Corbin Russwin Hardware (RU) – CL3300 Series.

C. Lock Trim Design: As specified in Hardware Sets.

## 2.6 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  2. Strikes for Bored Locks and Latches: BHMA A156.2.
  3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
  4. Dustproof Strikes: BHMA A156.16.

## 2.7 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
  2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
  3. Cycle Testing: Provide closers which have surpassed 10 million cycles in a test witnessed and verified by UL.
  4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  - a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
  - b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
  - c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
  - d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

B. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Acceptable Manufacturers:
  - a. Corbin Russwin Hardware (RU) - DC6000 Series.

## 2.8 AUTOMATIC DOOR OPERATORS

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
  1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
- B. Electrohydraulic Door Operators: Self-contained low-pressure units with rack and pinion design contained within a cast aluminum housing. Door closing speed controlled by independent hydraulic adjustment valves in the sweep and latch range of the closing cycle. Operator is to provide conventional door closer opening and closing forces unless the power operator motor is activated. Unit is to include an adjustable hydraulic backcheck valve to cushion the door speed if opened violently. Non-handed units for both push and pull side applications.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- D. Standard: Certified ANSI/BHMA A156.19.
  - 1. Performance Requirements:
    - a. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
    - b. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.
- E. Configuration: Surface mounted. Door operators to control single swinging and pair of swinging doors.
- F. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.
  - 1. On-off switch to control power to be key switch operated.
- G. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
- H. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
- I. Activation Devices: Provide activation devices in accordance with ANSI/BHMA A156.19 standard, for condition of exposure indicated and for long term, maintenance free operation under normal traffic load operation. Coordinate activation control with electrified hardware and access control interfaces. Activation switches are standard SPST, with optional DPDT availability.
- J. Signage: As required by cited ANSI/BHMA A156.19 standard for the type of operator.
  - 1. Acceptable Manufacturers:
    - a. Norton Door Controls (NO) - 6000 Series.

## 2.9 ARCHITECTURAL TRIM

- A. Door Protective Trim

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), fabricated from the following.
  - a. Stainless Steel: .050-inch thick, with countersunk screw holes (CSK).
4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.
6. Acceptable Manufacturers:
  - a. Rockwood Manufacturing (RO).
  - b. Trimco (TC).

## 2.10 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
  1. Acceptable Manufacturers:
    - a. Rockwood Manufacturing (RO).
    - b. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Acceptable Manufacturers:
  - a. Rixson Door Controls (RF).
  - b. Rockwood Manufacturing (RO).

## 2.11 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. 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 perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: 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 UL-10C.
  1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
  1. Pemko Manufacturing (PE).
  2. Reese Enterprises, Inc. (RS).

## 2.12 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

## 2.13 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
  3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### 3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.

Lehi Municipal Pool Building - Addition and Remodel  
 451 East 200 South  
 Lehi, Utah 84043

- C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. Manufacturer's Abbreviations:

1. MK - McKinney
2. AD - Adams Rite
3. RO - Rockwood
4. RU - Corbin Russwin
5. RF - Rixson
6. NO - Norton
7. PE - Pemko

**Hardware Schedule**

**Set: 1.0**

Doors: 113B, 117A

2 Continuous Hinge	MCK-12HD	CL	MK
1 Header Bolt (inactive leaf)	4085-IB	603	AD
1 Header Bolt	4016		AD
1 Threshold Bolt	4015-18-IB	603	AD
1 Mortise Deadlock	MS1850S	628	AD
2 Cylinder	1000-118- A03- CMK	626	RU
1 Cylinder Guard	MS4043-00	RC130	AD
1 Status Indicator	4089	RC130	AD
2 Push Bar & Pull	BF15747	US32D	RO
2 Closer (surface)	DC6200	689	RU
2 Wall Stop	406	US32D	RO



Lehi Municipal Pool Building - Addition and Remodel  
 451 East 200 South  
 Lehi, Utah 84043

1 Threshold	271A		PE
1 Gasketing	by door mfg.		

**Set: 2.0**

Doors: 101B, 113A

2 Continuous Hinge	MCK-12HD	CL	MK
1 Header Bolt (inactive leaf)	4085-IB	603	AD
1 Header Bolt	4016		AD
1 Threshold Bolt	4015-18-IB	603	AD
1 Mortise Deadlock	MS1850S	628	AD
2 Cylinder	1000-118- A03- CMK	626	RU
1 Cylinder Guard	MS4043-00	RC130	AD
1 Status Indicator	4089	RC130	AD
2 Push Bar & Pull	BF15747	US32D	RO
2 Closer (surface)	DC6210 A11	689	RU
1 Threshold	271A		PE
1 Gasketing	by door mfg.		

**Set: 3.0**

Doors: 132B, 133B

1 Continuous Hinge	MCK-12HD	CL	MK
1 Mortise Deadlock	MS1850S	628	AD
2 Cylinder	1000-118- A03- CMK	626	RU
1 Cylinder Guard	MS4043-00	RC130	AD
1 Status Indicator	4089	RC130	AD
1 Push Bar & Pull	BF15747	US32D	RO
1 Closer (surface)	DC6210 A11	689	RU
1 Threshold	271A		PE
1 Gasketing	by door mfg.		

**Set: 4.0**

Doors: 115A, 116A

3 Hinge	TA2714	US26D	MK
1 Mortise Lock (lockable privacy)	ML2068 NSA M19V CMK	626	RU
1 Closer (surface)	DC6200	689	RU
1 Kick Plate	K1050 10" x 2" LDW	US32D	RO
1 Wall Stop	406	US32D	RO
1 Threshold	271A		PE
1 Gasketing	PK55BL		PE
1 Sweep	18061CNB		PE

**Set: 5.0**

Doors: 112B, 130B

3 Hinge	T4A3386 NRP	US32D	MK
1 Deadbolt (classroom)	DL3017 CMK	626	RU

Lehi Municipal Pool Building - Addition and Remodel  
 451 East 200 South  
 Lehi, Utah 84043

1 Push Bar & Pull	BF15747	US32D	RO
1 Door Operator	6070	689	NO
2 Actuator	505		NO
1 Kick Plate	K1050 10" x 2" LDW	US32D	RO
1 Threshold	271A		PE
1 Gasketing	PK55BL		PE
1 Sweep	18061CNB		PE

**Set: 6.0**

Doors: 106C, 131A

3 Hinge	TA2714	US26D	MK
1 Cylindrical Lock (storeroom)	CL3357 NZD CMK	626	RU
1 Wall Stop	406	US32D	RO
3 Silencer	608		RO

**Set: 7.0**

Doors: 110A, 119A

3 Hinge	TA2714	US26D	MK
1 Cylindrical Lock (storeroom)	CL3357 NZD CMK	626	RU
1 Roller Stop	455	US26D	RO
3 Silencer	608		RO

**Set: 8.0**

Doors: 109A, 120A

3 Hinge	TA2714	US26D	MK
1 Cylindrical Lock (storeroom)	CL3357 NZD CMK	626	RU
1 Surface OH Stop	10-X36	630	RF
3 Silencer	608		RO

**Set: 9.0**

Doors: 118A, 111A

3 Hinge	TA2714	US26D	MK
1 Cylindrical Lock (storeroom)	CL3357 NZD CMK	626	RU
1 Closer (surface)	DC6210 A11	689	RU
1 Gasketing	PK55BL		PE

**Set: 10.0**

Doors: 132A

3 Hinge	TA2714	US26D	MK
1 Cylindrical Lock (office)	CL3351 NZD CMK	626	RU
1 Wall Stop	409	US32D	RO
3 Silencer	608		RO

Lehi Municipal Pool Building - Addition and Remodel  
 451 East 200 South  
 Lehi, Utah 84043

**Set: 11.0**

Doors: 102A, 106B, 128A, 133A

3 Hinge	TA2714	US26D	MK
1 Cylindrical Lock (classroom)	CL3355 NZD CMK	626	RU
1 Closer (surface)	DC6200/6210	689	RU
1 Kick Plate	K1050 10" x 2" LDW	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608		RO

**Set: 12.0**

Doors: 101A

6 Hinge	T4A3786	US26D	MK
2 Flush Bolt	555	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Deadbolt (classroom)	DL3017 CMK	626	RU
2 Push Bar & Pull	BF15747	US32D	RO
2 Closer (surface)	DC6210 A3	689	RU
2 Kick Plate	K1050 10" x 2" LDW	US32D	RO
2 Wall Stop	406	US32D	RO
2 Silencer	608		RO

**Set: 13.0**

Doors: 106A

3 Hinge	TA2714	US26D	MK
1 Deadbolt (classroom)	DL3017 CMK	626	RU
1 Door Pull	111	US32D	RO
1 Push Plate	70F	US32D	RO
1 Closer (surface)	DC6200	689	RU
1 Kick Plate	K1050 10" x 2" LDW	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608		RO

**Set: 14.0**

Doors: 112A, 130A

3 Hinge	T4A3786	US26D	MK
1 Push Bar & Pull	BF15747	US32D	RO
1 Closer (surface)	DC6210 A3	689	RU
1 Kick Plate	K1050 10" x 2" LDW	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608		RO

**Set: 15.0**

Doors: 114A

1 Cylinder	1000-118- CMK (if required)	626	RU
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Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1 Balance of Hardware by door mfg.

**END OF SECTION 08 7100**

## **SECTION 088000**

### **GLAZING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Glass.
- B. Glazing compounds and accessories.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 06 4100 - Architectural Wood Casework: Cabinets with requirements for glass shelves.
- B. Section 07 9005 - Joint Sealers: Sealant and back-up material.
- C. Section 08 4313 - Aluminum-Framed Storefronts.
- D. Section 08 4413 - Glazed Aluminum Curtain Walls. Coordinate with for mock-up requirements.

##### **1.03 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005.
- C. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2005.
- D. ASTM C1036 - Standard Specification for Flat Glass; 2006.
- E. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; 2004.
- F. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass; 2003.
- G. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2005a.
- H. ASTM E 1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2007.
- I. ASTM E 2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2002.
- J. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2004.
- K. GANA (SM) - FGMA Sealant Manual; Glass Association of North America; 1990.

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit two samples 12x 12 inch in size of glass units.
- E. Samples: Submit 3 inch long bead of glazing sealant, color as selected.
- F. Manufacturer's Certificate: Certify that glass meets or exceeds specified requirements.

### **1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

### **1.06 MOCK-UP**

- A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.
- B. A minimum of two (2) mockups shall be constructed, at ground level, and shall be used for final color selection and detail (installation) approval. Mockups shall be not smaller than 6 feet high x 8 feet long. Mockup shall remain in place until directed by the Architect to be removed.
- C. Locate where directed.
- D. Mockup may not remain as part of the Work.

### **1.07 FIELD CONDITIONS**

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

### **1.08 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a ten (10) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

## **PART 2 PRODUCTS**

### **2.01 GLAZING TYPES**

- A. Glass Type "1": Low-e-coated, clear insulating glass.
  - 1. Overall Unit Thickness: 1 inch (25 mm).
  - 2. Thickness of Each Glass Lite: 6.0 mm.
  - 3. Outdoor Lite: Fully tempered float glass Starphire.
  - 4. Interspace Content: Air.
  - 5. Indoor Lite: Fully tempered float glass.
  - 6. Low-E Coating: Sputter on second surface.
    - a. Equal to: PPG Industries, Inc.; Solarban 60.
  - 7. Visible Light Transmittance: 74 percent minimum.
  - 8. Winter Nighttime U-Factor: 0.29 maximum.
  - 9. Summer Daytime U-Factor: 0.27 maximum.
  - 10. Solar Heat Gain Coefficient: 0.41 maximum.
  - 11. Shading Coefficient: 0.48 maximum.
  - 12. Provide safety glazing labeling.
- B. Glass Type "2": Clear fully tempered float glass.
  - 1. Thickness: 6.0 mm.
  - 2. Provide safety glazing labeling.

### **2.02 EXTERIOR GLAZING ASSEMBLIES**

- A. Structural Design Criteria: Select type and thickness to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with 2006 IBC code.

1. Use the procedure specified in ASTM E1300 to determine glass type and thickness.
2. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
3. Thicknesses listed are minimum.

### **2.03 GLASS MATERIALS**

- A. Float Glass Manufacturers:
1. Zeledyne: [www.versaluxglass.com](http://www.versaluxglass.com).
  2. AGC Flat Glass North America, Inc: [www.afglass.com](http://www.afglass.com).
  3. Pilkington North America Inc: [www.pilkington.com](http://www.pilkington.com).
  4. PPG Industries, Inc: [www.ppg.com](http://www.ppg.com).
  5. Northwestern Industries, Inc.
  6. Substitutions: Refer to Section 016000 - Product Requirements.
- B. Float Glass: All glazing is to be float glass unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
  2. Heat-Strengthened and Fully Tempered Types: ASTM C1048.
  3. Tinted Types: Color and performance characteristics as indicated.
  4. Thicknesses: As indicated; for exterior glazing comply with specified requirements for wind load design regardless of specified thickness.
- C. Clear Float Glass: Clear, annealed.
1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
  2. 6 mm minimum thick.
- D. Heat-Treated Float Glass: Clear, annealed, with roll-wave distortion parallel to the bottom edge of the glass as installed, unless otherwise indicated.
1. Comply with ASTM C 1048, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
  2. Provide heat-strengthened float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with the glass design requirements in Part 1 Performance Requirements.
  3. 6 mm minimum thick.
- E. Safety Glass: Clear; fully tempered with horizontal tempering.
1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select) and ASTM C 1048.
  2. Comply with 16 CFR 1201 test requirements for Category II.
  3. 6 mm minimum thick.
  4. Provide this type of glazing in the locations required by code., and as shown on the drawings.
- F. Low E Glass: Float type, heat strengthened, clear.
1. Coating on inner surface.
  2. Comply with ASTM C 1036, Type I, transparent flat, Quality Q3 (glazing select).
  3. Comply with ASTM C 1048.
  4. 6 mm minimum thick.

### **2.04 SEALED INSULATING GLASS UNITS**

- A. Manufacturers:
1. Any of the manufacturers specified for float glass.
  2. Any fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty, if any.

- B. Sealed Insulating Glass Units: Types as indicated above.
  - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
  - 2. Edge Spacers: Aluminum, bent and soldered corners.
  - 3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
  - 4. Purge interpane space with dry hermetic air.
- C. Durability: Certified by an independent testing agency to comply with ASTM E 2190.
- D. Purge interpane space with dry hermetic air.
- E. Edge Seal Construction: Aluminum, bent and soldered corners.
- F. Edge Seal Material: silver color.

## **2.05 GLAZING COMPOUNDS**

- A. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; black color.

## **2.06 GLAZING ACCESSORIES**

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C 864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C 864 Option I; color as selected by Architect.

## **PART 3 EXECUTION**

### **3.01 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 the referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site.
- C. Apply primers to joint surfaces as determined by preconstruction sealant-substrate testing.
- D. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- E. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel.

### **3.02 EXAMINATION**

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.



### **3.03 PREPARATION**

- A. Prime surfaces scheduled to receive sealant if required by manufacturer.
- B. Install sealants in accordance with ASTM C1193 and FGMA Sealant Manual.
- C. Install sealant in accordance with manufacturer's instructions.

### **3.04 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)**

- A. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

### **3.05 INSTALLATION - EXTERIOR WET METHOD (SEALANT AND SEALANT)**

- A. Place setting blocks at 1/4 points and install glazing pane or unit.
- B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.
- C. Fill gaps between glazing and stops with silicone type sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
- D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

### **3.06 MANUFACTURER'S FIELD SERVICES**

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

### **3.07 CLEANING**

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.
- D. Wash glass on both exposed surfaces in each area of the Project not more that five days before the dated of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

### **3.08 PROTECTION**

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste.
- B. Protect glass from contact with contaminating substances resulting from construction activities, including weld splatter.
- C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during the construction period.

**END OF SECTION**



## **SECTION 08 8300**

### **MIRRORS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Glass mirrors.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 10 2800 - Toilet, Bath, and Laundry Accessories: Metal-framed mirrors.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM C1036 - Standard Specification for Flat Glass; 2006.
- B. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2004.
- C. GANA (TIPS) - Mirrors Handle with Extreme Care: Tips For the Professional on the Care and Handling of Mirrors; National Association of Mirror Manufacturers; 2004 (<http://www.mirrorlink.org/members/technical.htm>).

##### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Mirror Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

##### **1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS) "Mirrors Handle with Extreme Care: Tips For the Professional on the Care and Handling of Mirrors."

##### **1.06 FIELD CONDITIONS**

- A. Do not install mirrors when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

##### **1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

#### **PART 2 PRODUCTS**

##### **2.01 MATERIALS**

- A. Mirror Glass - General: Select materials and/or provide supports as required to limit mirrored glass deflection to 1/200 or flexure limit of glass with full recovery of glazing materials,

whichever is less.

- B. Mirror Glass: ASTM C 1036, Type 1 transparent flat, Class 1 clear, Quality Q1 (mirror select); 6 mm minimum thick.
  - 1. Sizes noted on Drawings.

## **2.02 GLAZING ACCESSORIES**

- A. Mirror Attachment Accessories: Stainless steel clips.
- B. Mirror Adhesive: Chemically compatible with mirror coating and wall substrate.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive mirrors.

### **3.02 PREPARATION**

- A. Clean contact surfaces with solvent and wipe dry.

### **3.03 INSTALLATION - GENERAL**

- A. Install mirrors in accordance with GANA recommendations.
- B. Set mirrors plumb and level, free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Frameless Mirrors: Set mirrors with clips. Anchor rigidly to wall construction.

### **3.04 CLEANING**

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

### **3.05 PROTECTION**

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

**END OF SECTION**

## **DIVISION 09 – FINISHES**

09 2116 - Gypsum Board Assemblies

09 3000 - Tiling

09 5100 - Acoustical Ceilings

09 6500 - Resilient Flooring

09 6723 - Epoxy Resinous Flooring

09 6813 - Tile Carpeting

09 9100 - Painting



## SECTION 09 2116

### GYPSUM BOARD ASSEMBLIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Gypsum sheathing.
- B. Cementitious backing board.
- C. Gypsum wallboard.

##### 1.02 RELATED REQUIREMENTS

- A. Section 05 4000 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
- B. Section 07 2100 - Thermal Insulation: Insulation.
- C. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
- D. Section 07 9005 - Joint Sealers: Acoustic sealant.
- E. Section 09 3000 - Tiling: Tile backing board.

##### 1.03 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 1999 (R2005).
- B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002 (Reapproved 2007).
- C. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board; 2007.
- D. ASTM C 1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2005.
- E. ASTM C 1177/C 1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2006.
- F. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2007a.
- G. ASTM C 1280 - Standard Specification for Application of Gypsum Sheathing; 2007.
- H. ASTM C 1396/C 1396M - Standard Specification for Gypsum Board; 2006a.
- I. ASTM C1629/C1629 - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2006.
- J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2000 (Reapproved 2005).
- K. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2007.

##### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.

## 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum five (5) years of documented experience.

## PART 2 PRODUCTS

### 2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.

### 2.02 BOARD MATERIALS

- A. Wallboard: Paper-faced gypsum wallboard as defined in ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  2. Thickness:
    - a. Vertical Surfaces: 5/8 inch.
    - b. Ceilings: 5/8 inch.
  3. Paper-Faced Products:
    - a. American Gypsum; EagleRoc Regular Gypsum Wallboard and FireBloc Type X Gypsum Wallboard.
    - b. CertainTeed Corporation; ProRoc Brand Gypsum Board.
    - c. Georgia-Pacific Gypsum LLC; ToughRock Gypsum Wallboard.
    - d. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
    - e. USG Corporation; Sheetrock Brand Gypsum Panels.
    - f. Substitutions: See Section 016000 - Product Requirements.
- B. Impact-Rated Wallboard: Tested to Level 3 soft-body and hard-body impact in accordance with ASTM C1629.
1. Application: High-traffic areas indicated.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
  4. Unfaced Type: Interior fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M.
  5. Type: Fire-resistance rated Type X, UL or WH listed.
  6. Thickness: 5/8 inch.
  7. Edges: Tapered.
  8. Products:
    - a. National Gypsum Company; Gold Bond Hi-Impact Brand XP Wallboard.
    - b. USG Corporation; Fiberock Brand Panels--VHI Abuse-Resistant.
    - c. Substitutions: See Section 016000 - Product Requirements.
- C. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. Glass-Mat-Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178.
    - a. Standard Type: Thickness 1/2 inch.
    - b. Fire-Resistant Type: Type X core, thickness 5/8 inch.
    - c. Products:
      - 1) Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
      - 2) Substitutions: See Section 016000 - Product Requirements.
- D. Ceiling Board: Special sag-resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.



2. Thickness: 5/8 inch.
3. Edges: Tapered.
4. Products:
  - a. CertainTeed Corporation; ProRoc Interior Ceiling.
  - b. Georgia-Pacific Gypsum LLC; ToughRock CD Ceiling Board.
  - c. National Gypsum Company; High Strength Brand Ceiling Board.
  - d. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.
  - e. Substitutions: See Section 016000 - Product Requirements.
- E. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
  1. Application: Exterior sheathing, unless otherwise indicated.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. Glass-Mat-Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
  4. Type X Thickness: 5/8 inch.
  5. Edges: V-shaped tongue and groove, for horizontal application.
  6. Glass-Mat-Faced Products:
    - a. CertainTeed Corporation; GlasRoc Brand.
    - b. Georgia-Pacific Gypsum LLC; DensGlass Gold Sheathing.
    - c. USG Corporation; Securock Glass-Matt Sheathing.
    - d. Substitutions: See Section 016000 - Product Requirements.

### **2.03 ACCESSORIES**

- A. Acoustic Insulation: As specified in Section 07 2100.
- B. Acoustic Sealant: As specified in Section 07 9005.
- C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless otherwise indicated.
  1. Types: As detailed or required for finished appearance.
  2. Special Shapes: In addition to conventional cornerbead and control joints, provide U-bead at exposed panel edges.
- D. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
  1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
  2. Ready-mixed vinyl-based joint compound.
  3. Chemical hardening type compound.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.

### **3.02 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  1. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.

### **3.03 BOARD INSTALLATION**

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exterior Sheathing: Comply with ASTM C1280. Install sheathing horizontally, with edges butted tight and ends occurring over firm bearing.
  - 1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
- F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- G. Installation on Metal Framing: Use screws for attachment of all gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
- H. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.

### **3.04 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

### **3.05 JOINT TREATMENT**

- A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. Paper Faced Gypsum Board: Use fiberglass joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 2. Level 3: Walls to receive textured wall finish.
  - 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
  - 4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
  - 2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

### **3.06 TOLERANCES**

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

**END OF SECTION**



## SECTION 09 3000

### TILING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for shower receptors.
- D. Cementitious backer board as tile substrate.
- E. Coated glass mat backer board as tile substrate.
- F. Stone thresholds.
- G. Ceramic accessories.
- H. Ceramic trim.
- I. Non-ceramic trim.

##### 1.02 RELATED REQUIREMENTS

- A. Section 07 9005 - Joint Sealers.
- B. Section 09 2116 - Gypsum Board Assemblies: Installation of tile backer board.

##### 1.03 REFERENCE STANDARDS

- A. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2005.
  - 1. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2005.
  - 2. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar; 1999 (R2005).
  - 3. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex Portland Cement Mortar; 1999 (R2005).
  - 4. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 1999 (R2005).
  - 5. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (R2005).
  - 6. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (R2005).
  - 7. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (R2005).
  - 8. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (R2005).
  - 9. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (R2005).
  - 10. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 1999 (R2005).
  - 11. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded,

- Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005.
12. ANSI A118.1 - American National Standard Specifications for Dry-Set Portland Cement Mortar; 1999 (R2005).
  13. ANSI A118.4 - American National Standard Specifications for Latex-Portland Cement Mortar; 1999 (R2005).
  14. ANSI A118.7 - American National Standard Specifications for Polymer Modified Cement Grouts for Tile Installation; 1999 (R2005).
  15. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (R2005).
  16. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 1999 (R2005).
  17. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2008.
- B. ASTM C 1178/C 1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2006.
- C. TCA (HB) - Handbook for Ceramic Tile Installation; Tile Council of North America, Inc.; 2007/2008.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 x 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

#### **1.06 QUALITY ASSURANCE**

- A. Maintain one copy of TCA Handbook and ANSI A108 Series/A118 Series on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

#### **1.08 FIELD CONDITIONS**

- A. Do not install adhesives in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

## **PART 2 PRODUCTS**

### **2.01 TILE**

- A. Manufacturers: All products of each type by the same manufacturer. Unless approved in writing by the Architect.
  - 1. American Olean: [www.americanolean.com](http://www.americanolean.com).
  - 2. Dal-Tile Corporation: [www.daltile.com](http://www.daltile.com).
  - 3. Summitville Tiles, Inc: [www.summitville.com](http://www.summitville.com).
  - 4. Contempo Tile.
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Ceramic Mosaic Tile: ANSI A137.1, and as follows:
  - 1. Moisture Absorption: 0 to 0.5 percent.
  - 2. Size and Shape: 2 inch square.
  - 3. Edges: Square.
  - 4. Surface Finish: Unglazed.
  - 5. Colors: As scheduled and as shown on the drawings.
- C. Glazed Wall Tile: ANSI A137.1, and as follows:
  - 1. Moisture Absorption: 3.0 to 7.0 percent.
  - 2. Size and Shape: 4-1/4 inch square.
  - 3. Edges: Cushioned and coved.
  - 4. Surface Finish: Semi-Gloss.
  - 5. Colors: As scheduled and as shown on the drawings.

### **2.02 TRIM AND ACCESSORIES**

- A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
  - 1. Soap Dish: With handle, clam shell design, recess mounted; cast strength sufficient to resist lateral pull force of 75 lbs.
- B. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
  - 1. Manufacturer: Same as for tile.
- C. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
  - 1. Applications: Use in the following locations:
    - a. Open edges of wall tile.
    - b. Open edges of floor tile.
    - c. Transition between floor finishes of different heights.
    - d. Expansion and control joints, floor and wall.
    - e. Floor to wall joints.
    - f. Borders and other trim as indicated on drawings.
  - 2. Manufacturer:
    - a. Schluter-Systems: [www.schluter.com](http://www.schluter.com).
    - b. Substitutions: See Section 016000 - Product Requirements.
- D. Thresholds: Marble, white or gray, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.
  - 1. Applications: Provide at the following locations:
    - a. At doorways and openings where tile terminates and as shown on the drawings.
    - b. At open edges of floor tile where adjacent finish is a different height.

## **2.03 MORTAR MATERIALS**

- A. Manufacturers:
  - 1. Bonsal American, Inc: [www.sakrete.com](http://www.sakrete.com)
  - 2. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 3. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Mortar Bed Materials: Portland cement, sand, latex additive, and water.
- C. Mortar Bond Coat Materials:
  - 1. Dry-Set Portland Cement type: ANSI A118.1.
  - 2. Latex-Portland Cement type: ANSI A118.4.

## **2.04 GROUT MATERIALS**

- A. Manufacturers:
  - 1. Bonsal American, Inc: [www.sakrete.com](http://www.sakrete.com)
  - 2. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 3. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Standard Grout: Polymer modified cement grout, sanded or unsanded, as specified in ANSI A118.7.

## **2.05 ACCESSORY MATERIALS**

- A. Waterproofing Membrane at Showers and Tiled Tubs: PVC sheet membrane, 40 mils thick, minimum; specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
  - 1. Manufacturers:
    - a. Compositite Corporation; Composeal Blue Shower Pan: [www.compositite.com](http://www.compositite.com).
    - b. Substitutions: See Section 016000 - Product Requirements.
- B. Reinforcing Mesh: 2 x 2 inch size weave of 16/16 wire size; welded fabric, galvanized.
- C. Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
- D. Coated Glass Mat Backer Board: ASTM C 1178/C 1178M, with coated inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
  - 1. Product: DensShield Tile Guard manufactured by G-P Gypsum.
  - 2. Fire-Resistant Type: Type X core, thickness 5/8 inch.
- E. Mesh Tape: 2-inch wide self-adhesive fiberglass mesh tape.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended



by tile manufacturer and setting materials manufacturer.

- E. Verify that required floor-mounted utilities are in correct location.

### **3.02 PREPARATION**

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.
- E. Install tile backer board in strict accordance with manufacturer's instructions, using galvanized roofing nails or corrosion-resistant bugle head drywall screws. Bed fiberglass self-adhesive tape at all joints and corners with material used to set tiles.

### **3.03 INSTALLATION - GENERAL**

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and TCA Handbook recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Install non-ceramic trim in accordance with manufacturer's instructions.
- H. Install thresholds where indicated.
- I. Sound tile after setting. Replace hollow sounding units.
- J. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- K. Allow tile to set for a minimum of 48 hours prior to grouting.
- L. Grout tile joints. Use standard grout unless otherwise indicated.
- M. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

### **3.04 INSTALLATION - FLOORS - THIN-SET METHODS**

- A. Over interior concrete substrates, install in accordance with TCA Handbook Method F113, dry-set or latex-portland cement bond coat, with standard grout, unless otherwise indicated.
  - 1. Where waterproofing membrane is indicated, install in accordance with TCA Handbook Method F122, with latex-portland cement grout.

### **3.05 INSTALLATION - FLOORS - MORTAR BED METHODS**

- A. Over interior concrete substrates, install in accordance with TCA Handbook Method F112, bonded, unless otherwise indicated.
  - 1. Where waterproofing membrane is indicated, with standard grout or no mention of grout

type, install in accordance with TCA Handbook Method F121.

- B. Waterproofing Membrane: Install as specified in ANSI A108.13.
- C. Mortar Bed Thickness: Minimum 5/8 inch, unless otherwise indicated.

### **3.06 INSTALLATION - SHOWERS**

- A. At tiled shower receptors install in accordance with TCA Handbook Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
- B. At shower ceilings install in accordance with TCA Handbook Method B412, over cementitious backer units with waterproofing membrane.
- C. Grout with standard grout as specified above.
- D. Seal joints between tile work and other work with sealants specified in Section 079005.

### **3.07 INSTALLATION - WALL TILE**

- A. Over coated glass mat backer board on studs, install in accordance with TCA Handbook Method W245.
- B. Over interior concrete and masonry install in accordance with TCA Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.

### **3.08 CLEANING**

- A. Clean tile and grout surfaces according to manufacturer's written instructions.

### **3.09 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

**END OF SECTION**

## **SECTION 09 5100**

### **ACOUSTICAL CEILINGS**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Suspended metal grid ceiling system.
- B. Suspended FRP ceiling grid.
- C. Acoustical units.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 079005 - Joint Sealers: Acoustical sealant.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM C 635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2004.
- B. ASTM C 636/C 636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2006.
- C. ASTM E 580/E 580M - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint; 2006.
- D. ASTM E 1264 - Standard Classification for Acoustical Ceiling Products; 1998 (Reapproved 2005).

##### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

##### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples 6 x 6 inch in size illustrating material and finish of acoustical units.
- D. Samples: Submit two samples each, 12 inches long, of suspension system main runner.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

##### **1.06 QUALITY ASSURANCE**

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

##### **1.07 FIELD CONDITIONS**

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent

prior to, during, and after acoustical unit installation.

## **PART 2 PRODUCTS**

### **2.01 ACOUSTICAL UNITS**

- A. Manufacturers:
  - 1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
  - 2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 3. USG: [www.usg.com](http://www.usg.com).
  - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Acoustical Units - General: ASTM E1264, Class A.
- C. Acoustical Panels: Painted mineral fiber, ASTM E 1264 Type III, with the following characteristics:
  - 1. Size: 24 x 48 inches.
  - 2. Thickness: 3/4 inches.
  - 3. Composition: Wet felted.
  - 4. Light Reflectance: 84 percent, determined as specified in ASTM E1264.
  - 5. NRC Range:.45 to.55, determined as specified in ASTM E1264.
  - 6. Ceiling Attenuation Class (CAC): 38/40, determined as specified in ASTM E1264.
  - 7. Edge: Reveal edge (FL).
  - 8. Surface Color: White.
  - 9. Surface Pattern: C (perforated, small holes)/D (fissured)/F (heavily textured)/I (embossed)/K (surface scored).
  - 10. Product: Aspen, ILLUSION Two/24 (652) by USG Interiors.
- D. Acoustical Panels: Ceramic-bonded mineral fiber, ASTM E 1264 Type XX, with the following characteristics:
  - 1. Size: 24 x 48 inches.
  - 2. Thickness: 5/8 inches.
  - 3. Light Reflectance: 82 percent, determined as specified in ASTM E1264.
  - 5. NRC Range:.50 determined as specified in ASTM E1264.
  - 6. Ceiling Attenuation Class (CAC): 40 determined as specified in ASTM E1264.
  - 7. Edge: Square.
  - 8. Surface Color: White.
  - 9. Surface Pattern: C (perforated, small holes)/E (lightly textured)/G (smooth).
  - 10. Product: Radar Ceramic *ClimaPlus* (56645) by USG Interiors.

### **2.02 SUSPENSION SYSTEM(S)**

- A. Manufacturers:
  - 1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
  - 2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 3. Chicago Metallic Corporation: [www.chicagometallic.com](http://www.chicagometallic.com).
  - 4. USG: [www.usg.com](http://www.usg.com).
  - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
  - 1. Profile: Tee; 15/16 inch wide face.
  - 2. Construction: Double web.
  - 3. Finish: White painted.
- D. Exposed Fiberglass Reinforced Plastic Suspension System: Pultruded FRP; intermediate duty.

1. Profile: Tee; 1-1/2 inch wide face.
2. Product: Sanigrid II by Kemlite Company, Inc.

### **2.03 ACCESSORIES**

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
  1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Beam End Retaining Clips: Equal to Armstrong, BERC2 - 2 inch Beam End Retaining Clip, 0.034 inch thick, hot-dipped galvanized cold-rolled steel per ASTM A568. Provide at each main beam or cross tee to join with wall molding.
- D. Seismic Joint Clip: Equal to Armstrong SJCG - Seismic Joint Clip or ACM7 Seismic Clip, 5 inches x 1-1/2 inch, hot-dipped galvanized cold-rolled steel per ASTM A568. Two-piece clip/unit designed to accommodate a seismic separation joint.
- E. Acoustical Sealant For Perimeter Moldings: Specified in Section 079005.
- F. Touch-up Paint: Type and color to match acoustical and grid units.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

### **3.02 INSTALLATION - SUSPENSION SYSTEM**

- A. Install suspension system in accordance with ASTM C 636/C 636M, ASTM E 580/E 580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  1. Use longest practical lengths.

2. Overlap and rivet corners.

### **3.03 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units with pattern parallel to longest room axis.
- D. Fit border trim neatly against abutting surfaces.
- E. Install units after above-ceiling work is complete.
- F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- G. Cutting Acoustical Units:
  1. Cut to fit irregular grid and perimeter edge trim.
  2. Make field cut edges of same profile as factory edges.
  3. Double cut and field paint exposed reveal edges.
- H. Where round obstructions occur, provide preformed closures to match perimeter molding.
- I. Install hold-down clips, where indicated, on each panel to retain panels tight to grid system; comply with fire rating requirements.
- J. Install hold-down clips on panels within 20 ft of an exterior door.

### **3.04 TOLERANCES**

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

**END OF SECTION**

## **SECTION 096500**

### **RESILIENT FLOORING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Resilient base.
- B. Installation accessories.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM F 1861 - Standard Specification for Resilient Wall Base; 2002.
- B. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; [www.baaqmd.gov](http://www.baaqmd.gov); current edition.
- C. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).

##### **1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's selection.
- D. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

##### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

##### **1.06 FIELD CONDITIONS**

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

#### **PART 2 PRODUCTS**

##### **2.01 RESILIENT BASE**

- A. Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic; top set Style A, Straight, and as follows:
  - 1. Height: 4 inch.

2. Thickness: 0.125 inch thick.
3. Finish: Satin.
4. Length: Roll.
5. Color: Multiple colors as selected from manufacturer's full range of available colors.
6. Accessories: Premolded external corners and end stops.
7. Manufacturers:
  - a. Burke Flooring: [www.burkemerger.com](http://www.burkemerger.com).
  - b. Johnsonite, Inc: [www.johnsonite.com](http://www.johnsonite.com).
  - c. Roppe Corp: [www.roppe.com](http://www.roppe.com).
  - d. Substitutions: See Section 016000 - Product Requirements.

## **2.02 ACCESSORIES**

- A. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
  1. Provide only products having lower volatile organic compound (VOC) content than required by the more stringent of the South Coast Air Quality Management District Rule No.1168 and the Bay Area Air Quality Management District Regulation 8, Rule 51.
- B. Moldings and Edge Strips: Same material as flooring.
- C. Filler for Coved Base: Plastic.
- D. Sealer and Wax: Types recommended by flooring manufacturer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

### **3.02 PREPARATION**

- A. Clean substrate.

### **3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- I. Install flooring in recessed floor access covers, maintaining floor pattern.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- J. Install feature strips where indicated.

### **3.04 RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

### **3.05 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.

### **3.06 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

**END OF SECTION**



## SECTION 09 6723

### EPOXY RESINOUS FLOORING

#### 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 resinous flooring systems with epoxy body coat(s).
  - 1. Application Method: Self-leveling slurry with broadcast aggregates and troweled or screeded.
- B. Related Sections include the following:
  - 1. Division 07 Section "Joint Sealants" for sealants installed at joints in resinous flooring systems.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Initial Selection: For each type of exposed finish required.
- C. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
- D. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.
- E. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- F. Material Test Reports: For each resinous flooring component.
- G. Material Certificates: For each resinous flooring component, signed by manufacturer.
- H. Maintenance Data: For resinous flooring to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
  - 1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer for applying resinous flooring systems indicated.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.
    - a. Include 48-inch (1200-mm) length of integral cove base.
  - 2. Simulate finished lighting conditions for Architect's review of mockups.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

## PART 2 - PRODUCTS

### 2.1 RESINOUS FLOORING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. General Polymers Corporation, a division of the Sherwin-Williams Company.
    - a. Equal to: Ceramic Carpet #400, Decorative Broadcast Epoxy Flooring System.
- B. System Characteristics:
1. Color and Pattern: As selected by Architect from manufacturer's full range of selected ceramic carpet blends.
  2. Wearing Surface: Manufacturer's standard orange-peel texture.
  3. Integral Cove Base: 4 inches (100 mm) high.
  4. Overall System Thickness: Not less than 1/8 inch (3.2 mm).
- C. System Components: Manufacturer's standard components that are compatible with each other and as follows:
1. Body Coat(s):
    - a. Resin: Epoxy.
    - b. Formulation Description: 100 percent solids.
    - c. Application Method: Self-leveling slurry with broadcast aggregates.
      - 1) Thickness of Coats: Not less than 1/8 inch (3.2 mm).
      - 2) Number of Coats: Two.
    - d. Aggregates: Colored quartz (ceramic-coated silica).
  2. Primer: Type recommended by manufacturer for substrate and body coat(s) indicated.
    - a. Formulation Description: 100 percent solids.
  3. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coat(s) indicated and that prevents substrate cracks from reflecting through resinous flooring.
    - a. Formulation Description: 100 percent solids.
    - b. Provide fiberglass scrim embedded in reinforcing membrane.
  4. Topcoat: Chemical-resistant sealing or finish coat(s).
    - a. Resin: Antimicrobial Poly-Cote Polyurethane.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- b. Formulation Description: 100 percent solids.
  - c. Type: Clear.
  - d. Finish: Satin.
  - e. Number of Coats: One.
- D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
- 1. Compressive Strength: 12,000 per ASTM C 579.
  - 2. Tensile Strength: 2,500 per ASTM C 307.
  - 3. Flexural Modulus of Elasticity: 4,500 per ASTM C 580.
  - 4. Impact Resistance: No chipping, cracking, or delamination and not more than **1/16-inch (1.6-mm)** permanent indentation per MIL-D-3134.
  - 5. Resistance to Elevated Temperature: No slip or flow of more than **1/16 inch (1.6 mm)** per MIL-D-3134.
  - 6. Abrasion Resistance: 90-100 mgs maximum weight loss per ASTM D 4060.
  - 7. Flammability: Self-extinguishing per ASTM D 635.
  - 8. Hardness: 70/65, Shore D per ASTM D 2240.

## 2.2 ACCESSORY MATERIALS

- A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated.
- 1. Formulation Description: 100 percent solids.
- C. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.
- 1. Formulation Description: 100 percent solids.
    - a. Provide fiberglass scrim embedded in reinforcing membrane.
- D. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
  - 1. Roughen concrete substrates as follows:
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.
  - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
  - 3. Verify that concrete substrates are dry.
    - a. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
  - 4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

### **3.2 APPLICATION**

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
  - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  - 3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
    - a. Apply joint sealant to comply with manufacturer's written recommendations.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.
- D. Apply reinforcing membrane to substrate cracks.

- E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
- F. Apply self-leveling slurry body coat(s) in thickness indicated for flooring system.
  - 1. Broadcast aggregates and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- G. Apply troweled or screeded body coat(s) in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- H. Apply grout coat, of type recommended by resinous flooring manufacturer to fill voids in surface of final body coat and to produce wearing surface indicated.
- I. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

### **3.3 FIELD QUALITY CONTROL**

- A. Core Sampling: At the direction of Owner and at locations designated by Owner, take 1 core sample per 1000 sq. ft. (92.9 sq. m) of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.
- B. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.
  - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
  - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
  - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

### **3.4 CLEANING AND PROTECTING**

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

**END OF SECTION 09 6723**



## **SECTION 096813**

### **TILE CARPETING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Carpet tile, fully adhered.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

##### **1.03 REFERENCE STANDARDS**

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2006.
- B. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2008.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2008.
- D. CRI 104 - Standard for Installation of Commercial Textile Floorcovering Materials; Carpet and Rug Institute; 2002.
- E. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; current listings at [www.carpet-rug.org](http://www.carpet-rug.org).
- F. CRI (GLP) - Green Label Plus Carpet Testing Program - Approved Products; Carpet and Rug Institute; current listings at [www.carpet-rug.org](http://www.carpet-rug.org).
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association; 2006.

##### **1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate layout of joints.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Submit two, 4 inch long samples of edge strip.
- F. Manufacturer's Installation Instructions: Indicate special procedures.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
  - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet with minimum three years experience.

### **1.06 FIELD CONDITIONS**

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. InterfaceFLOR; Product Entropy.
- B. Other Acceptable Manufacturers:
  - 1. Substitutions: See Section 016000 - Product Requirements.

### **2.02 MATERIALS**

- A. Carpet Tile: Tufted, tip-sheared, manufactured in one color dye lot.
  - 1. Product Number: 146487230
  - 2. Yarn System: Blue Chip Type 6,6 Nylon.
  - 3. Total Recycled Content: 66% - 74%
  - 4. Soil/Stain Protection: Protekt
  - 5. Tile Size: 19.69 x 19.69 inch, nominal.
  - 6. Thickness: 0.28 inch.
  - 7. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
  - 8. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
  - 9. VOC Content: Provide CRI Green Label Plus certified product; in lieu of labeling, independent test report showing compliance is acceptable.
  - 10. Gage: 1/12 inch.
  - 11. Stitches: 9.66 per inch.
  - 12. Pile Height: 0.21 inch.
  - 13. Pile Thickness: 0.143
  - 14. Pile Density Factor: 5035 kilotex.
  - 15. Backing Material: GlasBac RE Tile.
  - 16. Total Weight: 20 oz/sq yd.

### **2.03 ACCESSORIES**

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, color as selected by Architect.
- C. Stair Nosing: As specified in Section 09 6500.
- D. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- C. Verify that concrete sub-floor surfaces are dry enough and ready for flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by carpet tile manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

### **3.02 PREPARATION**

- A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.

### **3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Complete installation of edge strips, concealing exposed edges.

### **3.04 INSTALLATION ON STAIRS**

- A. Use one piece of carpet for each tread and the riser below. Apply seam adhesive to all cut edges.
- B. Lay carpet with pile direction in the length of the stair.
- C. Adhere carpet tight to stair treads and risers.

### **3.05 CLEANING**

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

**END OF SECTION**



## SECTION 09 9100

### PAINTING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Section includes painting work, interior and exterior. Work Includes, but is not limited to painting the following:
1. Exterior steel.
  2. Metal doors, metal door frames, roll-up metal doors, grilles, and frames.
  3. Exterior metal mechanical units.
  4. Interior walls and ceilings.
  5. Interior steel rails and misc. metal.
  6. Exterior Soffits
  7. Exterior exposed metal flashing.
  8. Interior and exterior brick and masonry.
  9. Exterior and Interior wood.
  10. Work includes field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, plug mold, electric panels, and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated. Field painting of a roof mounted mechanical units is part of this section.
- B. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.
- C. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint all exposed surfaces whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard or custom colors and finishes. Multiple colors may be selected by the Architect for any type of paint system.
1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
  2. Walls behind scheduled coverings shall receive prime coat.
  3. If it can be seen, paint it.
- D. Following categories of work are not included as part of field-applied finish work.
1. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, prefinished partition systems, acoustic materials, architectural woodwork and casework, elevator entrance doors and frames, elevator equipment, and finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets.
  2. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.
  3. Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.
  4. Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting.

5. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.
- E. Related Sections:
  1. Shop Primers: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.
    - a. Unless otherwise specified, shop priming of fabricated components such as architectural woodwork, wood casework and shop-fabricated or factory-built mechanical and electrical equipment or accessories is included under other sections of these specifications.
- F. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

## **1.02 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical information including Paint label analysis and application instructions for each material proposed for use.
- B. Samples: Prior to beginning work, Architect will furnish color chips for surfaces to be painted. Use representative colors when preparing samples for review. Submit samples for Architect's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.
  1. On 12" x 12" hardboard, provide two samples of each color and material, with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color, and texture is achieved.
  2. On actual wood surfaces, provide two 4" x 8" samples of natural and stained wood finish. Label and identify each as to location and application.
    - a. On actual wall surfaces and other exterior and interior building components, duplicate painted finishes of prepared samples. Provide full-coat finish samples on at least 100 sq. ft. of surface, or as directed, until required sheen, color and texture is obtained; simulate finished lighting conditions for review of in-place work.
    - b. Final acceptance of colors will be from samples applied on the job.

## **1.03 QUALITY ASSURANCE**

- A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.
- B. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

## **1.04 DELIVERY AND STORAGE**

- A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:
  1. Name or title of material.
  2. Fed. Spec. number, if applicable.
  3. Manufacturer's stock number and date of manufacture.
  4. Manufacturer's name.
  5. Contents by volume, for major pigment and vehicle constituents.
  6. Thinning instructions.
  7. Application instructions.

8. Color name and number.
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.
  1. Protect from freezing where necessary. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

### **1.05 JOB CONDITIONS**

- A. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50oF and 90oF, unless otherwise permitted by paint manufacturer's printed instructions.
- B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45oF and 95oF, unless otherwise permitted by paint manufacturer's printed instructions.
- C. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
  1. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.
- D. Determine moisture content of surfaces to be painted by performing appropriate tests using a commercially available moisture meter. Apply paint only when surfaces are within limits specified by the paint manufacturer's printed instructions.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURER**

- A. Approved Manufacturers:
  1. PPG Industries, Pittsburgh Paints (Pittsburgh).
  2. Pratt and Lambert (P & L).
  3. The Sherwin-Williams Company (S-W).
  4. Benjamin Moore & Co.
  5. Kwal-Howells Paint.

### **2.02 PAINT, GENERAL**

- A. Material Compatibility:
  1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
  2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
  3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  4. Floor Coatings: VOC not more than 100 g/L.
  5. Shellacs, Clear: VOC not more than 730 g/L.

6. Shellacs, Pigmented: VOC not more than 550 g/L.
- C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  2. Restricted Components: Paints and coatings shall not contain any of the following:
    - a. Acrolein.
    - b. Acrylonitrile.
    - c. Antimony.
    - d. Benzene.
    - e. Butyl benzyl phthalate.
    - f. Cadmium.
    - g. Di (2-ethylhexyl) phthalate.
    - h. Di-n-butyl phthalate.
    - i. Di-n-octyl phthalate.
    - j. 1,2-dichlorobenzene.
    - k. Diethyl phthalate.
    - l. Dimethyl phthalate.
    - m. Ethylbenzene.
    - n. Formaldehyde.
    - o. Hexavalent chromium.
    - p. Isophorone.
    - q. Lead.
    - r. Mercury.
    - s. Methyl ethyl ketone.
    - t. Methyl isobutyl ketone.
    - u. Methylene chloride.
    - v. Naphthalene.
    - w. Toluene (methylbenzene).
    - x. 1,1,1-trichloroethane.
    - y. Vinyl chloride.

### **2.03 MATERIALS**

- A. Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.
- B. Proprietary names used to designate color or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.
- C. Federal Specifications establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums.
- D. Manufacturer's products which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to Architect. Furnish material data and manufacturer's certificate of performance to Architect for any proposed substitutions.
- E. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.
- F. Lead content in pigment, if any, is limited to contain not more than 0.06% lead, as lead metal



based on the total non-volatile (dry-film) of paint by weight.

1. This limitation is extended to interior surfaces and those exterior surfaces, such as stairs, decks, porches, railings, windows, and doors which are readily accessible to children under seven years of age.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.
- B. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.
- C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

#### **3.02 PREPARATION**

- A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.
- B. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of any anticipated problems in using the specified coating systems with substrates primed by others.
- C. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.
- D. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.
- E. Cementitious Materials: Prepare cementitious surfaces to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.
  1. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
  2. Clean concrete floor surfaces scheduled to be painted with a commercial solution or muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid, and allow to dry before painting.
- F. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.
  1. Caulk fabrication joints in hollow metal door frames which paint application cannot bridge.
- G. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.
- H. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent.

- I. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.
  1. Prime, stain, or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling.
  2. When transparent finish is required, use spar varnish for backpriming.
- J. Materials Preparation:
  1. Mix and prepare painting materials in accordance with manufacturer's directions.
  2. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
  3. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

### 3.03 APPLICATION

- A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
  1. Paint colors, surface treatments, and finishes, are indicated in "schedules" of the contract documents.
  2. Provide finish coats which are compatible with prime paints used.
  3. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
  4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.
  5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
  6. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.
  7. Finish doors on tops, bottoms and side edges same as faces, unless otherwise indicated.
  8. Sand lightly between each succeeding enamel or varnish coat.
  9. Omit first coat (exterior faces of surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.
- B. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
  1. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
  2. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.
- C. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to those items exposed to mechanical equipment rooms and in occupied spaces.
  1. Mechanical items to be painted include, but are not limited to, the following:

- a. Piping, pipe hangers, and supports.
  - b. Roof mounted mechanical units.
  - c. Ductwork, where exposed in occupied spaces.
  - d. Motor, mechanical equipment, and supports.
  - e. Accessory items.
  2. Electrical items to be painted include, but are not limited to, the following:
    - a. Conduit and fittings.
- D. Prime Coats: Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others.
1. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- E. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- F. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- G. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.
- H. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

### **3.04 FIELD QUALITY CONTROL**

- A. The right is reserved by Owner to invoke the following material testing procedure at any time, and any number of times during period of field painting:
1. Owner will engage services of an independent testing laboratory to sample paint being used. Samples of materials delivered to project site will be taken, identified and sealed, and certified in presence of Contractor.
    - a. Testing laboratory will perform appropriate tests for any or all of following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis.
    - b. If test results show that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

### **3.05 CLEAN-UP AND PROTECTION**

- A. Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.
1. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- B. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
1. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after

- completion of painting operations.
2. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.
- C. Extra Stock: Deliver stock or maintenance materials to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.
1. Paint: Furnish not less than one (1) full gallon for each color and type of paint installed.

### 3.06 EXTERIOR PAINT SCHEDULE

- A. General: Provide the following Paint systems for the various substrates, as indicated.
1. METAL (Aluminum)
    - a. Latex Systems
      - Gloss Finish
      - 1st Coat: S-W DTM Acrylic Gloss Coating, B66 Series
      - 2nd Coat: S-W DTM Acrylic Gloss Coating, B66 Series  
(10 mils wet, 4 mils dry per coat)
  2. METAL (Galvanized)
    - a. Latex Systems
      - Gloss Finish
      - 1st Coat: S-W DTM Acrylic Primer, B66W1 Series  
(10 mils wet, 5 mils dry per coat)
      - 2nd Coat: S-W DTM Acrylic Gloss Coating, B66 Series
      - 3rd Coat: S-W DTM Acrylic Gloss Coating, B66 Series  
(10 mils wet, 4 mils dry per coat)
  3. METAL (Misc. Iron, Ornamental Iron, Catwalks, Fire Escapes, Hydrants, Handrails, Ladders, Fences)
    - a. Alkyd Systems
      - Gloss Finish
      - 1st Coat: S-W Kem Kromik Universal Metal Primer, B50Z Series  
(6 mils wet, 3 mils dry)
      - 2nd Coat: S-W Industrial Enamel, B54Z Series
      - 3rd Coat: S-W Industrial Enamel, B54Z Series  
(5 mils wet, 2 mils dry per coat)
  4. EXPOSED METAL - (Steel components at Main Entry Canopy indicated for Metallic Finish)
    1. Polyamide Epoxy System
      - a. Primer:
        - 1) Surface preparation: Commercial Blast Cleaning (SSPC-SP6)
        - 2) Steel: Tnemec; Series 66 Hi-Build Epoxoline, Polyamide Epoxy Primer  
(7 mils wet, 4 mils dry)
      - b. 1st Coat: Tnemec; Series 1077 Enduralume, Aliphatic Acrylic Polyurethane (5.5 mils wet, 3 mils dry)
      - c. 2nd Coat: Tnemec; Series 763 Endura-Clear, Aliphatic Acrylic Polyurethane (2 mils wet, 1.5 mils dry)

### 3.07 INTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated.
1. MASONRY PAINTED - (Concrete Masonry Units)
    - a. Latex Systems
      - Semi-Gloss Finish
      - 1st Coat: S-W ProMar Interior/Exterior Block Filler B25W25

(75-125 sq.ft./gal.)

- 2nd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series
- 3rd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series (4 mils wet, 1.5 mils dry per coat)

b. Epoxy System (Water Base)

Semi-Gloss Finish

- 1st Coat: S-W Heavy Duty Block Filler, B42W46 (87-108 sq.ft./gal. 8-10 mils dry)
- 2nd Coat: S-W Water Based Catalyzed Epoxy B70/B60V25
- 3rd Coat: S-W Water Based Catalyzed Epoxy B70/B60V25 (8 mils wet, 3 mils wet per coat)

2. METAL - (Galvanized)

a. Latex Systems

1) Semi-Gloss Finish

- 1st Coat: S-W DTM Acrylic Primer, B66W1 Series (10 mils wet, 5 mils dry per coat)
- 2nd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series
- 3rd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series (4 mils wet, 1.3 mils dry per coat)

3. METAL - (Structural Steel Columns, Joists, Trusses, Beams, Misc. & Ornamental Iron, Doors, Door Frames, Non-Galvanized Metal)

a. Latex Systems

1) Semi-Gloss Finish

- 1st Coat: DTM Acrylic Primer/Finish, B66W1 (6 mils wet, 3 mils dry)
- 2nd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series
- 3rd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series (4 mils wet, 1.3 mils dry per coat)

b. Alkyd Systems (Contractor Option for Doors and Door Frames)

Semi-Gloss Finish

- 1st Coat: S-W Kem Kromik Universal Primer, B50Z Series (6 mils wet, 3 mils dry)
- 2nd Coat: S-W ProMar 200 Alkyd Semi-Gloss, B34W200 Series
- 3rd Coat: S-W ProMar 200 Alkyd Semi-Gloss, B34W200 Series (4 mils wet, 1.7 mils dry per coat)

4. DRYWALL (Walls, Ceilings, Gypsum Board, Etc.)

a. Latex Systems

Semi-Gloss Finish

- 1st Coat: S-W Preprite 200 Latex Wall Primer, B28W200 (4 mils wet, 1.2 mils dry)
- 2nd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series
- 3rd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series (4 mils wet, 1.3 mils dry per coat)

b. Epoxy System (Water Base)

Semi-Gloss Finish

- 1st Coat: S-W Preprite 200 Latex Wall Primer, B28W200 (4 mils wet, 1.2 mils dry)
- 2nd Coat: S-W Water Based Catalyzed Epoxy, B70/B60V25

- 3rd Coat: S-W Water Based Catalyzed Epoxy, B70/B60V25 (8 mils wet, 3 mils dry per coat)
- 1) Approved Manufacturer's
    - (a) Porter Paints
    - (b) Columbia Paint and Coatings
5. DRYWALL (Graphics, Deep Tone Accents, Special Features, Etc.)
- a. Latex Systems
    - Low Luster/Low Sheen
      - 1st Coat: S-W Preprite 200 Latex Wall Primer, B28W200 (4 mils wet, 1.2 mils dry)
      - 2nd Coat: S-W ColorAccents Interior Latex Satin Wall Paint, Y38 Series (4 mils wet, 1.5 mils dry)
      - 3rd Coat: S-W ColorAccents Interior Latex Satin Wall Paint, Y38 Series (4 mils wet, 1.5 mils dry)Provide additional coats as required to provide full coverage of surfaces.    - 4th Coat: MCT, Waterborne Acrylic Polyurethane Multipurpose Clear Topcoat
6. DRYWALL (Behind Scheduled Wall Coverings, Tackable Wall Panels, Casework)
- a. Latex Systems
    - Semi-Gloss Finish
      - 1st Coat: S-W Preprite 200 Latex Wall Primer, B28W200 (4 mils wet, 1.2 mils dry)
7. CONCRETE SLABS (Floors not scheduled for applied finishes)
- a. Membrane Curing and Sealing Compound: ASTM C 309 Type 1 - Clear or translucent, Class A.
    - 1) Waterborne, modified acrylic formulation.
    - 2) Provide Scofield Cureseal-W as manufactured by L.M. Scofield Company.
  - b. Traction Additive: Synthetic aggregate composed of lightweight polypropylene spheres that remain suspended in the curing and sealing compound, creating a textured surface without sharp edges. The small, clear particles shall not be readily noticeable on the finished floor and shall not discolor the surface.
    - 1) Provide Scofield Traction Additive as manufactured by L.M. Scofield Company.
8. WOODWORK (PAINTED)
- a. Latex Systems
    - Semi-Gloss Finish
      - 1st Coat: S-W Wall & Wood Primer, B49W2 (4 mils wet, 2 mils dry)
      - 2nd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series
      - 3rd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series (4 mils wet, 1.5 mils dry per coat)
  - b. Alkyd Systems (Contractor Option)
    - Semi-Gloss Finish
      - 1st Coat: S-W PrepRite Wall & Wood Oil Primer/Undercoater, B49 (4 mils wet, 2 mils dry)
      - 2nd Coat: S-W ProMar 200 Alkyd Semi-Gloss B34W200 Series
      - 3rd Coat: S-W ProMar 200 Alkyd Semi-Gloss B34W200 Series (4 mils wet, 2 mils dry per coat)

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

9. MASONRY (Concrete Masonry Units (CMU) - Integral Color/Sealed)
  - a. 1st/2nd Base Coat: Coronado 138-10 Clear Acrylic Epoxy Sealer
    - 1) Apply minimum two (2) coats at rate as recommended by manufacturer, but not less than 175 to 200 sq. ft. per gallon per coat. Allow 12 hours dry time prior to applying second coat.
  - b. 3rd/4th Sealer Coat: Coronado 827 Series Superthane Aliphatic Acrylic Urethane
    - 1) Apply two (2) uniform pinhole free, continuous flood coats (apply at rate of 175-200 Sq. Ft. Per Gallon over masonry block or 250-300 Sq. Ft. Per Gallon over masonry brick) over entire surface. Runs or sags shall be immediately brushed out to even the coat. Allow 4 hours dry time prior to applying second coat.

**END OF SECTION 09 9100**





## **DIVISION 10 – SPECIALTIES**

10 1400 - Signs

10 2113.13 - Metal Toilet Compartments

10 2113.19 - Phenolic Toilet Compartments

10 2813 - Toilet and Bath Accessories

10 4400 - Fire Protection Specialties

10 5100 - Lockers

10 5126 - Plastic Lockers



## SECTION 10 1400

### SIGNS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following types of signs:
  - 1. Panel signs.
    - a. Interior room identification signs.
    - b. Handicap accessibility signage.
    - c. Handicap entry signs.
    - d. Maximum occupancy load signs.
  - 2. Dimensional letters and numbers.

##### 1.03 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- C. Shop drawings showing fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
  - 1. Provide message list for each sign required, including large-scale details of wording and lettering layout.
  - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
  - 3. Templates: Furnish full-size spacing templates for individually mounted dimensional letters and numbers.
- D. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
  - 1. Samples for selection of color, pattern, and texture:
    - a. Cast Acrylic Sheet and Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.
    - b. Aluminum: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.

##### 1.04 QUALITY ASSURANCE

- A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.
- B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

- C. Handicapped Accessibility: Provide signs which are in conformance with the requirements of ANSI A117.1-latest edition and the Americans with Disabilities Act of 1990 (ADA).
- D. Design Concept: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

#### **1.05 DELIVERY AND HANDLING**

- A. Delivery: Provide protective covering or crating as recommended by the manufacturer to protect sign components and surfaces against damage during transportation and delivery.
- B. Handle signs carefully to prevent breakage, surface abrasion, denting, soiling, and other defects. Comply with the manufacturer's written handling instructions for unloading components subject to damage.
  - 1. Inspect sign components for damage on delivery.
  - 2. Do not install damaged sign components.
  - 3. Repair minor damage to signs, provided the finished repair is equal in all respects to the original work and is approved by Architect; otherwise, remove and replace damaged sign components.

#### **1.06 PROJECT CONDITIONS**

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
  - 1. Manufacturers of Panel Signs:
    - a. ABC Architectural Signing System.
    - b. ASI Sign Systems, Inc.
    - c. Best Manufacturing Company.
    - d. Spanjer Brothers, Inc.
    - e. Vomar Products, Inc.
  - 2. Manufacturers of Dimensional Letters:
    - a. ASI Sign Systems, Inc.
    - b. Metal Arts.
    - c. Metallic Arts, Inc.
    - d. The Southwell Company.
    - e. Spanjer Brothers, Inc.
    - f. Vomar Products, Inc.

#### **2.02 MATERIALS**

- A. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F (80 deg C), and of the following general types:
  - 1. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.
- B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), 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 6061-T6.

- C. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by the sign manufacturer for the casting process used and for the use and finish indicated.
- D. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.
- E. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

### **2.03 PANEL SIGNS**

- A. General: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
  - 1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch 1.5 mm measured diagonally.
- B. Basis-of-Design Product: ASI Sign Systems, Inc.; ASI Tactile Graphics Plaque Sign System or a comparable product of one of the following:
  - 1. Available Manufacturers:
    - a. APCO Graphics, Inc.
    - b. Best Manufacturing Co.
    - c. Mohawk Sign Systems.
- C. Sign Face: High impact aluminum tri-hydrate filled polyester acrylate resin, pressure molded into a single polymerized component, using manufacturer's standard co-molding process.
- D. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to comply with the following requirements:
  - 1. Edge Condition: Square cut.
  - 2. Corner Condition: Square.
  - 3. Depth: 0.25 inch thickness.
  - 4. Panel Appearance: As selected by Architect.
  - 5. Color: As selected by Architect from manufacturer's full range of colors.
  - 6. Surface Texture: As selected by Architect.
  - 7. Letter Style: Arial.
  - 8. Letter Height: As scheduled.
- E. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Background chassis shall be concealed by modules and accessories.
- F. Graphic Content and Style: Provide sign copy that complies with requirements indicated in the Sign Schedule for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage. Provide all signage with permanent ADA text.
  - 1. Provide signage indicating handicap entry at each set of entry doors into facility.
  - 2. Provide maximum occupancy load signs in assembly rooms as required by code.
- G. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
  - 1. Raised-Copy Thickness: Not less than 1/32 inch 0.8 mm.
- H. Applied Copy: Die-cut characters from vinyl film of nominal thickness of 3 mils (0.076 mm) with pressure-sensitive adhesive backing. Apply copy to exposed face of panel sign, glass, doors, or

wall surfaces as indicated.

- I. Colored Coatings: For copy and background colors, provide Pantone Matching System (PMS) colored coatings, including inks and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for application intended.

#### **2.04 DIMENSIONAL LETTERS AND NUMBERS**

- A. Cast Letters and Numbers: Form individual letters and numbers by casting. Produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects. Cast lugs into the back of characters and tap to receive threaded mounting studs. Comply with requirements indicated for finish, style, and size.
  1. Metal: Aluminum.
    - a. Finish: Baked-enamel finish, color as selected by Architect.
  2. Provide letters of size and style as indicated attached to interior and exterior of building and as directed by architect.
  3. Monument Sign: Attach to free standing monument sign as indicated and as directed by the architect.

#### **2.05 FINISHES**

- A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.
- B. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.
- C. Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
  1. Baked-Enamel Finish: AA-M4xC12C42R1x (Mechanical Finish: Manufacturer's standard, other nondirectional textured; Chemical Finish: Chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.
    - a. Organic Coating: Thermosetting-modified acrylic enamel primer/topcoat system complying with AAMA 603.8 except with a minimum dry film thickness of 1.5 mils, medium gloss.
      - 1) Color: As selected by the Architect from the manufacturer's standard colors.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall and other conditions affecting performance of work.
  1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Verify that items, including anchor inserts, provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Examine walls and partitions for proper backing for wall mounted signs.

- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
  - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
- B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:
  - 1. Provide screws, bolts, and other exposed fastening devices of the same material as the items being fastened. Provide types, gages, and lengths to suit installation conditions. Use theft-proof fasteners where exposed to view.
- C. Bracket-Mounted Units: Provide the manufacturer's standard brackets, fittings, and hardware as appropriate for mounting signs that project at right angles from walls and ceilings. Attach brackets and fittings securely to walls or ceilings with concealed fasteners and anchoring devices to comply with manufacturer's directions.
- D. Dimensional Letters and Numbers: Mount letters and numbers using standard fastening methods recommended by the manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish letter spacing and to locate holes for fasteners.
  - 1. Projected Mounting: Mount characters at projection distance from wall surface indicated or as directed by the Architect.

### **3.03 CLEANING AND PROTECTION**

- A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

**END OF SECTION 10 1400**





Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

## **SECTION 10 2113.13**

### **METAL TOILET COMPARTMENTS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Steel toilet compartments configured as toilet enclosures and urinal screens.

##### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for each exposed product and for each color and texture specified.

##### **1.3 INFORMATIONAL SUBMITTALS**

- A. Product certificates.

##### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

##### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
  - 1. Electrolytically Zinc Coated: ASTM A 879/A 879M, **01Z (03G)**.
  - 2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvanized.
- B. Zamac: ASTM B 86, commercial zinc-alloy die castings.

### **2.2 STEEL UNITS**

- 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. **Accurate Partitions Corporation.**
  - 2. **American Sanitary Partition Corporation.**
  - 3. **Bradley Corporation; Mills Partitions.**
    - a. Equal to Series 400 Sentinel.
  - 4. **Flush Metal Partition Corp.**
  - 5. **General Partitions Mfg. Corp.**
  - 6. **Hadrian Manufacturing Inc.**
  - 7. **Knickerbocker Partition Corporation.**
  - 8. **Sanymetal; a Crane Plumbing company.**
- B. Toilet-Enclosure Style: Overhead braced.
- C. Urinal-Screen Style: Wall hung, flat panel with post to ceiling.
- D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Provide with no-sightline system. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
  - 1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of **1 inch (25 mm)** for doors and panels and **1-1/4 inches (32 mm)** for pilasters.
  - 2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
  - 3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
- E. Urinal-Screen Construction:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Flat-Panel Urinal Screen: Matching panel construction.
- F. Facing Sheets and Closures: Electrolytically coated or hot-dip galvanized-steel sheet with nominal base-metal (uncoated) thicknesses standard with manufacturer.
- G. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than **3 inches (76 mm)** high, finished to match hardware.
- H. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters or **1-3/4-inch- (44-mm-)** square, aluminum tube with satin finish; with shoe and sleeve (cap) matching that on the pilaster.
- I. Brackets (Fittings):
  1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- J. Steel-Sheet Finish: Manufacturer's standard baked-on finish, with [one color] [two colors] in each room.
  1. Color: As selected by Architect from manufacturer's full range.

## **2.3 ACCESSORIES**

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
  1. Material: Chrome-plated zamac.
  2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
  3. Latch and Keeper: Manufacturer's standard 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 compartments designated as accessible.
  4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
  5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
  6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

## **2.4 FABRICATION**

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.
- C. Door Size and Swings: Unless otherwise indicated, provide **24-inch- (610-mm-)** wide, in-swinging doors for standard toilet compartments and **36-inch- (914-mm-)** wide, out-swinging doors with a minimum **32-inch- (813-mm-)** wide, clear opening for compartments designated as accessible.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
- B. Clearances: Maximum **1/2 inch (13 mm)** between pilasters and panels; **1 inch (25 mm)** between panels and walls.
- C. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

### **3.2 ADJUSTING**

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

**END OF SECTION 10 2113.13**

## SECTION 10 2113.19

### PHENOLIC TOILET COMPARTMENTS

#### 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. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Sections:
  - 1. Section 10 2800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show locations of cutouts for compartment-mounted toilet accessories.
  - 2. Show locations of reinforcements for compartment-mounted grab bars.
  - 3. Show locations of centerlines of toilet fixtures.
- C. Samples for Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment, from manufacturer.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

### **PART 2 - PRODUCTS**

#### 2.1 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless-Steel Castings: ASTM A 743.

#### 2.2 PHENOLIC-CORE UNITS

- 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. [Accurate Partitions Corporation.](#)
  - 2. [Bobrick Washroom Equipment, Inc.](#)
  - 3. [Bradley Corporation; Mills Partitions.](#)
  - 4. [General Partitions Mfg. Corp.](#)
  - 5. [Knickerbocker Partition Corporation.](#)

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

6. Metpar Corp.
7. Sanymetal; a Crane Plumbing company.
8. Young Group Ltd. (The); Fabricated Products Division; DesignRite Partitions.

- B. Toilet-Enclosure Style: Overhead braced.
- C. Urinal-Screen Style: Wall Hung.
- D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum **3/4-inch**-thick doors and pilasters and minimum **1/2-inch**-thick panels.
- E. Pilaster Shoes and Sleeves (Caps): Fabricated from stainless-steel sheet, not less than **0.031-inch** nominal thickness and **3 inches** high, finished to match hardware.
- F. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- G. Phenolic-Panel Finish:
1. Facing Sheet Finish: One color and pattern in each room.
  2. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard dark color core.

## 2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
1. Material: Stainless steel.
  2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
  3. Latch and Keeper: Manufacturer's standard 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 compartments designated as accessible.
  4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
  5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
  6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

## 2.4 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

### 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

**END OF SECTION 10 2113.19**



## SECTION 10 2813

### TOILET AND BATH ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes the following:
  - 1. Toilet and bath accessories.
  - 2. Warm-air dryers.
  - 3. Underlavatory guards.

##### 1.02 SUBMITTALS

- A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- B. Samples: For each accessory item to verify design, operation, and finish requirements.
  - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.
- D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.
- E. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

##### 1.03 QUALITY ASSURANCE

- A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.
- B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.
  - 1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
  - 2. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

##### 1.04 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

##### 1.05 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

- B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
  - 1. Minimum Warranty Period: 15 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide accessories by the following manufacturer:
  - 1. Toilet and Bath Accessories:
    - a. American Specialties, Inc.
  - 2. Warm-Air Dryers:
    - a. Dyson Airblade.
    - b. American Specialties, Inc.
  - 3. Underlavatory Guards:
    - a. Brocar Products, Inc.
    - b. Truebro, Inc.

### **2.02 MATERIALS**

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
- C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).
- E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- F. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.
- G. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
- H. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- I. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

### **2.03 FABRICATION**

- A. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.
- C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

- D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
  - 1. Provide galvanized steel backing sheet, not less than 0.034 inch (0.85 mm) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
- E. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
  - 1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- F. 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**

#### **3.01 INSTALLATION**

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

#### **3.02 ADJUSTING AND CLEANING**

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

#### **3.03 TOILET AND BATH ACCESSORY SCHEDULE**

- A. Grab Bar: Where this designation is indicated, provide stainless-steel grab bar complying with the following:
  - 1. Stainless-Steel Nominal Thickness: Minimum 0.05 inch (1.3 mm).
  - 2. Mounting: Concealed with manufacturer's standard flanges and anchors.
  - 3. Gripping Surfaces: Manufacturer's standard slip-resistant texture.
  - 4. Outside Diameter: 1-1/2 inches (38 mm) for heavy-duty applications.
- B. Sanitary Napkin Disposal Unit: Where this designation is indicated, provide stainless-steel sanitary napkin disposal unit complying with the following:
  - 1. Products: Provide the following:
    - a. Bobrick, B-270
  - 2. Surface-Mounted Type: With seamless exposed walls; self-closing top cover; locking bottom panel with stainless-steel, continuous hinge; and removable, reusable receptacle.
- C. Robe Hook: Bradley, 9314.
  - 1. Single-Prong Unit: Stainless-steel, single-prong robe hook with rectangular wall bracket and backplate for concealed mounting.
- D. Mirror Unit: Where this designation is indicated, provide mirror unit complying with the following:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Stainless-Steel, Angle-Framed Mirror: Fabricate frame from minimum nominal 0.05-inch- (1.3-mm-) thick stainless-steel angles, with square corners mitered, welded, and ground smooth.
- I. Warm-Air Dryer:
    1. Basis-of-Design Product: Bobrick, B-708.
    2. Mounting: Surface mounted.
    3. Operation: Electronic-sensor activated with timed power cut-off switch.
      - a. Operation Time: Remove hands or 90 second automatic shutoff.
    4. Cover Material and Finish: White iron-casting with high-gloss, acid-resistant, multicoat vitreous enamel.
    5. Electrical Requirements: 115 V, 20 A, 2300 W.
  - J. Underlavatory Guard: Where this designation is indicated, provide underlavatory guard complying with the following:
    1. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

**END OF SECTION**

## SECTION 10 4400

### FIRE PROTECTION SPECIALTIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

##### 1.02 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; National Fire Protection Association; 2007.
- B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

##### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

##### 1.04 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Fire Extinguishers, Cabinets and Accessories:
  - 1. JL Industries, Inc: [www.jlindustries.com](http://www.jlindustries.com).
  - 2. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com).
  - 3. Potter-Roemer: [www.potterroemer.com](http://www.potterroemer.com).
  - 4. Substitutions: See Section 016000 - Product Requirements.

##### 2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
  - 1. Provide extinguishers labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.
- B. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gage.
  - 1. Class B:C.
  - 2. Size 10.
  - 3. Finish: Baked enamel, red color.

### **2.03 FIRE EXTINGUISHER CABINETS**

- A. Metal: Formed aluminum.
- B. Cabinet Configuration: Recessed type.
  - 1. Sized to accommodate accessories.
  - 2. Trim: Flat, 2 inch wide face.
  - 3. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.
- C. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
- D. Door Glazing: Plastic, clear, 1/8 inch thick acrylic. Set in resilient channel gasket glazing.
- E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- F. Weld, fill, and grind components smooth.
- G. Finish of Cabinet Exterior Trim and Door: Anodized to color as selected.
- H. Finish of Cabinet Interior: White enamel.

### **2.04 ACCESSORIES**

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Cabinet Signage: As scheduled.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify rough openings for cabinet are correctly sized and located.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 48 inches from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers and accessories in cabinets.
- E. Position cabinet signage where indicated.

**END OF SECTION**

## SECTION 10 5100

### LOCKERS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Locker units with hinged doors.
- B. Metal tops and filler panels.

##### 1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete base construction.
- B. Section 061000 - Rough Carpentry: Wood blocking and nailers.

##### 1.03 REFERENCE STANDARDS

- A. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.

##### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on locker types, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan options. Architect shall direct numbering plan.
- D. Samples: Submit two samples 3 x 6 inches in size, of each color scheduled; applied to specified base metal.
- E. Manufacturer's Installation Instructions: Indicate component installation assembly.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Lockers: Basis-of-Design Product - Subject to compliance with requirements, provide **Penco Products, Inc.**; Vanguard or comparable product.
  - 1. Substitutions: See Section 016000 - Product Requirements.

##### 2.02 MATERIALS

- A. Sheet Steel: ASTM A 653/A 653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; to the following minimum thicknesses:
  - 1. Body and Shelf: 24 gage, 0.024 inch.
  - 2. Door Outer Face: 18 gage, 0.048 inch.
  - 3. Door Inner Face: 20 gage, 0.036 inch.
  - 4. Door Frame: 16 gage, 0.060 inch.
  - 5. Hinges: 14 gage, 0.075 inch.
  - 6. Base: 20 gage, 0.036 inch.
  - 7. Sloping Top: 20 gage, 0.036 inch.
  - 8. Trim: 20 gage, 0.036 inch.
- B. Accessories For Each Locker: Two single prong wall hooks, coat hanger bar.

## **2.03 LOCKER UNITS**

- A. Width: Width in inches as shown on the drawings.
- B. Depth: Depth in inches as shown on the drawings.
- C. Height: Height in inches as shown on the drawings.
- D. Configuration: single and double tier.
- E. Mounting: Surface mounted.
- F. Base: Metal base, where shown on the drawings.
  - 1. Base Height: 4 inch.
- G. Top: Sloped metal with closures.
- H. Locking: Equipped with hasps to accept pad locks and complying with clearance and ADA accessibility guidelines.
- I. Ventilation Method: Door louvers.
- J. Class: Quiet.
- K. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
- L. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
- M. Doors: Hollow double pan, sandwich construction with acoustic insulation fill, 1-3/16 inch thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.
- N. Hinges: Manufacturer's standard, steel, full height, continuous hinges, welded to door and attached to door frame with no fewer than four factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
- O. Number Plates: Provide oval shaped brass plates. Form numbers minimum 3/8 inch high of block font style with ADA designation, in contrasting color.
- P. Provide ventilation openings at top and bottom of each locker.
- Q. Form recess for operating handle and locking device.
- R. Finish edges smooth without burrs.
- S. Fabricate sloped metal tops, ends and closure pieces.
- T. Provide perforated end panels and filler strips.

## **2.04 FINISHING**

- A. Clean, degrease, and neutralize metal; prime and finish with one coat of baked enamel.
- B. Paint locker bodies and doors in contrasting colors.
- C. Paint locker units 1 color, as selected.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that prepared bases are in correct position and configuration.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Verify bases and embedded anchors are properly sized.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Place and secure on prepared base.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels, filler panels, and sloped tops.
- G. Install accessories.
- H. Replace components that do not operate smoothly.

### **3.03 CLEANING**

- A. Clean locker interiors and exterior surfaces.

**END OF SECTION**



## **SECTION 105126**

### **PLASTIC LOCKERS**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY & SPECIFICATION**

- A. This Section includes the following:
  - 1. Wardrobe lockers, including the following:
    - a. Multiple-tier as indicated on the drawings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 03 Section "Concrete" for locker bases.
  - 2. Division 06 Section "Miscellaneous Carpentry" for wood furring and grounds.

##### **1.02 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Manufacturer's printed data including materials, accessories, construction, finishes, assembly, and installation instructions for lockers and benches.
- C. Shop Drawings: Layout and dimensions of metal lockers and benches. Indicate relationship to adjoining surfaces. Show locker elevations and details, fillers, trim, base, sloping tops, and accessories. Include locker numbering sequence. Indicate installation and anchorage requirements.
- D. Samples for Color Selection: Manufacturer's color charts showing a full range of available colors.
- E. Maintenance Instructions: Instructions for cleaning lockers and for adjusting, repairing, and replacing locker doors and latching mechanisms.

##### **1.03 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of authorized manufacturers and use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Components shall have uniform thickness and flatness (+/- 0.032").
- C. Colors shall be consistent for all tops, shelves, pegboards, doors, side panels and other components of like grade and surface texture.
- D. Single-Source Responsibility: Obtain locker units and accessories from one manufacturer.

##### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for locker installation.
- B. Protect lockers from damage during delivery, handling, storage, and installation.
- C. Deliver master keys, control keys, and combination control charts to Owner.

#### **PART 2 - PRODUCTS**

##### **2.01 MANUFACTURERS**

- A. Solid plastic lockers shall be equal to those manufactured by Santana Products, Inc., 1300 Meylert Avenue, Scranton, PA 18509. Lockers constructed of other materials, or material with a

core and not of solid plastic, will not be acceptable.

- B. Approved Manufacturers:
1. The Mills Company, a subsidiary of Bradley Corporation.
  2. PSISC, Columbia.
  3. ASI Storage System.
  4. Other manufacturer's of solid plastic lockers shall submit for approval prior to bidding.

## **2.02 MATERIALS**

- A. Sides, shelves, tops and bottoms shall be made from polymer resin manufactured under high pressure to form solid plastic components 3/8 inch thick with a homogenous color.
- B. Doors shall be made from polymer resin manufactured under high pressure to form solid plastic components 1/2 inch thick with a homogeneous color.
- C. Door frames shall be constructed from polymer resins manufactured under high pressure to form solid plastic components 1/2 inch thick with a homogeneous color.
- D. Continuous latch shall provide a spring loaded, slide latch mechanism that is capable of accepting various locking mechanisms. Latch mechanism shall be attached to the door, providing a continuous security latch.
- E. Door hinge shall be continuous and integrate into the full-length of the door and main locker frame, made entirely from plastic, with a Type 304 stainless steel knuckle pin.
- F. Coat hooks shall be made from chrome plated zamac and attached with stainless steel screws, three per opening.
- G. Finish shall be commercial grade matte finish for tops, bottoms, side-walls, shelves and backs, in the color natural white. Doors and frames shall have a slightly textured finish and be from the manufacturer's list of standard colors.

## **2.03 LOCKS**

- A. Fabricate lockers to receive the following locking devices, installed on lockers using security-type fasteners:
1. Projecting Handle and Latch for Padlocks: Manufacturer's standard, positive automatic, prelocking, pry-resistant latch and pull; chromium-plated, heavy-duty, vandal-resistant, lift-up handle, as follows:
    - a. Provide minimum three-point latching for each door more than 42 inches (1067 mm) high; minimum two-point latching for each door 42 inches (1067 mm) high or less.
    - b. Housing shall be bolted to door with a minimum of 2 tamper proof fasteners. Tabs shall not be accepted or approved.

## **2.04 LOCKER ACCESSORIES**

- A. Number Plates: Manufacturer's standard etched, embossed, or stamped, nonferrous-metal number plates with numerals not less than 3/8 inch (9 mm) high. Number lockers in sequence indicated. Attach plates to each locker door, near top, centered, with at least 2 fasteners of same finish as number plate.
- B. Continuously Sloping Tops: Manufacturer's standard continuously sloped top. Provide closures at ends and sloped corner fillers.
1. Filler Panels: Factory fabricated of material matching lockers.
  2. Boxed End Panels: Manufacturer's standard end-finishing panels to conceal exposed ends of nonrecessed lockers.

## **2.05 FABRICATION**

- A. Fabricate lockers square, rigid, and without warp, with faces flat and free of dents or distortion. Make exposed edges free of sharp edges and burrs, and safe to touch. Secure frame members together to form a rigid, 1-piece structure.
  - 1. Form locker body panels, doors, shelves and accessories from 1-piece sheet unless otherwise indicated.
  - 2. Preassemble lockers by fastening all joints, seams, and connections. Smooth exposed surfaces flush.

## **2.06 FINISHES, GENERAL**

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 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 they are assembled or installed to minimize contrast.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install lockers complete with accessories according to manufacturer's recommendations. Install plumb, level, rigid, and flush.
- B. Connect together locker groups with standard fasteners according to manufacturer's recommendations, with no exposed fasteners on face frames.
- C. Anchor lockers to floors and walls at intervals recommended by manufacturer but no greater than 36 inches (910 mm). Install anchors through back-up reinforcing plates where necessary to avoid distortion, using concealed fasteners.
- D. Install sloping top units to lockers using concealed fasteners. Provide hairline joints and concealed splice plates.
- E. Install boxed end panels to conceal exposed ends of nonrecessed lockers.
- F. Anchor locker benches to uniformly spaced brackets/pedestals not more than 72 inches (1830 mm) apart, and securely fasten to bench top and anchor to masonry base.

### **3.02 ADJUSTING, CLEANING, AND PROTECTION**

- A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.
- B. Clean interior and exposed exterior surfaces and polish stainless-steel and nonferrous metal surfaces.
- C. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.
- D. Touch up marred finishes, or replace locker units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

**END OF SECTION 105126**



**DIVISION 11 – EQUIPMENT**

Not Used





**DIVISION 12 – FURNISHINGS**

Not Used



**DIVISION 13 – SPECIAL CONSTRUCTION**

Not Used



**DIVISION 14 – CONVEYING EQUIPMENT**

Not Used



**DIVISION 21 – FIRE SUPPRESSION**

Not Used





## **DIVISION 22 – PLUMBING**

- 22 0500 - Common Work Results for Plumbing
- 22 0513 - Common Motor Requirements for Plumbing Equipment
- 22 0517 - Sleeves and Sleeve Seals for Plumbing Piping
- 22 0518 - Escutcheons for Plumbing Piping
- 22 0519 - Meters and Gages for Plumbing Piping
- 22 0523 - General-Duty Valves for Plumbing Piping
- 22 0529 - Hangers and Supports for Plumbing Piping and Equipment
- 22 0533 - Heat Tracing for Plumbing Piping
- 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment
- 22 0553 - Identification for Plumbing Pipes and Equipment
- 22 0700 - Plumbing Insulation
- 22 0719 - Plumbing Piping Insulation
- 22 1116 - Domestic Water Piping
- 22 1119 - Domestic Water Piping Specialties
- 22 1123 - Domestic Water Pumps
- 22 1223 - Facility Indoor Potable-Water Storage Tanks
- 22 1316 - Sanitary Waste and Vent Piping
- 22 1319 - Sanitary Waste Piping Specialties
- 22 1413 - Facility Storm Drainage Piping
- 22 1423 - Storm Drainage Piping Specialties
- 22 4000 - Plumbing Fixtures
- 22 4713 - Drinking Fountains



## **SECTION 22 0500**

### **COMMON WORK RESULTS 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. This Section includes the following:
  1. Piping materials and installation instructions common to most piping systems.
  2. Transition fittings.
  3. Dielectric fittings.
  4. Mechanical sleeve seals.
  5. Sleeves.
  6. Escutcheons.
  7. Grout.
  8. Equipment installation requirements common to equipment sections.
  9. Painting and finishing.
  10. Concrete bases.
  11. Supports and anchorages.
  12. Link Seal
  13. Lead Free requirements.

##### **1.3 SEISMIC REQUIREMENTS**

- A. Equipment, pipe hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.

##### **1.4 LEAD FREE REQUIREMENTS**

- A. For all projects within the United States, and when water is anticipated for human consumption, all pipes, pipe fittings, plumbing fittings and fixtures shall comply with PUBLIC LAW 111-380 "Reduction of Lead in Drinking Water Act" 124 STAT. 4131, 42-USC 1201, January 4<sup>th</sup>, 2011.

##### **1.5 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.

- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases and accessible tunnels.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.
- G. Lead Free:
  - 1. Not containing more than 0.2 percent lead when used with respect to solder and flux.
  - 2. Not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings and fixtures.
  - 3. Calculation: The weighted average lead content of a pipe, pipe fitting, plumbing fitting or fixture shall be calculated by using the formula prescribed in the law named in LEAD FREE REQUIREMENTS above.

## 1.6 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.
- B. Welding certificates.

## 1.7 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## **1.9 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
- B.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### **2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### **2.3 JOINING MATERIALS**

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

## **2.4 TRANSITION FITTINGS**

- A. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.

## **2.5 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epco Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **2.7 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## **2.8 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- D. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## **2.9 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **2.10 LINK SEAL**

- A. Link-Seal® Modular Seal Pressure Plates
  - 1. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
    - a. Izod Impact - Notched = 2.05ft-lb/in. per ASTM D-256
    - Flexural Strength @ Yield = 30,750 psi per ASTM D-790
    - Flexural Modulus = 1,124,000 psi per ASTM D-790
    - Elongation Break = 11.07% per ASTM D-638
    - Specific Gravity = 1.38 per ASTM D-792



2. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a "Hex Nut Interlock" designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer's name molded into it.
3. For fire and Hi-Temp service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.
4. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be: 316 Stainless Steel per ASTM F593-95, with a 85,000 psi average tensile strength.

## **2.11 LEAD FREE PRODUCTS:**

- A. For all products to be purchased whenever water is anticipated for human consumption, all pipes, pipe fittings, plumbing fittings and fixtures shall comply with the LEAD FREE REQUIREMENTS in PART 1 above.

## **PART 3 - EXECUTION**

### **3.1 PLUMBING DEMOLITION**

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
  1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### **3.2 SEISMIC REQUIREMENTS**

- A. Comply with SEI/ASCE 7 and with requirements for seismic seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

### **3.3 LEAD FREE REQUIREMENTS**

- A. Installations where water is anticipated for human consumption, all pipes, pipe fittings, plumbing fittings and fixtures shall be Lead Free as given in PART 1 above.

### **3.4 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
  - 2. Existing Piping: Use the following:
    - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.

- b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
  - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
  - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
  - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
  - f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
  - g. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
  - h. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.5 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. 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.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- J. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### **3.6 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.7 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.8 PAINTING**

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.9 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### **3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### **3.11 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### **3.12 GROUTING**

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**END OF SECTION 220500**





## **SECTION 220513**

### **COMMON MOTOR REQUIREMENTS FOR PLUMBING 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 requirements in this Section except when the requirements in plumbing equipment schedules, other specification sections, drawing notes or in other contract documents are more stringent.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

##### **2.2 MOTOR CHARACTERISTICS**

- A. Duty: Continuous duty at ambient temperature of 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. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F..
- J. 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.
- K. 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.

### **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.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- 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** (Not Applicable)

**END OF SECTION 220513**



## SECTION 220517

### SLEEVES AND SLEEVE SEALS FOR PLUMBING 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. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Grout.

##### 1.3 ACTION SUBMITTALS

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

#### PART 2 - PRODUCTS

##### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

##### 2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. CALPICO, Inc.
3. Link-Seal
4. Metraflex Company (The).
5. Pipeline Seal and Insulator, Inc.
6. Proco Products, Inc.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: **EPDM-rubber** interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: **Carbon steel**.
  3. Connecting Bolts and Nuts: **Carbon steel, with corrosion-resistant coating**, of length required to secure pressure plates to sealing elements.

### 2.3 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: **5000-psi, 28-day** compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide **1-inch** annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches** above finished floor level.
  3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than **NPS 6**: **Cast-iron wall sleeves** .
    - b. Piping **NPS 6** and Larger: **Cast-iron wall sleeves**.
  2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than **NPS 6**: **Cast-iron wall sleeves with sleeve-seal system** .
      - 1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping **NPS 6** and Larger: **Cast-iron wall sleeves with sleeve-seal system** .
      - 1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than **NPS 6**: **Cast-iron wall sleeves with sleeve-seal system**.
      - 1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping **NPS 6** and Larger: **Cast-iron wall sleeves with sleeve-seal system** .

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- 1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
  - a. Piping Smaller Than **NPS 6**: **Galvanized-steel-pipe sleeves** .
  - b. Piping **NPS 6** and Larger: **Galvanized-steel-pipe sleeves** .
5. Interior Partitions:
  - a. Piping Smaller Than **NPS 6**: **Galvanized-steel-pipe sleeves** .
  - b. Piping **NPS 6** and Larger: Galvanized-steel-sheet sleeves.

**END OF SECTION 220517**



## SECTION 220518

### ESCUTCHEONS FOR PLUMBING 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. Escutcheons.

##### 1.3 ACTION SUBMITTALS

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

#### PART 2 - PRODUCTS

##### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

#### PART 3 - EXECUTION

##### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to 2 inch, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:
  - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type with polished, chrome-plated finish.
  - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
  - c. Insulated Piping: One-piece, stamped-steel type with chrome-plated finish.
  - d. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - e. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
  - f. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - g. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
  - h. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
  - i. Bare Piping Larger than 2 inch in Unfinished Service Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
  - j. Bare Piping 2 inch and Smaller in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
  - k. Bare Piping in Equipment Rooms Larger than 2 inch: One-piece, stamped-steel type with chrome- or cadmium-plated finish.
  
2. Escutcheons for Existing Piping:
  - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
  - b. Insulated Piping: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed hinge.
  - c. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
  - d. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed.
  - e. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
  - f. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed.
  - g. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated or rough-brass finish.
  - h. Bare Piping Larger than 2 inch in Unfinished Service Spaces: Split-plate, stamped-steel type with polished, chrome-plated finish and concealed.
  - i. Bare Piping 2 inch and Smaller in Equipment Rooms: Split-casting brass type with polished, chrome-plated or rough-brass finish.
  - j. Bare Piping Larger than 2 inch in Equipment Rooms: Split-plate, stamped-steel type with chrome- or cadmium-plated finish and concealed.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION 220518**

## **SECTION 220523**

### **GENERAL-DUTY VALVES FOR PLUMBING PIPING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze swing check valves.
4. Iron swing check valves.
5. Iron swing check valves with closure control.
6. Bronze globe valves.
7. Iron globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

##### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of valve indicated.

##### **1.3 QUALITY ASSURANCE**

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

#### **PART 2 - PRODUCTS**

##### **2.1 GENERAL REQUIREMENTS FOR VALVES**

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- D. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
  - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
  
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 2. Butterfly Valves: With extended neck.
  
- F. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Solder Joint: With sockets according to ASME B16.18.
  - 3. Threaded: With threads according to ASME B1.20.1.

## **2.2 BRONZE BALL VALVES**

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.
    - b. Conbraco Industries, Inc.; Apollo Valves.
    - c. Crane Co.; Crane Valve Group; Crane Valves.
    - d. Hammond Valve.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.
    - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: 150 psig.
    - c. CWP Rating: 600 psig.
    - d. Body Design: Two piece.
    - e. Body Material: Bronze.
    - f. Ends: Threaded.
    - g. Seats: PTFE or TFE.
    - h. Stem: Bronze.
    - i. Ball: Chrome-plated brass.
    - j. Port: Full.

## **2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES**

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Flo Fab Inc.
  - f. Hammond Valve.
  - g. Kitz Corporation.
  - h. Milwaukee Valve Company.
  - i. NIBCO INC.
  - j. Spence Strainers International; a division of CIRCOR International, Inc.
  - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
  - b. American Valve, Inc.
  - c. Conbraco Industries, Inc.; Apollo Valves.
  - d. Crane Co.; Crane Valve Group; Center Line.
  - e. Crane Co.; Crane Valve Group; Stockham Division.
  - f. Flo Fab Inc.
  - g. Hammond Valve.
  - h. Kitz Corporation.
  - i. Milwaukee Valve Company.
  - j. Mueller Steam Specialty; a division of SPX Corporation.
  - k. NIBCO INC.
  - l. Spence Strainers International; a division of CIRCOR International, Inc.
  - m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated.

## **2.4 BRONZE SWING CHECK VALVES**

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.
    - b. Crane Co.; Crane Valve Group; Crane Valves.
    - c. Crane Co.; Crane Valve Group; Jenkins Valves.
    - d. Crane Co.; Crane Valve Group; Stockham Division.
    - e. Hammond Valve.
    - f. Kitz Corporation.
    - g. Milwaukee Valve Company.
    - h. NIBCO INC.
    - i. Red-White Valve Corporation.
    - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  2. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.
    - e. Ends: Threaded.
    - f. Disc: Bronze.
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Crane Co.; Crane Valve Group; Jenkins Valves.
    - c. Crane Co.; Crane Valve Group; Stockham Division.
    - d. Hammond Valve.
    - e. Kitz Corporation.
    - f. Milwaukee Valve Company.
    - g. NIBCO INC.
    - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  2. Description:
    - a. Standard: MSS SP-80, Type 4.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.
    - e. Ends: Threaded.
    - f. Disc: PTFE or TFE.

## **2.5 IRON SWING CHECK VALVES**

- A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  
2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Clear or full waterway.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following]
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  
2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Clear or full waterway.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Composition.
  - g. Seat Ring: Bronze.
  - h. Disc Holder: Bronze.
  - i. Disc: PTFE or TFE.
  - j. Gasket: Asbestos free.

## 2.6 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.
- h. Closure Control: Factory-installed, exterior lever and weight.

## 2.7 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

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

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Hammond Valve.
- d. Kitz Corporation.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Powell Valves.
- h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

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

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. NIBCO INC.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

## 2.8 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Powell Valves.
  - i.
  - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-85, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Packing and Gasket: Asbestos free.

## PART 3 - EXECUTION

### 3.1 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.
- 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 chainwheels on operators for butterfly and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
  1. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

### **3.2 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### **3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly valves.
  - 2. Throttling Service: Globe valves.
  - 3. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 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.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
  - 7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

### **3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE**

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Bronze Angle Valves: Class 125, bronze disc.
  - 3. Ball Valves: Two piece, full port, brass or bronze with brass trim.
  - 4. Bronze Swing Check Valves: Class 125, bronze disc.
  - 5. Bronze Globe Valves: Class 125, bronze nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  - 2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze seat disc.
  - 3. Iron Swing Check Valves: Class 125, metal seats.
  - 4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
  - 5. Iron Globe Valves: Class 125.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**END OF SECTION 220523**



## SECTION 220529

### 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. This Section includes the following hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Pipe positioning systems.
  - 8. Equipment supports.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
  - 3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
  - 4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

##### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

##### 1.4 SEISMIC REQUIREMENTS

- A. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- B. Refer to Section 220548 for all seismic issues.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Seismic:
  - 1. Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.
  - 2. Refer to Section 220548 for all seismic issues.

## 1.6 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Powder-actuated fastener systems.
  - 4. Pipe positioning systems.
  - 5. Mechanical Anchors: ICC-ES Evaluation Reports validating 'Cracked Concrete' testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems. Refer to Section 220548 for all seismic issues.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers. Include Product Data for components.
  - 2. Metal framing systems. Include Product Data for components.
  - 3. Pipe stands. Include Product Data for components.
  - 4. Equipment supports.
- C. Welding certificates.
- D. 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. Seismic calculations and detailed analysis: Indicate fabrication and arrangement. Refer to Section 220548 for all seismic issues.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

## **1.7 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.", AWS D1.4, "Structural Welding Code--Reinforcing Steel." and ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.2, "Structural Welding Code--Aluminum."
  - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  - 4. ASME Boiler and Pressure Vessel Code: Section IX.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.2 STEEL PIPE HANGERS AND SUPPORTS**

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
  - 1. Anvil International.
  - 2. AAA Technology & Specialties Co., Inc.
  - 3. Bergen-Power Pipe Supports.
  - 4. B-Line Systems, Inc.; a division of Cooper Industries.
  - 5. Carpenter & Paterson, Inc.
  - 6. Empire Industries, Inc.
  - 7. ERICO/Michigan Hanger Co.
  - 8. Globe Pipe Hanger Products, Inc.
  - 9. Grinnell Corp.
  - 10. GS Metals Corp.
  - 11. National Pipe Hanger Corporation.
  - 12. PHD Manufacturing, Inc.
  - 13. PHS Industries, Inc.
  - 14. Piping Technology & Products, Inc.
  - 15. Tolco Inc.
  - 16. Simpson Strong-Tie Co.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

### **2.3 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

### **2.4 METAL FRAMING SYSTEMS**

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

- B. Manufacturers:

1. Anvil International.
2. B-Line Systems, Inc.; a division of Cooper Industries.
3. ERICO/Michigan Hanger Co.; ERISTRUT Div.
4. GS Metals Corp.
5. Hilti, Inc.
6. Power-Strut Div.; Tyco International, Ltd.
7. Thomas & Betts Corporation.
8. Tolco Inc.
9. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

### **2.5 THERMAL-HANGER SHIELD INSERTS**

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

- B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.



- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 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.
  - 1. Manufacturers:
    - a. Hilti, Inc.
    - b. MKT Fastening, LLC.
    - c. Powers Fasteners.
    - d. Simpson Strong-Tie Co.
- B. Mechanical-Expansion Anchors and Concrete Screws: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Manufacturers with these anchors have been designated below with:
  - 1. Manufacturers:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head.
    - e. MKT Fastening, LLC.
    - f. Powers Fasteners.
    - g. Simpson Strong-Tie Co.
- C. For anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems, Anchors shall have been tested for 'Cracked Concrete' per A.C. 193 per a valid ICC-ES Evaluation Report. Refer to Section 220548 for all seismic issues.

## 2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  - 1. Manufacturers:
    - a. Anvil International.
    - b. ERICO/Michigan Hanger Co.
    - c. MIRO Industries.
    - d. Unipure
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Manufacturers:
  - a. MIRO Industries.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  1. Manufacturers:
    - a. Anvil International.
    - b. ERICO/Michigan Hanger Co.
    - c. MIRO Industries.
    - d. Portable Pipe Hangers.
  2. Base: Stainless steel.
  3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  1. Manufacturers:
    - a. Anvil International.
    - b. Portable Pipe Hangers.
  2. Bases: One or more plastic.
  3. Vertical Members: Two or more protective-coated-steel channels.
  4. Horizontal Member: Protective-coated-steel channel.
  5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

## **2.8 PIPE POSITIONING SYSTEMS**

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
  1. C & S Mfg. Corp.
  2. HOLDRITE Corp.; Hubbard Enterprises.
  3. Samco Stamping, Inc.

## **2.9 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## **2.10 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, 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 APPLICATIONS**

- A. Specific hanger and support requirements are specified 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 padded hangers for piping that is subject to scratching.
- 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 120 to 450 deg F pipes, NPS 4 to NPS 16, 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 24, 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 2.
  - 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  - 11. Extension Hinged or 2-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.
  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 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 2 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 20, 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 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, 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 or Simpson Blue Banger Concrete insert with UL & FM approvals): 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 absorb 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 absorb 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 absorb 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-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

### **3.2 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Steel 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 building structure.
- C. 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 above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. 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. Powder actuated fasteners shall not be used for seismic bracing attachments.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for 'Cracked Concrete' per A.C. 193 and shall have a valid ICC-ES Evaluation Report.
  - 3. Refer to Section 220548 for all seismic issues.
- G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. 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. Refer to Section 220548 for all seismic issues.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. 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.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
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 according to 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 inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.3 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 smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports. For applications where seismic bracing is required, 'Cracked Concrete' expansion anchors or concrete screws tested per A.C. 193 must be provided for seismic bracing anchorage where post-installed anchors are required. Refer to Section 220548 for all seismic issues.

### **3.4 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 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 contours of welded surfaces match adjacent contours.

### **3.5 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 .



### **3.6 PAINTING**

- A. Touch Up: 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. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 220529**



## SECTION 220533

### HEAT TRACING FOR PLUMBING 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. This Section includes plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:

- 1. Constant wattage.

##### 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
  - 1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

##### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## **1.5 WARRANTY**

- A. When warranties are required, verify with Owner's counsel that special warranties stated in this Article are not less than remedies available to Owner under prevailing local laws. Coordinate with Division 01 Section "Product Requirements."
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 CONSTANT-WATTAGE HEATING CABLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. BH Thermal Corporation.
  - 2. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
  - 3. Delta-Therm Corporation.
  - 4. Easy Heat Inc.
  - 5. Nelson Heat Trace.
  - 6. Pyrotenax; a division of Tyco Thermal Controls.
  - 7. Raychem; a division of Tyco Thermal Controls.
  - 8. Thermon Manufacturing Co.
  - 9. Trasor Corp.
- B. Heating Element: Pair of parallel No. 12 AWG, nickel-coated stranded copper bus wires with single-stranded resistor wire connected between bus wires. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight.
- C. Electrical Insulating Jacket: Flame-retardant fluoropolymer.
- D. Cable Cover: Stainless-steel braid, and polyolefin outer jacket with UV inhibitor.
- E. Maximum Operating Temperature (Power On): 392 deg F.
- F. Capacities and Characteristics:
  - 1. Maximum Heat Output: Provide capacities and characteristics as noted on the drawings.

### **2.2 CONTROLS**

- A. Pipe-Mounting Thermostats for Freeze Protection:
  - 1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
  - 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

## **2.3 ACCESSORIES**

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Division 22 Section "Identification for Plumbing Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
  1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
  2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
  1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
  2. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 APPLICATIONS**

- A. Install the following types of electric heating cable for the applications described:
  1. Snow and Ice Melting in Gutters and Downspouts: Constant-wattage heating cable.
  2. Freeze protection for roof drainage piping: Constant-wattage.

### **3.3 INSTALLATION**

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written recommendations using cable protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating Cable Installation for Snow and Ice Melting in Gutters and Downspouts: Install in gutters and downspouts with clips furnished by manufacturer that are compatible with gutters, and downspouts.
- C. Electric Heating Cable Installation for Freeze Protection for Piping:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Install electric heating cables after piping has been tested and before insulation is installed.
  2. Install electric heating cables according to IEEE 515.1.
  3. Install insulation over piping with electric cables according to Division 22 Section "Plumbing Insulation."
  4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- D. Set field-adjustable switches and circuit-breaker trip ranges.
- E. Protect installed heating cables, including nonheating leads, from damage.

### **3.4 CONNECTIONS**

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.5 FIELD QUALITY CONTROL**

- A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
1. Test cables for electrical continuity and insulation integrity before energizing.
  2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
- C. Remove and replace malfunctioning units and retest as specified above.

**END OF SECTION 220533**

**SECTION 220548**

**VIBRATION AND SEISMIC CONTROLS 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. This Section includes the following restraints and vibration isolation as defined in Section 230548 "Vibration Isolation and Seismic Controls for HVAC" for the following:
  - 1. Plumbing Piping.
  - 2. Plumbing Equipment.

**PART 2 - PRODUCTS**

2.1 (NOT USED)

**PART 3 - EXECUTION**

3.1 (NOT USED)

**END OF SECTION 220548**





## **SECTION 220553**

### **IDENTIFICATION 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. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Stencils.
  - 5. Valve tags.
  - 6. Warning tags.

##### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- 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.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

##### **1.4 COORDINATION**

- 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.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT LABELS**

#### **A. Plastic Labels for Equipment:**

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. 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-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. 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), plus the Specification Section number and title where equipment is specified.

#### **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), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

### **2.2 WARNING SIGNS AND LABELS**

#### **A. Material and Thickness:** Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

#### **B. Letter Color:** Black.

#### **C. Background Color:** Yellow.

#### **D. Maximum Temperature:** Able to withstand temperatures up to 160 deg F.

#### **E. Minimum Label Size:** Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

#### **F. 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-fourths the size of principal lettering.

#### **G. Fasteners:** Stainless-steel rivets or self-tapping screws.

#### **H. Adhesive:** Contact-type permanent adhesive, compatible with label and with substrate.

- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## **2.3 PIPE LABELS**

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: At least 1-1/2 inches high.

## **2.4 STENCILS**

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  1. Stencil Material: Fiberboard or metal.
  2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
  3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

## **2.5 VALVE TAGS**

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  1. Valve-tag schedule shall be included in operation and maintenance data.

## **2.6 WARNING TAGS**

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Yellow background with black lettering.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.2 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.3 PIPE LABEL INSTALLATION**

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Low-Pressure, Compressed-Air Piping:
  - a. Background Color: Comply with ASME A13.1.
  - b. Letter Color: Comply with ASME A13.1.
2. Medium-Pressure, Compressed-Air Piping:
  - a. Background Color: Comply with ASME A13.1.
  - b. Letter Color: Comply with ASME A13.1.
3. Domestic Water Piping:
  - a. Background Color: Comply with ASME A13.1.
  - b. Letter Color: Comply with ASME A13.1.
4. Sanitary Waste and Storm Drainage Piping:
  - a. Background Color: Comply with ASME A13.1.
  - b. Letter Color: Comply with ASME A13.1.

**3.4 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  1. Valve-Tag Size and Shape:
    - a. Cold Water: 1-1/2 inches, round.
    - b. Hot Water: 1-1/2 inches, round.
    - c. Low-Pressure Compressed Air: 1-1/2 inches, round.
    - d. High-Pressure Compressed Air: 1-1/2 inches, round.
  2. Valve-Tag Color:
    - a. Cold Water: Comply with ASME A13.1.
    - b. Hot Water: Comply with ASME A13.1.
    - c. Low-Pressure Compressed Air: Comply with ASME A13.1.
    - d. High-Pressure Compressed Air: Comply with ASME A13.1.
  3. Letter Color:
    - a. Cold Water: Comply with ASME A13.1.
    - b. Hot Water: Comply with ASME A13.1.
    - c. Low-Pressure Compressed Air: Comply with ASME A13.1.
    - d. High-Pressure Compressed Air: Comply with ASME A13.1.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**3.5 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 220553**

**SECTION 220700**

**PLUMBING 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:
  - 1. Insulation Materials:
    - a. Flexible elastomeric.
    - b. Mineral fiber.
  - 2. Adhesives.
  - 3. Lagging adhesives.
  - 4. Sealants.
  - 5. Factory-applied jackets.
  - 6. Field-applied fabric-reinforcing mesh.
  - 7. Field-applied jackets.
  - 8. Tapes.
  - 9. Securements.
  - 10. Corner angles.
- B. Related Sections include the following:
  - 1. Division 23 Section "HVAC Insulation."

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.

- C. Qualification Data: For qualified Installer.
- D. 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.
- E. Field quality-control reports.

#### **1.4 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. 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.

#### **1.5 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.

#### **1.6 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.
- C. Coordinate installation and testing of heat tracing.

#### **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 INSULATION MATERIALS**

- A. Comply with requirements in Part 3 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: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- 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.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.
- I. Mineral-Fiber, Preformed Pipe Insulation:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000(Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.
  2. 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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.
    - c. Knauf Insulation; Pipe and Tank Insulation.
    - d. Manson Insulation Inc.; AK Flex.
    - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

## 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.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; AeroSeal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-82.
  - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
  - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
  - d. Marathon Industries, Inc.; 225.
  - e. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Dow Chemical Company (The); 739, Dow Silicone.
  - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
  - c. P.I.C. Plastics, Inc.; Welding Adhesive.
  - d. Red Devil, Inc.; Celulon Ultra Clear.
  - e. Speedline Corporation; Speedline Vinyl Adhesive.

### **2.3 MASTICS**

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-35.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
  - c. ITW TACC, Division of Illinois Tool Works; CB-50.
  - d. Marathon Industries, Inc.; 590.
  - e. Mon-Eco Industries, Inc.; 55-40.
  - f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, 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, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; Encacel.
  - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
  - c. Marathon Industries, Inc.; 570.
  - d. Mon-Eco Industries, Inc.; 55-70.
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 LAGGING ADHESIVES**

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-52.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
    - c. Marathon Industries, Inc.; 130.
    - d. Mon-Eco Industries, Inc.; 11-30.
    - e. Vimasco Corporation; 136.
  - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
  - 3. Service Temperature Range: Minus 50 to plus 180 deg F.
  - 4. Color: White.

## **2.5 SEALANTS**

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-76-8.
    - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
    - c. Marathon Industries, Inc.; 405.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Vimasco Corporation; 750.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 5. Color: Aluminum.
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-76.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 5. Color: White.

## **2.6 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. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

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.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
  - a. Products: Subject to compliance with requirements, provide the following:
    - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
  - a. Products: Subject to compliance with requirements, provide the following:
    - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
  - a. Products: Subject to compliance with requirements, provide the following:
    - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

## 2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; Metal Jacketing Systems.
  - b. PABCO Metals Corporation; Surefit.
  - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - e. 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.

## 2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 4 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

6. Tensile Strength: 55 lbf/inch in width.

## 2.9 SECUREMENTS

### A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products; Bands.
  - b. PABCO Metals Corporation; Bands.
  - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.
    - 4) Nelson Stud Welding; CHP.
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. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
    - 2) GEMCO; Press and Peel.
    - 3) Midwest Fasteners, Inc.; Self Stick.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Aluminum or Stainless steel], fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum or stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. C & F Wire.
  - b. Childers Products.
  - c. PABCO Metals Corporation.
  - d. RPR Products, Inc.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment 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.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

#### **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 equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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 as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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. Manholes.
  - 5. Handholes.

6. 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 Division 07 Section "Penetration Firestopping" 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 Division 07 Section "Penetration Firestopping."

### **3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION**

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
  1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
  - a. Do not weld anchor pins to ASME-labeled pressure vessels.
  - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
  - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
  - d. Do not overcompress insulation during installation.
  - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
  - f. Impale insulation over anchor pins and attach speed washers.
  - g. 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.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum or stainless steel, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.6 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, vessels, and equipment. 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.

### **3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION**

- 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.

### **3.8 MINERAL-FIBER INSULATION INSTALLATION**

- 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 but 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.

### 3.9 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.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.



- C. 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.
  
- D. Where PVDC jackets are indicated, install as follows:
  - 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
  - 2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presize jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
  - 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
  - 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
  - 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### **3.10 FINISHES**

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  - 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 EQUIPMENT INSULATION SCHEDULE**

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
  
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
  
- C. Steam-to-hot-water converter insulation shall be one of the following:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
2. Mineral-Fiber Pipe and Tank: 2 inches thick.

D. Domestic water pump insulation shall be the following:

1. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.

E. Domestic hot-water pump insulation shall be the following:

1. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.

F. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:

1. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.
2. Mineral-Fiber Pipe and Tank: 1 inch thick.

### **3.12 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.

### **3.13 INDOOR PIPING INSULATION SCHEDULE**

A. Domestic Cold Water:

1. NPS 1-1/2 and Smaller: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch
2. NPS 2 and Larger: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/2 and Smaller: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.
2. NPS 2 and Larger: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

C. Domestic Chilled Water (Potable):

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. All Pipe Sizes: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.

D. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.

E. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.

F. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.

**3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE**

A. Storm Water and Overflow Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

**3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. None.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches.

1. Aluminum, Stucco Embossed: 0.016 inch thick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. Aluminum, Stucco Embossed with 1-1/4-Inch- Deep Corrugations: 0.032 inch thick.

F. Piping, Concealed:

1. None.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

G. Piping, Exposed:

1. PVC: 20 mils thick.

### **3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC: 20 mils thick.

**END OF SECTION 220700**

**SECTION 220719**

**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. Domestic recirculating hot-water piping.
  - 4. Roof drains and rainwater leaders.
  - 5. Supplies and drains for handicap-accessible lavatories and sinks.

**1.3 DEFINITIONS:**

- A. Refer to Section 220500 "Common Work Results for Plumbing".

**1.4 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 attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

**1.5 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.

## **1.6 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 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.

## **1.7 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.

## **1.8 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- 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.
- C. Coordinate installation and testing of heat tracing.

## **1.9 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," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Insulation for below-ambient service requires a vapor-barrier.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. 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.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- H. 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.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- I. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000-Degree Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket with factory-

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- J. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Ramco Insulation, Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

## 2.3 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. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aero seal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 2. 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).



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.
  - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 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. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  - 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.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
  - b. Eagle Bridges - Marathon Industries; 501.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
  - d. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F .
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
  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.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Eagle Bridges - Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. Vimasco Corporation; WC-1/WC-5.
  2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F .
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.

## **2.5 SEALANTS**

- A. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F .
5. Color: White.
6. 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).

## **2.6 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## **2.7 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: Color-code jackets based on system. Color as selected by Architect.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

## **2.8 TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fason 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches .
  3. Thickness: 11.5 mils .
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 370 White PVC tape.
  - b. Compac Corporation; 130.
  - c. Venture Tape; 1506 CW NS.
2. Width: 2 inches .
3. Thickness: 6 mils .
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

## 2.9 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

## 2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
  - a. Engineered Brass Company.
  - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
  - c. McGuire Manufacturing.
  - d. Plumberex.
  - e. Truebro; a brand of IPS Corporation.
  - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. 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.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
  - a. Truebro; a brand of IPS Corporation.
  - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
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.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F . Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

#### **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 2 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, 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 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. Domestic Cold Water:

1. NPS 1-1/2 and Smaller: Insulation shall be one of the following;
  - a. Flexible Elastomeric: 1 inch thick .
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick .

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. NPS 2 and Larger: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1-1/2 inches thick. .
  - b. Mineral-Fiber, Preformed Pipe Insulation, 1-1/2 inches thick. .
  
- B. Domestic Hot and Recirculated Hot Water:
  1. NPS 1-1/2 and Smaller: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1" thick. .
  2. NPS 2 and Larger: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick .
  
- C. Stormwater and Overflow:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  
- D. Roof Drain and Overflow Drain Bodies:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Blanket Insulation, Type I: 1 inch thick.
    - c. Drain Manufacturer's Pre-formed bowl Insulation: 1 inch thick.
  
- E. Sanitary Waste Piping Where Heat Tracing Is Installed:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
  
- F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F :
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3/4 inch thick.
  
- G. Hot Service Drains:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
  
- H. Hot Service Vents:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

**3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE**

- A. Domestic Water Piping:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- C. Sanitary Waste Piping Where Heat Tracing Is Installed:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- D. Hot Service Drains:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- E. Hot Service Vents:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type II: 1 inch thick.

**3.11 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE**

- A. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

**3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  - 1. None.
  - 2. PVC: 20 mils thick.
- D. Piping, Exposed:
  - 1. PVC, Color-Coded by System: 30 mils thick. .

**3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  - 1. None.
- D. Piping, Exposed:
  - 1. Aluminum, Stucco Embossed: 0.016 inch thick.

**3.14 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET**

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

**END OF SECTION 220719**



## **SECTION 221116**

### **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.
- B. Related Requirements:
  - 1. Division 22 Section "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

##### **1.3 SEISMIC REQUIREMENTS**

- A. Seismic Performance: Pipe hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration And Seismic Control For Plumbing Piping And Equipment."

##### **1.4 ACTION SUBMITTALS**

- A. Product Data: For transition fittings and dielectric fittings.
- 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. Seismic calculations: Refer to Section 220548 for all seismic issues.

##### **1.5 INFORMATIONAL SUBMITTALS**

- A. System purging and disinfecting activities report.

- B. Field quality-control reports.

## **1.6 FIELD CONDITIONS**

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Construction Manager or owner no fewer than two days in advance of proposed interruption of water service.
  - 2. Do not interrupt water service without Construction Manager's written permission.

## **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. Plastic piping components shall be marked with "NSF-pw."
- C. All piping shall be American made and tested; no import pipe will be permitted.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. All piping installed in or passing through a plenum must be plenum rated, fire wrapped, or installed in a metal conduit.

### **2.2 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tube: ASTM B 88, Type K water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Elkhart Products Corporation.
  - b. NIBCO Inc.
  - c. Viega.
2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

### **2.3 DUCTILE-IRON PIPE AND FITTINGS**

- A. Mechanical-Joint, Ductile-Iron Pipe:
  1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
  1. AWWA C110/A21.10, ductile or gray iron.
  2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
  1. AWWA C153/A21.53, ductile iron.
  2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

### **2.4 CPVC PIPING**

- A. CPVC Pipe: ASTM F 441, Schedule 80.
  1. CPVC Socket Fittings: ASTM F 439 for Schedule 80.
  2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
- B. CPVC Piping System: ASTM D 2846, SDR 11, pipe and socket fittings.
- C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

### **2.5 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.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

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, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
  - F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
    1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    3. Solvent cement and 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. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.6 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.
- C. Sleeve-Type Transition Coupling: AWWA C219.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cascade Waterworks Manufacturing.
    - b. Dresser, Inc.; Piping Specialties Products.
    - c. Ford Meter Box Company, Inc. (The).
    - d. JCM Industries.
    - e. Romac Industries, Inc.
    - f. Smith-Blair, Inc.; a Sensus company.
    - g. Viking Johnson.
- D. Plastic-to-Metal Transition Fittings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Charlotte Pipe and Foundry Company.
    - b. Harvel Plastics, Inc.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- c. Spears Manufacturing Company.
- 2. Description:
  - a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
  - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Colonial Engineering, Inc.
    - b. NIBCO Inc.
    - c. Spears Manufacturing Company.
  - 2. Description:
    - a. CPVC four-part union.
    - b. Brass threaded end.
    - c. Solvent-cement-joint plastic end.
    - d. Rubber O-ring.
    - e. Union nut.

## 2.7 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 Nipples and Waterways:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elster Perfection Corporation.
    - b. Grinnell Mechanical Products; Tyco Fire Products LP.
    - c. Matco-Norca.
    - d. Clearflow/Perfection Corp.
    - e. Precision Plumbing Products, Inc.
    - f. Victaulic Company.
  - 2. Standard: IAPMO PS 66 or ASTM F-1545-97.
  - 3. Electroplated steel nipple or waterway complying with ASTM F 1545 or ANSI/NSF-61 Compliant.
  - 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
  - 5. End Connections: Male threaded or grooved.
  - 6. Lining: Inert and noncorrosive, propylene or LTHS.

### **PART 3 - EXECUTION**

#### **3.1 EARTHWORK**

- A. Comply with requirements in Division 31 Section "Earth Moving" 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. Polypropylene pipe in or passing through plenums must be fire wrapped or installed in a metal conduit.
- C. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- D. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- E. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- F. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Division 22 Section "Domestic Water Piping Specialties."
- G. Install shutoff valve immediately upstream of each dielectric fitting.
- H. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Division 22 Section "Domestic Water Piping Specialties."
- I. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
  - 1. Piping will be drained seasonally for freeze protection.
- J. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- K. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- L. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- M. 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.

- N. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- O. Install piping to permit valve servicing.
- P. 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.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping."
- U. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Division 22 Section "Domestic Water Pumps."
- V. Install thermometers on inlet piping from each water heater. Comply with requirements for thermometers in Division 22 Section "Meters and Gages for Plumbing Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

### **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. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.

- E. 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."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- H. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. 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.
- I. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. 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.
- J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- K. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. CPVC Piping: Join according to ASTM D 2846 Appendix.
- L. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### **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 fittings.

### **3.5 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/waterways..
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples/waterways..

- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric nipples/waterways.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
  - 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.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. 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.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
  - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  - 3. NPS 2: 10 feet with 3/8-inch rod.
  - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
  - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
  - 7. NPS 6: 12 feet with 3/4-inch rod.
  - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
5. NPS 6: 48 inches with 3/4-inch rod.
6. NPS 8: 48 inches with 7/8-inch rod.

- J. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- K. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- L. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### **3.7 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. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in Division 22 plumbing fixture Sections.
  4. 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.

### **3.8 IDENTIFICATION**

- A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### **3.9 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.

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
  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.

### **3.11 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 chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-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 procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### **3.12 PIPING SCHEDULE**

- A. Some piping types and sizes mentioned in this section may not be used on this project.
- B. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

- C. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
  - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- F. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
  - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
  - 2. Mechanical-joint, ductile-iron pipe; standard-, mechanical-joint fittings; and mechanical joints.
- G. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be the following:
  - 1. Mechanical-joint, ductile-iron pipe; standard-, mechanical-joint fittings; and mechanical joints.
- H. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
  - 1. Hard or soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- I. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- copper, solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  - 3. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.
  - 4. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
  - 5. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.[ NPS 1-1/2 and NPS 2 CPVC pipe with CPVC socket fittings may be used instead of tubing.]
- J. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- copper, solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  - 3. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.
  - 4. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
- K. Aboveground domestic water piping, NPS 5 and larger, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- copper, solder-joint fittings; and soldered joints.
  - 2. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.

### **3.13 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 for piping NPS 3 and smaller. Use butterfly, with flanged ends for piping NPS 4 and larger.
  2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
  4. 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 221116**

**SECTION 221119**

**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. This Section includes the following domestic water piping specialties:
1. Vacuum breakers.
  2. Backflow preventers.
  3. Water pressure-reducing valves.
  4. Balancing valves.
  5. Temperature-actuated water mixing valves.
  6. Strainers.
  7. Outlet boxes.
  8. Hose bibbs.
  9. Wall hydrants.
  10. Drain valves.
  11. Water hammer arresters.
- B. Related Sections include the following:
1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties 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. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

## **PART 2 - PRODUCTS**

### **2.1 VACUUM BREAKERS**

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ames Co.
    - b. Cash Acme.
    - c. Conbraco Industries, Inc.
    - d. FEBCO; SPX Valves & Controls.
    - e. Rain Bird Corporation.
    - f. Toro Company (The); Irrigation Div.
    - g. Watts Industries, Inc.; Water Products Div.
    - h. Zurn Plumbing Products Group; Wilkins Div.
  - 2. Standard: ASSE 1001.
  - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
  - 4. Body: Bronze.
  - 5. Inlet and Outlet Connections: Threaded.
  - 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Arrowhead Brass Products, Inc.
    - b. Cash Acme.
    - c. Conbraco Industries, Inc.
    - d. Legend Valve.
    - e. MIFAB, Inc.
    - f. Prier Products, Inc.
    - g. Watts Industries, Inc.; Water Products Div.
    - h. Woodford Manufacturing Company.
    - i. Zurn Plumbing Products Group; Light Commercial Operation.
    - j. Zurn Plumbing Products Group; Wilkins Div.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Toro Company (The); Irrigation Div.
  - f. Watts Industries, Inc.; Water Products Div.
  - g. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.
  - b. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

## 2.2 BACKFLOW PREVENTERS

A. Double-Check Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Industries, Inc.; Water Products Div.
  - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; [flanged] <Insert type> for NPS 2-1/2 and larger.
7. Accessories:
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

**B. Dual-Check-Valve Backflow Preventers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Ford Meter Box Company, Inc. (The).
  - f. Honeywell Water Controls.
  - g. Legend Valve.
  - h. McDonald, A. Y. Mfg. Co.
  - i. Mueller Co.; Water Products Div.
  - j. Watts Industries, Inc.; Water Products Div.
  - k. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Body: Bronze with union inlet.

**C. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Lancer Corporation.
  - c. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

## **2.3 WATER PRESSURE-REDUCING VALVES**

**A. Water Regulators: (Direct Type)**

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



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Honeywell Water Controls.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
  3. Pressure Rating: Initial working pressure of 150 psig.
  4. Body: Bronze, provide chrome-plated finish if connected to chrome plated or stainless steel piping for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
  5. Valves for Booster Heater Water Supply: Include integral bypass.
  6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

## 2.4 BALANCING VALVES

### A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Flo Fab Inc.
  - c. ITT Industries; Bell & Gossett Div.
  - d. NIBCO INC.
  - e. TAC Americas.
  - f. Taco, Inc.
  - g. Victaulic
  - h. Watts Industries, Inc.; Water Products Div.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: bronze,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

### B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Flo Fab Inc.
  - c. ITT Industries; Bell & Gossett Div.
  - d. NIBCO INC.
  - e. TAC Americas.
  - f. Watts Industries, Inc.; Water Products Div.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

### C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

## **2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES**

### **A. Individual-Fixture, Thermostatic Mixing Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Honeywell Water Controls.
  - d. Lawler Manufacturing Company, Inc.
  - e. Leonard Valve Company.
  - f. Powers; a Watts Industries Co.
  - g. Watts Industries, Inc.; Water Products Div.
  - h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

## **2.6 STRAINERS FOR DOMESTIC WATER PIPING**

### **A. Y-Pattern Strainers:**

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.020 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
  - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Factory-installed, hose-end drain valve.

## **2.7 OUTLET BOXES**

### **A. Icemaker Outlet Boxes ICE-1:**

1. Basis of Design: Guy Gray model FR1212SHACP fire rated washing machine box with one ¼ turn valve with water hammer arrestor and 1-1/2" drain connection.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company.
  - b. Guy Gray Manufacturing Co., Inc.
  - c. IPS Corporation.
  - d. LSP Products Group, Inc.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- e. Oatey.
  - f. Plastic Oddities; a division of Diverse Corporate Technologies.
  - g. Symmons Industries, Inc.
  - h. Watts Industries, Inc.; Water Products Div.
  - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
  - j. Zurn Plumbing Products Group; Light Commercial Operation.
3. Mounting: Recessed.
  4. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic box and faceplate.
  5. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
  6. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
  7. Drain: [NPS 1-1/2] [NPS 2] standpipe and P-trap for direct waste connection to drainage piping.
  8. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
  9. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

## 2.8 HOSE BIBBS

### A. Hose Bibbs HB-1:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.9 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants NFH-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Woodford Manufacturing Company.
  - h. Zurn Plumbing Products Group; Light Commercial Operation.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
  3. Pressure Rating: 125 psig.
  4. Operation: Loose key.
  5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  6. Inlet: NPS 3/4 or NPS 1.
  7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  8. Box: Deep, flush mounting with cover.
  9. Box and Cover Finish: Polished nickel bronze.
  10. Operating Keys: Two with each wall hydrant.

## **2.10 DRAIN VALVES**

### **A. Ball-Valve-Type, Hose-End Drain Valves:**

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## **2.11 WATER HAMMER ARRESTERS**

### **A. Water Hammer Arresters:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. PPP Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products Inc.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install thermometers and water regulators if specified.
  - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- H. Install water hammer arresters in water piping according to PDI-WH 201.

#### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

#### **3.3 LABELING AND IDENTIFYING**

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Double-check backflow-prevention assemblies.
  - 3. Carbonated-beverage-machine backflow preventers.
  - 4. Dual-check-valve backflow preventers.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

5. Water pressure-reducing valves.
6. Calibrated balancing valves.
7. Individual, thermostatic, water mixing valves.
8. Outlet boxes.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and prepare test reports:
  1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

### **3.5 ADJUSTING**

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

**END OF SECTION 221119**

## **SECTION 221123**

### **DOMESTIC WATER PUMPS**

#### **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 all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation:
  - 1. Separately-coupled, horizontally mounted, in-line centrifugal pumps.

##### **1.3 SEISMIC REQUIREMENTS**

- A. Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.

##### **1.4 SUBMITTALS**

- A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

##### **1.5 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

**1.7 COORDINATION**

- A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

**2.2 SEPARATELY COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS**

- A. Manufacturers:
  - 1. Armstrong.
  - 2. Aurora Pump; Pentair Pump Group (The).
  - 3. Bell & Gossett Domestic Pump; ITT Industries.
  - 4. Grundfos Pumps Corp.
  - 5. Taco, Inc.
  - 6. Thrush Company, Inc.
  - 7. Weinman Div.; Crane Pumps & Systems.
- B. Description: Factory-assembled and -tested, overhung-impeller, single-stage, separately coupled, horizontally mounted, in-line centrifugal pumps as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.
  - 1. Pump Construction: All bronze.
    - a. Casing: Radially split, cast iron, with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
    - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
    - c. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
    - d. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
    - e. Bearings: Oil-lubricated; bronze-journal or ball type.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
3. Motor: Single speed, with grease-lubricated ball bearings; and resiliently mounted to pump casing. Comply with requirements in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

## **2.3 FLEXIBLE CONNECTORS**

### **A. Manufacturers:**

1. Anamet, Inc.
2. Flex-Hose Co., Inc.
3. Flexicraft Industries.
4. Flex-Pression, Ltd.
5. Flex-Weld, Inc.
6. Fugate
7. Hyspan Precision Products, Inc.
8. Mercer Rubber.
9. Metraflex, Inc.
10. Proco Products, Inc.
11. Tozen America Corporation.
12. Twin City Hose.
13. Unaflex Inc.

- ### **B. Description:** Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze-welded to tubing. Include 125-psig minimum working-pressure rating and ends matching pump connections.

## **2.4 BUILDING-AUTOMATION-SYSTEM INTERFACE**

- ### **A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:**
1. On-off status of each pump.
  2. Alarm status.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- ### **A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.**

### **3.2 PUMP INSTALLATION**

- ### **A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."**
- ### **B. Comply with HI 1.4.**

- C. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- D. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- E. Install separately coupled, horizontally mounted, in-line centrifugal pumps with motor and pump shafts horizontal.
- F. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."
  - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
    - a. Separately coupled, horizontally mounted, in-line centrifugal pumps.
  - 2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
  - 3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and gage connectors.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- F. Interlock pump with water heater burner and time delay relay.

### **3.4 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:
  - a. Verify bearing lubrication.
  - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
  - c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.
8. Adjust temperature settings on thermostats.
9. Adjust timer settings.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain pumps. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION 221123**



**SECTION 221223**

**FACILITY INDOOR POTABLE-WATER STORAGE TANKS**

**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. Steel, precharged, potable-water storage tanks.

**1.3 SEISMIC REQUIREMENTS**

- A. Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water storage tanks.
  - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Manufacturer Seismic Qualification Certification: Submit certification that commercial water heaters, accessories, and components will withstand seismic forces defined in Division 22 Section "Mechanical Vibration and Seismic Controls." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
    - b. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- B. Product Certificates: For each type of potable-water storage tank, from manufacturer.
- C. Source quality-control reports.
- D. Purging and disinfecting reports.

## **1.6 QUALITY ASSURANCE**

- A. ASME Compliance for Steel Tanks: Fabricate and label steel, ASME-code, potable-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
- B. ASME Compliance for FRP Tanks: Fabricate and label FRP, ASME-code, potable-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, "Fiber-Reinforced Plastic Pressure Vessels."
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic potable-water storage tanks and components. Include appropriate NSF marking.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects," for potable-water storage tanks. Include appropriate NSF marking.

## **1.7 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## **PART 2 - PRODUCTS**

### **2.1 STEEL, PRECHARGED, POTABLE-WATER STORAGE TANKS**

- A. Steel, Precharged, Diaphragm, Water Storage Tanks:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AMTROL, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Flo Fab inc.
    - d. State Industries, Inc.
    - e. Taco, Inc.
    - f. Wessels Company.
  2. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with air-charging valve and air precharge.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
  4. Operation: Factory-installed, butyl-rubber diaphragm.
- B. Steel, Precharged, Bladder, Water Storage Tanks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong Pumps, Inc.
    - b. Flo Fab inc.
    - c. Taco, Inc.
    - d. Wessels Company.
    - e. Wood, John Co.
  2. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with air-charging valve and air precharge.
  3. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
  4. Operation: Factory-installed, butyl-rubber bladder.
- C. Construction: ASME code, steel, constructed with nontoxic welded joints, for 150-psig working pressure.
- D. Tappings: Factory-fabricated stainless steel, welded to tank before testing and labeling.
1. NPS 2 and Smaller: ASME B1.20.1, with female thread.
  2. NPS 2-1/2 and Larger: ASME B16.5, flanged.
- E. Specialties and Accessories: Include tappings in tank and the following:
1. Pressure gage.
- F. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank before testing and labeling.
- G. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
1. Lining Material: Cement.
  2. Coating: Glass.
- H. Exterior Coating: Manufacturer's standard enamel paint.
- I. Insulation: Factory-installed fiberglass or polyurethane foam; surrounding entire tank except connections and other openings; suitable for tank operating temperature; and complying with ASHRAE/IESNA 90.1.
- J. Jacket: Steel, with manufacturer's standard finish unless otherwise indicated.

## **2.2 SOURCE QUALITY CONTROL**

- A. Test and inspect potable-water storage tanks according to the following tests and inspections and prepare test reports:
  - 1. Pressure Testing for ASME-Code, Potable-Water Storage Tanks: Hydrostatically test to ensure structural integrity and freedom from leaks. Fill tanks with water, vent air, pressurize to 1-1/2 times tank pressure rating, disconnect test equipment, hold pressure for 30 minutes with no drop in pressure, and check for leaks.
- B. Repair or replace tanks that fail test with new tanks, and repeat until test is satisfactory.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Install water storage tanks on concrete bases, level and plumb, firmly anchored. Arrange so devices needing servicing are accessible.
  - 1. Install horizontal tanks on fabricated steel supports and saddles.
- C. Anchor tank supports and tanks to substrate.
  - 1. Use steel or FRP straps over or around plastic tanks.
- D. Install tank seismic restraints.
- E. Install thermometers and pressure gages on water storage tanks and piping if indicated. Thermometers and pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- F. Install the following devices on tanks where indicated:
  - 1. Pressure relief valves.
  - 2. Temperature and pressure relief valves.
  - 3. Vacuum relief valves.
  - 4. Tank vents on nonpressure tanks.
  - 5. Connections to accessories.
- G. After installing tanks with factory finish, inspect finishes and repair damages to finishes.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to potable-water storage tanks to allow service and maintenance.



- C. Connect water piping to water storage tanks with unions or flanges and with shutoff valves. Connect tank drains with shutoff valves and discharge over closest floor drains.
  - 1. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
    - a. Valves NPS 2 and Smaller: Gate or ball.
    - b. Valves NPS 2-1/2 and Larger: Gate or butterfly.
    - c. Drain Valves: NPS 3/4 gate or ball valve. Include outlet with, or nipple in outlet with, ASME B1.20.7, 3/4-11.5NH thread for garden-hose service, threaded cap, and chain.
  - 2. Water Piping Connections: Make connections to dissimilar metals with dielectric fittings. Dielectric fittings are specified in Division 22 Section "Domestic Water Piping."
  - 3. Connect air piping to hydropneumatic tanks with unions or flanges and gate or ball valves. Make connections to dissimilar metals with dielectric fittings, which are specified in Division 22 Section "General-Service Compressed-Air Piping."

### **3.3 IDENTIFICATION**

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following final checks before filling:
  - 1. Verify that air precharge in precharged tanks is correct.
  - 2. Test operation of tank accessories and devices.
  - 3. Verify that pressure relief valves have correct setting.
    - a. Manually operate pressure relief valves.
    - b. Adjust pressure settings.
  - 4. Verify that vacuum relief valves are correct size.
    - a. Manually operate vacuum relief valves.
    - b. Adjust vacuum settings.
- B. Filling Procedures: Follow manufacturer's written procedures. Fill tanks with water to operating level.

### **3.5 CLEANING**

- A. Clean and disinfect potable-water storage tanks.
- B. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, use procedure described in AWWA C652 or as described below:
  - 1. Purge water storage tanks with potable water.
  - 2. Disinfect tanks by one of the following methods:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- a. Fill tanks with water-chlorine solution containing at least 50 ppm of chlorine. Isolate tanks and allow to stand for 24 hours.
  - b. Fill tanks with water-chlorine solution containing at least 200 ppm of chlorine. Isolate tanks and allow to stand for three hours.
3. Flush tanks, after required standing time, with clean, potable water until chlorine is not present in water coming from tank.
  4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination made by authorities having jurisdiction shows evidence of contamination.
- C. Prepare written reports for purging and disinfecting activities.

**END OF SECTION 221223**

## **SECTION 221316**

### **SANITARY 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. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.

##### **1.3 SEISMIC REQUIREMENTS**

- 1. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- 2. Refer to Section 220548 for all seismic issues.

##### **1.4 DEFINITIONS**

- A. PVC: Polyvinyl chloride plastic.

##### **1.5 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.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for HVAC."

##### **1.6 ACTION SUBMITTALS**

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

## **1.7 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.

## **1.8 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-sewer" for plastic sewer piping; "NSF-drain" for plastic drain piping, and "NSF-tubular" for plastic continuous waste piping.

## **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.

### **2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: All cast-iron waste, vent and sewer pipe and fittings shall conform to the requirements of CISPI Standard 301 and ASTM A 888. All products shall be marked with the collective trademark of the Cast Soil Pipe Institute and shall be listed by NSF International or receive prior approval of the engineer. All cast-iron pipe and fittings shall be American made and tested. Non-compliant import cast-iron products will not be permitted. Any non-compliant cast-iron product installed by the contractor on this project will be replaced at the contractor's expense and shall include all repairs, patching, painting and other incidental work required to return the project to its pre-remediation state.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AB&I Foundry
    - b. Charlotte Pipe
    - c. Tyler Pipe
- B. CISPI, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- a. ANACO.
  - b. Ideal
  - c. Mission Rubber Company; a division of MCP Industries, Inc.
  - d. Tyler Pipe.
2. Standards: ASTM C 1277 and CISPI 310.
  3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
  4. Listing: Couplings shall be listed by NSF International. Each coupling shall be embossed with the NSF seal.

## **2.3 PVC PIPE AND FITTINGS**

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
  1. Adhesive primer shall have a VOC content of 550 g/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."
- E. 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."

## **PART 3 - EXECUTION**

### **3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

### **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 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. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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. 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. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping..
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- O. Install aboveground PVC piping according to ASTM D 2665.
- P. Install underground and PVC piping according to ASTM D 2321.
- Q. Install engineered soil and waste drainage and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

- R. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
  - 3. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

### **3.3 JOINT CONSTRUCTION**

- A. 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.
- B. 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 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports 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 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.
- 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  - 2. NPS 3: 48 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- I. Install supports for vertical PVC piping every 48 inches.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### **3.5 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 drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage 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 drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  5. Comply with requirements for cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
  6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make fixture and equipment connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### **3.6 IDENTIFICATION**

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### **3.7 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 drainage 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. 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. 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. 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. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. 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.

### **3.8 CLEANING AND PROTECTION**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains 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.

### **3.9 PIPING SCHEDULE**

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 3 and smaller shall be any of the following:
  1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
  2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 4 and larger shall be any of the following:
  1. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
  2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 3 and smaller shall be any of the following:
  1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
  2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 4 and larger shall be any of the following:
  1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
  2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  3. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- F. Underground, soil, waste, and vent piping NPS 3 and smaller shall be any of the following:
  - 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
  
- G. Underground, soil and waste piping NPS 4 and larger shall be any of the following:
  - 1. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

**END OF SECTION 221316**



**SECTION 221319**

**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. This Section includes the following sanitary drainage piping specialties:
  - 1. Cleanouts.
  - 2. Floor drains.
  - 3. Channel drainage systems.
  - 4. Roof flashing assemblies.
  - 5. Through-penetration firestop assemblies.
  - 6. Miscellaneous sanitary drainage piping specialties.
  - 7. Flashing materials.
- B. Related Sections include the following:
  - 1. Division 22 Section "Storm Drainage Piping Specialties" storm water, roof drains

**1.3 SEISMIC REQUIREMENTS**

- A. Component Importance Factor. All plumbing components shall be assigned a component importance factor. The component importance factor,  $I_p$ , shall be taken as 1.5 if any of the following conditions apply:
  - 1. The component is required to function for life-safety purposes after an earthquake.
  - 2. The component contains hazardous materials.
  - 3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
- B. All other components shall be assigned a component importance factor,  $I_p$ , equal to 1.0.
- C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

**1.4 DEFINITIONS**

- A. FOG: Fats, oils, and greases.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

## 1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- 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 NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

## 1.6 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 size and location of roof penetrations.

## PART 2 - PRODUCTS

### 2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Watts Drainage Products Inc.
    - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
  - 3. Size: Same as connected drainage piping
  - 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  - 5. Closure: Countersunk, brass plug.
  - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Oatey.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Light Commercial Operation.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, stainless-steel wall-installation frame and cover.

## 2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: See Schedule at end of this Section:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.6.3.
  4. Body Material: Gray iron.
  5. Seepage Flange: Required.
  6. Anchor Flange: Not required.
  7. Outlet: Bottom.
  8. Trap Material: Cast iron>.
  9. Trap Pattern: Deep-seal P-trap>.
  10. Trap Features: Trap-seal primer valve drain connection>.

### **2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES**

#### **A. Through-Penetration Firestop Assemblies:**

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ProSet Systems Inc.
3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
4. Size: Same as connected soil, waste, or vent stack.
5. 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.
6. 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.
7. Special Coating: Corrosion resistant on interior of fittings.

### **2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES**

#### **A. Deep-Seal Traps:**

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch- minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

#### **B. Floor-Drain, Trap-Seal Primer Fittings:**

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.



C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch > above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Cap Filters:

1. Description: Activated carbon filter in housing for installation at vent terminal as manufactured by Sweet Filter.
2. Size: Same as connected stack vent or vent stack.

## 2.5 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. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

C. Fasteners: Metal compatible with material and substrate being fastened.

D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- C. 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.
  - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- H. 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.
- I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

- J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- K. Install vent cap filters on each vent pipe passing through roof.
- L. Install wood-blocking reinforcement for wall-mounting-type specialties.
- M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- N. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.3 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.
- 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 Division 07 Section "Sheet Metal Flashing and Trim."

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- 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.

### **3.4 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.

### **3.5 FLOOR DRAIN SCHEDULE**

- FD-1 Floor Drain: Smith figure 2010-BP cast iron body and flashing collar with square nickel bronze adjustable strainer head with secured square hole grate and trap primer connection.
- FS-1 Floor Sink: Smith figure 3100 cast iron flanged receptor with acid resistant interior coating, nickel bronze rim and secured grate and aluminum dome bottom strainer. Coordinate grate configuration with Kitchen Equipment drawings.
- FS-2 Floor Sink: Smith figure 3100 cast iron flanged receptor with acid resistant interior coating, nickel bronze rim and secured grate and aluminum dome bottom strainer. Coordinate grate configuration with Kitchen Equipment drawings.

**END OF SECTION 221319**

## **SECTION 221413**

### **FACILITY STORM DRAINAGE 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. This Section includes the following storm drainage piping inside the building:
  - 1. Pipe, tube, and fittings.
  - 2. Special pipe fittings.
- B. Related Sections include the following:
  - 1. Division 22 Section "Sump Pumps."

##### **1.3 SEISMIC REQUIREMENTS**

- A. Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

##### **1.4 DEFINITIONS**

- A. PVC: Polyvinyl chloride plastic.

##### **1.5 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
  - 1. Storm Drainage Piping: 10-foot head of water.
- B. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 " Vibration and Seismic Controls for Plumbing Piping and Equipment."

##### **1.6 SUBMITTALS**

- A. Product Data: For pipe, tube, fittings, and couplings.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Shop Drawings:
  - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
  - 2. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.
- C. Field quality-control inspection and test reports.
- D. 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. Seismic calculations and detailed analysis: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices. Project specific design documentation and calculations shall be prepared and stamped by a registered professional engineer who is responsible for the seismic restraint design and who is licensed in the state where the project is being constructed (ASCE 7, 13.2.1.1).

## **1.7 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.2 PIPING MATERIALS**

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

### **2.3 PVC PIPE AND FITTINGS**

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

### **2.4 SPECIAL PIPE FITTINGS**

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

- 1. Manufacturers:

- a. Dallas Specialty & Mfg. Co.
- b. Fernco, Inc.
- c. Logan Clay Products Company (The).
- d. Mission Rubber Co.
- e. NDS, Inc.
- f. Plastic Oddities, Inc.

- 2. Sleeve Materials:

- a. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
- b. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

- 1. Manufacturers:

- a. Cascade Waterworks Mfg. Co.
- b. Mission Rubber Co.

## **PART 3 - EXECUTION**

### **3.1 EXCAVATION**

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

### **3.2 PIPING APPLICATIONS**

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Underground storm drainage piping shall be the following ( to 6" above finished floor):
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

### **3.3 PIPING INSTALLATION**

- A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
- B. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- C. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."
- E. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.
- I. Install PVC storm drainage piping according to ASTM D 2665.
- J. Install underground PVC storm drainage piping according to ASTM D 2321.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### **3.4 JOINT CONSTRUCTION**

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results Plumbing."
- B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

### **3.5 HANGER AND SUPPORT INSTALLATION**

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."



- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - 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.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### **3.6 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

### **3.7 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.
  - 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 storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. 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 separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

### **3.8 CLEANING**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains 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.

**END OF SECTION 221413**

**SECTION 221423**

**STORM DRAINAGE 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. This Section includes the following storm drainage piping specialties:
  - 1. Cleanouts.
  - 2. Roof drains.
  - 3. Miscellaneous storm drainage piping specialties.
  - 4. Flashing materials.
- B. Related Sections include the following:
  - 1. Division 22 Section "Sanitary Waste Piping Specialties" for backwater valves, floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, FOG disposal systems, grease interceptors and removal devices, oil interceptors, and solid interceptors.

**1.3 DEFINITIONS**

- A. PUR: Polyurethane plastic.
- B. PVC: Polyvinyl chloride plastic.

**1.4 SUBMITTALS**

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

**1.5 QUALITY ASSURANCE**

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

**1.6 COORDINATION**

- A. Coordinate size and location of roof penetrations.

## **PART 2 - PRODUCTS**

### **2.1 CLEANOUTS**

#### **A. Exposed Metal Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Sioux Chief Manufacturing Company, Inc
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

#### **B. Metal Floor Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Oatey.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Light Commercial Operation.
  - h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: [Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Stainless steel.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

#### **C. Cast-Iron Wall Cleanouts:**

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Sioux Chief Manufacturing Company, Inc
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

## 2.2 ROOF DRAINS

### A. Metal Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: See Schedule at end of this section for drain descriptions:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Sioux Chief Manufacturing Company, Inc
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.21.2M.
4. Body Material Cast iron.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Dome Material: Cast iron.
7. Extension Collars: Required.
8. Underdeck Clamp Required.
9. Sump Receiver: Required.

### B. Conductor Nozzles DSN-1:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

## 2.3 FLASHING MATERIALS

- A. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. 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.
  - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
  - 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
  - 2. Position roof drains for easy access and maintenance.
- F. Install manufactured, gray-iron downspout boots at grade with top [6 inches] [12 inches] [18 inches] above grade. Secure to building wall.
- G. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

#### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

### **3.3 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.
- 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. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### **3.4 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.

### **3.5 ROOF DRAIN SCHEDULE**

- RD-1 Roof Drain: Smith figure 101-ERC cast iron body with combined flashing clamp and cast iron gravel stop, cast iron dome, extension, sump receiver and underdeck clamp.
- DSN-1 Downspout nozzle: Smith figure 1770 downspout nozzle; cast bronze body and flange.

**END OF SECTION 221423**





## SECTION 224000

### 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. This Section includes the following conventional plumbing fixtures and related components:
  - 1. Faucets for lavatories showers and sinks.
  - 2. Flushometers.
  - 3. Toilet seats.
  - 4. Protective shielding guards.
  - 5. Fixture supports.
  - 6. Water closets.
  - 7. Urinals.
  - 8. Lavatories.
  - 9. Commercial sinks.
  - 10. Kitchen sinks.
  - 11. Service sinks.
  - 12. Lead Free fixtures.
- B. Related Sections include the following:
  - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
  - 2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
  - 3. Division 22 Section "Drinking Fountains and Water Coolers."

##### 1.3 LEAD FREE REQUIREMENTS

- A. For all projects within the United States, and when water is anticipated for human consumption, all pipes, pipe fittings, plumbing fittings and fixtures shall comply with PUBLIC LAW 111-380 "Reduction of Lead in Drinking Water Act" 124 STAT. 4131, 42-USC 1201, January 4<sup>th</sup>, 2011.

##### 1.4 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.
- G. Lead Free:
  - 1. Not containing more than 0.2 percent lead when used with respect to solder and flux.
  - 2. Not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings and fixtures.
  - 3. Calculation: The weighted average lead content of a pipe, pipe fitting, plumbing fitting or fixture shall be calculated by using the formula prescribed in the law named in LEAD FREE REQUIREMENTS above.

## 1.5 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

## 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
  
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
  - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
  - 4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
  - 5. Stainless-Steel Residential Sinks: ASME A112.19.3.
  - 6. Vitreous-China Fixtures: ASME A112.19.2M.
  - 7. Water-Closet, Flushometer Tank Trim: ASSE 1037.
  
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
  - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  - 4. Faucets: ASME A112.18.1.
  - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
  - 6. Hose-Coupling Threads: ASME B1.20.7.
  - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 8. NSF Potable-Water Materials: NSF 61.
  - 9. Pipe Threads: ASME B1.20.1.
  - 10. Supply Fittings: ASME A112.18.1.
  - 11. Brass Waste Fittings: ASME A112.18.2.
  - 12. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.
  
- I. Comply with the following applicable standards and other requirements specified for shower faucets:
  - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
  - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
  - 3. Faucets: ASME A112.18.1.
  - 4. Hand-Held Showers: ASSE 1014.
  - 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
  - 6. Hose-Coupling Threads: ASME B1.20.7.
  - 7. Manual-Control Antiscald Faucets: ASTM F 444.
  - 8. Pipe Threads: ASME B1.20.1.
  - 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
  - 10. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
  
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
  - 1. Atmospheric Vacuum Breakers: ASSE 1001.
  - 2. Brass and Copper Supplies: ASME A112.18.1.
  - 3. Dishwasher Air-Gap Fittings: ASSE 1021.
  - 4. Manual-Operation Flushometers: ASSE 1037.
  - 5. Plastic Tubular Fittings: ASTM F 409.
  - 6. Brass Waste Fittings: ASME A112.18.2.
  - 7. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
  2. Dishwasher Air-Gap Fittings: ASSE 1021.
  3. Flexible Water Connectors: ASME A112.18.6.
  4. Floor Drains: ASME A112.6.3.
  5. Grab Bars: ASTM F 446.
  6. Hose-Coupling Threads: ASME B1.20.7.
  7. Off-Floor Fixture Supports: ASME A112.6.1M.
  8. Pipe Threads: ASME B1.20.1.
  9. Plastic Toilet Seats: ANSI Z124.5.
  10. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
  3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
  4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
  5. Toilet Seats: Equal to 5 percent of amount of each type installed.

## PART 2 - PRODUCTS

### 2.1 LEAD FREE PRODUCTS:

- A. For all products purchased that where water is anticipated for human consumption, all pipes, pipe fittings, plumbing fittings and fixtures shall comply with the LEAD FREE REQUIREMENTS in PART 1 above.

### 2.2 LAVATORY FAUCETS

- A. Lavatory Faucets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Chicago Faucets.
    - b. Zurn Plumbing Products Group; Commercial Brass Operation.
    - c.
    - d. Moen, Inc.

### **2.3 SHOWER FAUCETS**

#### A. Shower Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Chicago Faucets.
  - b. Leonard Valve Company.
  - c. Moen, Inc.
  - d. Powers; a Watts Industries Co.
  - e. Symmons Industries, Inc.

### **2.4 SINK FAUCETS**

#### A. Sink Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Chicago Faucets.
  - b. Zurn Plumbing Products Group; Commercial Brass Operation.
  - c. Moen, Inc.

### **2.5 FLUSHOMETERS**

#### A. Flushometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Sloan Valve Company.
  - b. Zurn Plumbing Products Group; Commercial Brass Operation.
  - c. Moen, Inc.

### **2.6 TOILET SEATS**

#### A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bemis Manufacturing Company.
  - b. Centoco Manufacturing Corp.
  - c. Church Seats.
  - d. Olsonite Corp.
  - e. Sperzel.
2. Description: Toilet seat for water-closet-type fixture.
  - a. Material: Molded, solid plastic with antimicrobial agent.
  - b. Configuration: Open front without cover.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- c. Size: Elongated.
- d. Hinge Type: CK, check.
- e. Class: Heavy-duty commercial.
- f. Color: White.

## **2.7 PROTECTIVE SHIELDING GUARDS**

### **A. Protective Shielding Pipe Covers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Engineered Brass Co.
  - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
  - c. McGuire Manufacturing Co., Inc.
  - d. Plumberex Specialty Products Inc.
  - e. TCI Products.
  - f. TRUEBRO, Inc.
  - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
2. 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. Product shall also meet the ASTM E 84 25/450 smoke and flame rating.

## **2.8 FIXTURE SUPPORTS**

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

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

### **B. Urinal Supports:**

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

### **C. Lavatory Supports:**

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

## **2.9 WATER CLOSETS**

### A. Water Closets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard Companies, Inc.
  - b. Crane Plumbing, L.L.C./Fiat Products.
  - c. Kohler Co.

## **2.10 URINALS**

### A. Urinals:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard Companies, Inc.
  - b. Crane Plumbing, L.L.C./Fiat Products.
  - c. Kohler Co.

## **2.11 LAVATORIES**

### A. Lavatories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard Companies, Inc.
  - b. Crane Plumbing, L.L.C./Fiat Products.
  - c. Kohler Co.

## **2.12 COMMERCIAL SINKS**

### A. Commercial Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Elkay Manufacturing Co.
  - b. Just Manufacturing Company.

## **2.13 SERVICE SINKS**

### A. Service Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard Companies, Inc.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- b. Commercial Enameling Company.
- c. Eljer.
- d. Kohler Co.
- e. Crane Plumbing, L.L.C./Fiat Products.

## **2.14 KITCHEN EQUIPMENT**

- A. Kitchen Equipment (as noted on Kitchen Equipment Schedule):
  - 1. Rough-in and connect to Kitchen equipment as per the Kitchen Equipment Rough-in drawings. Provide all "P" traps required, chrome-plated cast brass. Tail pieces and trap arms shall be chrome-plated 17 ga. brass tubing.
  - 2. Provide Precision Plumbing Products water hammer arrestors upstream of all quick-closing valves, such as on disposers and dishwasher.
  - 3. Gas and water services to portable and countertop appliances shall be connected to equipment with flexible tubing and quick-disconnect fittings. Gas fittings and hoses shall be A.G.A. approved for commercial kitchen equipment.
  - 4. All exposed piping and fittings shall be chrome-plated or stainless steel. Furnish and install stops on all hot and cold water lines at equipment.
  - 5. Provide shut-off valves and unions in all gas, steam and condensate lines at each connection to equipment.
  - 6. All piping penetrations through walls shall be a minimum of 6" above the floor.
  - 7. Provide 3/4" Watts model U5BLP pressure reducing valve on supply line to dishwasher.
  - 8. Provide check valves on supplies to hose sprays.

## **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 cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Installations where water is anticipated for human consumption, all pipes, pipe fittings, plumbing fittings and fixtures shall be Lead Free as given in PART 1 above.
- B. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- C. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.



- D. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- E. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- F. Install wall-mounting fixtures with tubular waste piping attached to supports.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install toilet seats on water closets.
- N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- R. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- S. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- T. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

- U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- U. All plumbing fixtures are to be mounted at the height specified on the Architectural drawings.

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.4 FIELD QUALITY CONTROL**

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

### **3.5 ADJUSTING**

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

### **3.6 CLEANING**

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

### 3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

### 3.8 PLUMBING FIXTURE SCHEDULE

- WC-1 Water Closet (Floor Mounted, Flush Valve): Kohler K4350, Wellworth Toilet, vitreous china, 1.6 gallon flush. Elongated bowl design, 15" high, siphon jet flushing, 2-1/4" passageway, 1-1/2" top spud and 52048 bolt caps. Bemis 3155-C "Duraguard" white, solid plastic, open-front seat, less cover. Sloan Regal-111 1.6 gal flush valve and actuator.
- WC-2 Water Closet (Floor Mounted, Flush Valve, ADA Compliant): Kohler K-4386, Highcliff Toilet, vitreous china, 1.6 gallon flush. Elongated bowl design, 17-1/2" high, siphon jet flushing, 2-1/4" passageway, 1-1/2" top and 52048 bolt caps. Sloan Regal -111-ADA 1.6 gallon flush valve.
- U-1 Urinal: Kohler K-4920-T Branham vitreous china, floor mounted urinal with 3/4" top spud; Sloan Regal 186-1.0 manual flush valve.
- L-1 Lavatory (Wall Hung, Wrist Blades): Kohler K-2030, Greenwich, 20"x18" "D" shaped bowl, vitreous china, wall hung lavatory with front overflow and 4" centers drilling. Chicago 802-VE34VP317ABCP faucet, No. 317 4" wrist blades, 2.0 GPM. Flexible stainless steel supplies with loose key angle stops. Chicago 327A open grid drain and cast brass P-trap with clean-out plug. Powers e480 thermostatic mixing valve with integral and external check valves. Smith 0700 concealed arm chair carrier with foot support. Provide ADA compliant under counter piping wrap by Truebro, Lav Guard series in China white. See architectural interior elevations for mounting height.
- L-2 Lavatory (Wall Hung, lever handles): Elkay CHSB1716C type 304 stainless steel sink, 7" high backsplash, LKB400 faucet with 2" lever handles, Powers e480 thermostatic mixing valve with integral and external checks, LKB8 strainer, support brackets.
- S-1 (3) Compartment Sink: Elkay Model WNSF-8345LR4 Sturdibilt three compartment sink with left and right drain boards; 14 gauge nickel bearing type 304 stainless steel construction; all welded sink compartment with 1/4" radii cored corner construction; all welds to be ground smooth; channel rim with straight line styling; polished to LK-5K satin finish; sink compartments to be pitched to drain; support sink on four (4) LK-251 stainless steel tubular legs, 1-5/8" OD with adjustable bullet shaped feet; drilled for 2 faucets; (3) LK-25-RT stainless steel strainers with roto handle; Chicago No. 445 sink fittings with No. 369 handles, swing spout, No. E3 Soffflo aerator, and No. H 1/2" supply arms; 1/2" straight-way stops; 2" cast brass chrome plated "P" traps.
- SH-1 2 Station Shower: 2W Wall Shower/6'-0"/EF/IS/SX/SHV/ST Two station Econo shower, 18 gauge 304 stainless steel panels polished to #4 finish, equa-flo pressure balanced mixing valve, severe service shower head and vertical stainless steel shroud to conceal overhead piping.
- SH-2 ADA 2 Station Shower: WS-2W-HN Wall Shower/6'-0"/EF/IS/SX/SHV/ST Two station Econo shower (1) hand held wan and (1) fixed severe shower head, 18 gauge 304 stainless steel panels polished to #4 finish, equa-flo pressure balanced mixing valve and vertical stainless steel shroud to conceal overhead piping.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- SH-3 ADA Wall Shower: Bradley model WS-1X-HN-EF-TMV-S-G-SB-SL-SD-VS barrier free shower with diverter valve, standard institutional showerhead and hand shower with 24" slide bar; Equa-flo pressure balanced mixing valve; thermostatic mixing valve with integral and external checks; sloped top; vandal resistant screws; wall mounted cake soap dish.
  
- SS-1 Service Sink (Floor Mounted, Corner): Kohler K6710, Whitby, 28 x 28-inch, enameled cast iron floor-mounted corner model, K9146-3" drain with strainer, No. K8940 removable vinyl-coated rim guard; Chicago 897 faucet with vacuum breaker, screwdriver stops in shanks, 5 foot rubber hose and 853 wall hook.
  
- DF-1 Drinking Fountain: Elkay EDFPBM117C stainless steel bi-level drinking fountain with vandal resistant push button actuator, stainless steel back panel and flexi-guard anti-microbial safety bubbler.
  
- WB-1 Guy Gray model T-200 complete with connection faucets with top supply and 2" drain connection.

**END OF SECTION 224000**

## SECTION 224713

### DRINKING FOUNTAINS

#### 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 drinking fountains and related components.

##### 1.3 SEISMIC REQUIREMENTS

- A. Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include operating characteristics, and furnished specialties and accessories.
- B. Manufacturer Seismic Qualification Certification: Submit certification that plumbing equipment and components will withstand seismic forces defined in Division 22 Section "Mechanical Vibration and Seismic Controls."

##### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For drinking fountains to include in maintenance manuals.

#### PART 2 - PRODUCTS

- A. Drinking Fountains Stainless steel or Vitreous china, wall mounted or semi recessed, see schedule.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Elkay Manufacturing Co.
    - b. Filtrine Manufacturing Company.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- c. Halsey Taylor.
  - d. Haws Corporation.
2. Standards:
- a. Comply with ASME A112.19.3/CSA B45.4.
  - b. Comply with NSF 61.
3. Drain: Grid type with NPS 1-1/4 tailpiece.
4. Supply: NPS 3/8 with shutoff valve.
5. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
6. Support: ASME A112.6.1M, Type III lavatory carrier.
- B. Drinking Fountains: Stainless steel, recessed. See schedule.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
- a. Elkay Manufacturing Co.
  - b. Filtrine Manufacturing Company.
  - c. Halsey Taylor.
  - d. Haws Corporation.
2. Standard: Comply with NSF 61.
3. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap, complying with ASME A112.18.2/CSA B125.2.
4. Supply: NPS 3/8 with shutoff valve.
5. Support: Mounting frame or brackets for attaching to substrate.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- C. Install recessed drinking fountains secured to wood blocking in wall construction.
- D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Division 22 Section "Escutcheons for Plumbing Piping."
- H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07 Section "Joint Sealants."

### **3.3 CONNECTIONS**

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Division 22 Section "Domestic Water Piping."
- C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Division 22 Section "Sanitary Waste and Vent Piping."

### **3.4 ADJUSTING**

- A. Adjust fixture flow regulators for proper flow and stream height.

### **3.5 CLEANING**

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

### **3.6 FIXTURE SCHEDULE (See drawing schedules)**

**END OF SECTION 224713**





## **DIVISION 23 – HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)**

- 23 0100 - Mechanical Requirements
- 23 0500 - Common Work Results for HVAC
- 23 0513 - Common Motor Requirements for HVAC Equipment
- 23 0519 - Meters and Gages for HVAC
- 23 0523 - General-Duty Valves for HVAC Piping
- 23 0529 - Hangers and Supports for HVAC Piping and Equipment
- 23 0548 - Vibration and Seismic Controls for HVAC
- 23 0550 - Operations and Maintenance of HVAC Systems
- 23 0553 - Identification for HVAC Piping and Equipment
- 23 0593 - Testing Adjusting and Balancing for HVAC
- 23 0713 - Duct Insulation
- 23 0800 - Commissioning Mechanical Systems
- 23 0900 - Building Automation System
- 23 0993 - Sequences of Operation
- 23 1123 - Facility Natural Gas Piping
- 23 3001 - Common Duct Requirements
- 23 3113 - Metal Ducts
- 23 3119 - HVAC CASINGS
- 23 3300 - Air Duct Accessories
- 23 3713 - Diffusers, Registers, and Grilles
- 23 5214 - Finned Water-Tube Boilers
- 23 5233 - Finned Water-Tube Boilers
- 23 7413 - Packaged Outdoor Central-Station Air-Handling Units



## SECTION 23 0100

### MECHANICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 GENERAL CONDITIONS

- A. The General Conditions of the Contract, with the amendments, supplements, forms and requirements in Division 1, and herewith made a part of this Division.
- B. All sections of Division 21, 22, & 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.
- C. Mechanical equipment that is pre-purchased if any will be assigned to the Mechanical Contractor. By assignment to the Mechanical Contractor, the Mechanical Contractor shall accept and installed the equipment and provide all warranties and guarantees as if the Mechanical Contractor had purchased the equipment.
- D. Construction Indoor-Air Quality Management
  - 1. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
    - a. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
    - b. Replace all air filters immediately prior to occupancy.
  - 2. Comply with one of the following requirements:
    - a. After Construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. Ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
    - b. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.

##### 1.2 SCOPE OF WORK

- A. The project described herein is the LEHI SWIM POOL A&R. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. This Division will schedule the boiler inspection and pay for all costs associated with certifying the boiler with the state.

### **1.3 CODES & ORDINANCES**

- A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and Specifications be required to comply with these regulations, the Contractor shall notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.
- B. Applicable codes:
  - 1. Utah Boiler and Pressure Vessel Rules and Regulations-2013 Edition
  - 2. International Building code- 2012 Edition
  - 3. International Mechanical Code- 2012 Edition
  - 4. International Plumbing Code- 2012 Edition
  - 5. International Fire Code- 2012 Edition
  - 6. International Energy Code- 2009 Edition
  - 7. International Fuel Gas Code- 2012 Edition
  - 8. National Electrical Code- 2011 Edition

### **1.4 INDUSTRY STANDARDS**

- A. All work shall comply with the following standards.
  - 1. Associated Air Balance council (AABC)
  - 2. Air Conditioning and Refrigeration Institute (ARI)
  - 3. Air Diffusion council (ADC)
  - 4. Air Movement and Control Association (AMCA)
  - 5. American Gas Association (AGA)
  - 6. American National Standards Institute (ANSI)
  - 7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
  - 8. American Society of Mechanical Engineers (ASME)
  - 9. American Society of Testing Materials (ASTM)
  - 10. American Water Works Association (AWWA)
  - 11. Cooling Tower Institute (CTI)
  - 12. ETL Testing Laboratories (ETL)
  - 13. Institute of Electrical and Electronic Engineers (IEEE)
  - 14. Hydronics Institute (HI)
  - 15. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
  - 16. National Fire Protection Association (NFPA)
  - 17. National Electrical Code (NEC)
  - 18. National Electrical Manufacturers Association (NEMA)
  - 19. National Electrical Safety code (NESC)
  - 20. Utah safety Standard (OSHA), Utah State Industrial Council.
  - 21. Sheet Metal and Air Conditioning Contractor-s National Association (SMACNA)
  - 22. Underwriters Laboratories (UL)
  - 23. Tubular Exchanger Manufacturers Association, Inc. (TEMA)
  - 24. Heat Exchanger Institute (HEI)
  - 25. Hydraulic Institute (HI)
  - 26. Thermal Insulation Manufacturer-s Association (TIMA)
  - 27. Scientific Apparatus Makers Association (SAMA)
- B. Compliance Verification:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
2. Form U-1, the manufacturer's data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
3. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

## **1.5 UTILITIES & FEES**

- A. All fees for permits required by this work will be paid by this division. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or installed by this Contractor, shall be complete with all utilities, components, commodities and accessories required for a fully functioning system. This Contractor shall furnish smoke generators when required for testing, furnish glycol for glycol piping systems, full load of salt to fill brine tank for water softening system, furnish cleaners and water treatment additives.

## **1.6 SUBMITTALS AND SHOP DRAWINGS**

- A. General: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect manufacturer's data on products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of 14 days. The first day starts after the day they are received in the engineers office to which the project is being constructed from. If the Contractors schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within 14 days of returned submittals. Refer to each specification section for items requiring submittal review. Written approval of the Owner's Representative shall be obtained before installing any such equipment or materials for the project.
- B. Review by the Owner's Representative is for general conformance of the submitted equipment to the project specification. In no way does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. Regardless of any items overlooked by the submittal review, the requirements of the contract drawings and specifications must be followed and are not waived or superseded in any way by the review.
- C. By description, catalog number, and manufacturer's names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.
- D. If the Engineer is required to do additional design work to incorporate changes caused by submitting equipment or products, different than the design equipment specified, as defined above, the contractor shall reimburse the engineer for additional time and expenses at the engineer's current, recognized, hourly rates.
- E. Submittal Format: At the contractor's discretion, project submittals may be in either of the formats described in the following paragraphs, but mixing the two formats is not acceptable.

1. Hardcopy Submittal Format: Six (6) copies of the descriptive literature covering products and materials to be used in the installation of mechanical systems for this project will be provided for review. The submittals shall be prepared in an orderly manner, contained in a 3-ring loose-leaf binder with index and identification tab for each item or group of items and for each specification section. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within 120 days of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.
  - a. Submitted literature shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.
  - b. Submitted literature shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.
  - c. Submitted literature shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.
  
2. Electronic Submittal Format: Identify and incorporate information in each electronic submittal file as follows:
  - a. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  - b. Name file with submittal number or other unique identifier, including revision identifier.
  - c. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by:
    - 1) Architect.
  - d. Transmittal Form for Electronic Submittals:
    - 1) Use one of the following options acceptable to the Owner;
      - a) Software-generated form from electronic project management software.
      - b) Electronic form.
    - 2) The Electronic Submittal shall contain the following information:
      - a) Project name.
      - b) Date.
      - c) Name and address of Architect.
      - d) Name of Construction Manager.
      - e) Name of Contractor.
      - f) Name of firm or entity that prepared submittal.
      - g) Names of subcontractor, manufacturer, and supplier.
      - h) Category and type of submittal.
      - i) Submittal purpose and description.
      - j) Specification Section number and title.
      - k) Specification paragraph number or drawing designation and generic name for each of multiple items.
      - l) Drawing number and detail references, as appropriate.
      - m) Location(s) where product is to be installed, as appropriate.
      - n) Related physical samples submitted directly.

- o) Indication of full or partial submittal.
  - p) Transmittal number[, numbered consecutively].
  - q) Submittal and transmittal distribution record.
  - r) Other necessary identification.
  - s) Remarks.
- e. Metadata: Include the following information as keywords in the electronic submittal file metadata:
- 1) Project name.
  - 2) Number and title of appropriate Specification Section.
  - 3) Manufacturer name.
  - 4) Product name.

## 1.7 DRAWINGS AND MEASUREMENTS

- A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.
- B. It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect's office before work is started.
- C. This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time during the construction process, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.
- D. The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.
- E. The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.
- F. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or work of other trades. The drawings shall be a minimum scale of 1/4 inch= 1 foot and of such detail as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.
- G. Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will show all ductwork in the entire building and shall be coordinated with architectural, structural and electrical portions of the project. The contractor shall specifically obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be

made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

### **1.8 CONTRACTOR'S USE OF BUILDING EQUIPMENT**

- A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

### **1.9 EXISTING CONDITIONS**

- A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for an extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.
- B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.
- C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.

### **1.10 EQUIPMENT CAPACITIES**

- A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate that has capacities or performance less than that of design equipment.
- B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers' standard ratings shall be adjusted accordingly. All capacities and performances listed on drawings or in specifications are for job-site conditions.

### **1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT**

- A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic snubbers and/or seismic anchors.



**1.12 COOPERATION WITH OTHER TRADES**

- A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.
- B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.
- C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.
- D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110-16 and 384-4 of the National Electrical Code relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.

**1.13 RESPONSIBILITY OF CONTRACTOR**

- A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner's Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.
- B. If a conflict arises between the drawings and the specifications the most stringent procedure/action shall be followed. A clarification to the engineer will help to determine the course of action to be taken. If a conflict arises between specification sections the engineer will determine which course of action is to be followed.

**1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES**

- A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.
- B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

**1.15 UNFIT OR DAMAGED WORK**

- A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

**1.16 WORKMANSHIP**

- A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative. Nothing contained herein shall relieve the Contractor from making good and perfect work in all details in construction.

**1.17 SAFETY REGULATION**

- A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

**1.18 ELECTRICAL SERVICES**

- A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division unless shown to be furnished by Division 26. All such wiring shall be in conduit as required by electrical codes. Wiring in the mechanical rooms, fans rooms and inaccessible ceilings and walls shall be installed in conduit as well. Installation of any and all wiring done under Division 21, 22 and 23 shall be in accordance with the requirements of Division 26, Electrical.
- B. All equipment that requires an electrical connection shall be furnished so that it will operate properly and deliver full capacity on the electrical service available.
- C. Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.
- D. The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

**1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT**

- A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.
- B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions

occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.

- C. The Execution portions of the specifications specify what products and materials may be used. Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.
- D. The access to equipment shown on the drawings is the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.
- E. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.
- F. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

#### **1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS**

- A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor's expense.
- B. All open duct and pipe openings shall be adequately covered at all times.

#### **1.21 INSTALLATION CHECK**

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.
- B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.
- C. All costs for this work shall be included in the prices quoted by equipment suppliers.

#### **1.22 EQUIPMENT LUBRICATION**

- A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.
- B. Necessary time shall be spent with the Owner's Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.

- C. Detergent oil as used for automotive purposes shall not be used for this work.

### **1.23 CUTTING AND PATCHING**

- A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.
- B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

### **1.24 EXCAVATION AND BACKFILLING**

- A. All necessary excavations and backfilling for the Mechanical phase of this project shall be provided as work of this Division. Trenches for all underground pipelines shall be excavated to the required depths. The bottom of trenches shall be compacted hard and graded to obtain required fall. Backfill shall be placed in horizontal layers, not exceeding 12 inches in thickness, and properly moistened. Each layer shall be compacted, by suitable equipment, to a density of not less than 95 percent as determined by ASTM D-1557. After pipelines have been tested, inspected, and approved, the trench shall be backfilled with selected material. Excess earth shall be hauled from the job site. Fill materials approved by the Architect shall be provided as work of this Division.
- B. No trenches shall be cut near or under any footings without consultation first with the Architect's office. Any trenches or excavations more than 30 inches deep shall be tapered, shored, covered, or otherwise made absolutely safe so that no vehicle or persons can be injured by falling into such excavations, or in any way be harmed by cave-ins, shifting earth, rolling rocks, or by drowning. This protection shall be extended to all persons approaching excavation related to this work whether or not such persons are authorized to be in the vicinity of the construction.

### **1.25 ACCESS**

- A. Provide access doors in walls, ceilings and floors by this division unless otherwise noted. For access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation. . If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR Smith No. 4760 bonderized and painted. Doors in tile walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910
- B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.
- C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.
- D. It is the responsibility of this division to install terminal boxes, valves and all other equipment and devices so they can be accessed. If any equipment or devices are installed so they cannot be

accessed on a ladder a catwalk and ladder system shall be installed above the ceiling to access and service this equipment.

#### **1.26 CONCRETE BASES AND INSERTS**

- A. Bases: The concrete bases shall be provided and installed as work by this division. This Division shall be responsible for the proper size and location of bases and shall furnish all required anchor bolts and sleeves with templates to be installed as work of Division 3, Concrete.
- B. All floor-mounted mechanical equipment shall be set on 6-inch high concrete bases, unless otherwise noted or shown on drawings. Such bases shall extend 6 inches beyond equipment or mounting rails on all sides or as shown on the drawings and shall have a 1-inch beveled edge all around.
- C. Inserts: Where slotted or other types of inserts required for this work are to be cast into concrete, they shall be furnished as work of this Division
- D. Concrete inserts and pipe support systems shall be equal to Unistrut P3200 series for all piping where more than one pipe is suspended at a common location. Spacing of the inserts shall match the size and type of pipe and of ductwork being supported. The Unistrut insert and pipe support system shall include all inserts, vertical supports, horizontal support members, clamps, hangers, rollers, bolts, nuts, and any other accessory items for a complete pipe-supporting system.

#### **1.27 CLEANING AND PAINTING**

- A. Cleaning: After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.
- B. Painting: Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 9, Painting.
- C. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.
- D. Removal of Debris, Etc: Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

#### **1.28 CONTRACT COMPLETION**

- A. Incomplete and Unacceptable Work: If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.

- B. Maintenance Instructions: The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.
  
- C. Instructions To Owner's Representatives: In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to train the Owner's representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not be reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.
  
- D. Guarantee: By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.
  
- E. The guarantee so assumed by the Contractor and as work of this Section is as follows:
  - 1. That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.
  - 2. That the circulation of water shall be complete and even.
  - 3. That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.
  - 4. That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.
  - 5. That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.
  - 6. All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect's Certificate of Substantial Completion.
  - 7. All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.
  - 8. If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

**1.29 CURBS**

- A. Unless otherwise noted in these specifications or on the documents all roof curbs for all equipment are to be provided by Division 22 and 23.

**1.30 TEST RUN**

- A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

**1.31 EQUIPMENT STARTUP AND CHECKOUT:**

- A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.
- B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

**1.32 DEMOLITION**

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
- B. Proceed with demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- C. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
- D. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- E. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
- F. Maintain adequate ventilation when using cutting torches.
- G. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
- H. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
- I. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- J. Dispose of demolished items and materials promptly.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- K. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- L. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- M. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- N. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- O. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- P. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

**END OF SECTION 23 0100**



## SECTION 230500

### COMMON WORK RESULTS 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 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Painting and finishing.
  - 10. Concrete bases.
  - 11. Supports and anchorages.
  - 12. Link-Seal

##### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, and mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases, and accessible tunnels.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. CPVC: Chlorinated polyvinyl chloride plastic.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### **1.4 SUBMITTALS**

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

#### **1.5 QUALITY ASSURANCE**

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### **1.7 COORDINATION**

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### **2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### **2.3 JOINING MATERIALS**

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## **2.4 TRANSITION FITTINGS**

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Thompson Plastics, Inc.

## **2.5 DIELECTRIC FITTINGS**

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Watts Industries, Inc.; Water Products Div

## **2.6 MECHANICAL SLEEVE SEALS**

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **2.7 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

## **2.8 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

## **2.9 GROUT**

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **2.10 LINK-SEAL MODULAR SEAL PRESSURE PLATES**

- A. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
  - 1. Izod Impact - Notched = 2.05ft-lb/in. per ASTM D-256
  - 2. Flexural Strength @ Yield = 30,750 psi per ASTM D-790
  - 3. Flexural Modulus = 1,124,000 psi per ASTM D-790
  - 4. Elongation Break = 11.07% per ASTM D-638
  - 5. Specific Gravity = 1.38 per ASTM D-792
- B. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a "Hex Nut Interlock" designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer's name molded into it.
- C. For fire service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.
- D. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be:
  - 1. 316 Stainless Steel per ASTM F593-95, with a 85,000 psi average tensile strength.

## **PART 3 - EXECUTION**

### **3.1 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. PVC Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.2 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.



- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. 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.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### **3.3 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

- D. Install equipment to allow right of way for piping installed at required slope.

### **3.5 PAINTING**

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.6 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

### **3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### **3.8 GROUTING**

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

**3.9 LINK SEAL**

- A. Provide Link Seal at all piping penetrations from the outside.

**END OF SECTION 230500**



## **SECTION 230513**

### **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 requirements in this Section except when the requirements in equipment schedules, other specification sections, drawing notes or in other contract documents are more stringent.
- B. 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.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Motors 3/4 HP and larger: Polyphase.
- D. Motors smaller than 3/4 HP: Single phase.
- E. All motors shall have ASTM Grade 5 hardware that is Yellow Zinc-dichromate plated.

### **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. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F..
- J. 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.
- K. 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.

### **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.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- 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, unless otherwise indicated.

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

**END OF SECTION 230513**





## **SECTION 230519**

### **METERS AND GAGES 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 SUMMARY**

- A. Section Includes:
  - 1. Liquid-in-glass thermometers.
  - 2. Pressure gages.
  - 3. Gage attachments.
- B. Related Sections:
  - 1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.
  - 2. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.

##### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

##### **1.4 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of meter and gage, from manufacturer.

##### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

#### **PART 2 - PRODUCTS**

##### **2.1 LIQUID-IN-GLASS THERMOMETERS**

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Palmer Wahl Instrumentation Group.
  - b. Terice, H. O. Co.
  - c. Weiss Instruments, Inc.
  - d. Weksler.
2. Standard: ASME B40.200.
3. Case: Die Cast aluminum or brass; nominal size unless otherwise indicated.
4. Case Form: Adjustable angle type unless otherwise indicated, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Satin faced, nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Copper-plated steel, aluminum, stainless steel, or brass designed for thermowell installation. Stem shall be of length to match thermowell insertion length.
  - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## **2.2 DUCT-THERMOMETER MOUNTING BRACKETS**

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

## **2.3 PRESSURE GAGES**

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AMETEK, Inc.; U.S. Gauge.
    - b. Ashcroft Inc.
    - c. Ernst Flow Industries.
    - d. KOBOLD Instruments, Inc.
    - e. Marsh Bellofram.
    - f. Miljoco Corporation.
    - g. Noshok.
    - h. Palmer Wahl Instrumentation Group.
    - i. REOTEMP Instrument Corporation.
    - j. Terice, H. O. Co.
    - k. Weiss Instruments, Inc.
    - l. Weksler
    - m. WIKA Instrument Corporation.
    - n. Winters Instruments - U.S.
  2. Standard: ASME B40.100.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated. NPS 1/4 or NPS 1/2.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Satin faced, nonreflective aluminum with permanently etched scale markings graduated in psi .
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMETEK, Inc.; U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Ernst Flow Industries.
  - d. KOBOLD Instruments, Inc.
  - e. Marsh Bellofram.
  - f. Miljoco Corporation.
  - g. Noshok.
  - h. Palmer Wahl Instrumentation Group.
  - i. REOTEMP Instrument Corporation.
  - j. Terice, H. O. Co.
  - k. Weiss Instruments, Inc.
  - l. Weksler
  - m. WIKA Instrument Corporation.
  - n. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Liquid-filled, cast aluminum or drawn steel; diameter with back flange for panel surface mounting or front flange for panel recessed mounting. Flanges to include pre-drilled screw holes.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated. NPS 1/4 or NPS 1/2.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Satin faced, nonreflective aluminum with permanently etched scale markings graduated in psi .
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with ASME B1.20.1 pipe threads. Include extension for use on insulated piping. NPS 1/4 or NPS 1/2 .
  1. Surge-dampening device: porous-metal-type.
- B. Siphons:
  1. Loop-shaped section: Brass pipe with pipe threads. NPS 1/4 or NPS 1/2.

- C. Valves:
  - 1. Needle: Brass, with NPS 1/4 or NPS 1/2 ASME B1.20.1 pipe threads.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- B. Install needle-valve and snubber in piping for each pressure gage for fluids.
- C. Install thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic boiler.
- D. Install pressure gages in the following locations:
  - 1. Suction and discharge of each pump.

#### **3.2 CONNECTIONS**

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

#### **3.3 ADJUSTING**

- A. Adjust faces of meters and gages to proper angle for best visibility.

#### **3.4 THERMOMETER SCHEDULE**

- A. Thermometers at inlet and outlet of each hydronic boiler shall be one of the following:
  - 1. Industrial-style, liquid-in-glass type.

#### **3.5 THERMOMETER SCALE-RANGE SCHEDULE**

- A. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F.
- B. Scale Range for Air Ducts: Minus 40 to plus 110 deg F.

#### **3.6 PRESSURE-GAGE SCHEDULE**

- A. Pressure gages at inlet and discharge of each pressure-reducing valve shall be the one of following:
  - 1. Dry-case type, direct-mounted, metal case.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:
  - 1. Liquid-filled, direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each pump shall be one of the following:
  - 1. Liquid-filled, direct-mounted, metal case.

### **3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Chilled-Water, Condenser-Water, Heating, Hot-Water, Steam and Condensate Piping shall be twice the normal operating pressure of the measured system with gage ranges as follows:
  - 1. 0 to 30 psi .
  - 2. 0 to 100 psi .

**END OF SECTION 230519**



## **SECTION 230523**

### **GENERAL-DUTY VALVES FOR HVAC 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. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze lift check valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Bronze globe valves.
7. Iron globe valves.
8. Lubricated plug valves.

- B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

##### **1.3 DEFINITIONS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of valve indicated. Body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- B. Maintenance data for valves to be included in the operation and maintenance data specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

#### **1.5 QUALITY ASSURANCE**

- A. Source Limitations for Valves: Obtain each type of valve as listed in SUMMARY from a single source and from a single manufacturer.
- B. Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
  - 4. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

#### **1.6 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 weld ends.
  - 3. Set angle, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- 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.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL REQUIREMENTS FOR VALVES**

- A. Refer to HVAC valve schedule articles for applications of valves.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
  - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Solder Joint: With sockets according to ASME B16.18.
    - a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg. For, globe, and check valves: below 421 deg. F for ball valves.
  - 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. APCO Willamette Valve and Primer Corp.
  - 2. Babbitt Steam Specialty Company.
  - 3. Bray Controls.
  - 4. Center Line.
  - 5. Cla-Val Company.
  - 6. Conbraco Industries Inc.
  - 7. Crane Co.; Crane Valve Group.
  - 8. Fisher Valve by Emerson.
  - 9. Flo Fab Inc.
  - 10. Flow-Tek Inc.
  - 11. Grinnell Corporation.
  - 12. Hammond Valve.
  - 13. Jamesbury; a subsidiary of Metso Automation.
  - 14. Jomar International LTD.
  - 15. Keystone Valve USA, Inc.
  - 16. Kitz Corp.
  - 17. Legend Valve.
  - 18. Metraflex Company.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

19. Milwaukee Valve Company.
20. Mueller Steam Specialty.
21. NIBCO Inc.
22. Red-White Valve Corp.
23. Spence Strainers International.
24. Stockham Valves and Fittings, Inc.
25. Tyco Fire/Shurjoint Piping Products.
26. Tyco/Pentair LTD.
27. Val-Matic Valve & Mfg. Corp.
28. Victaulic Company.
29. Watts Regulator Company.

## **2.4 BRONZE BALL VALVES**

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

## **2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES**

A. 150 CWP, Iron, Single-Flange (Lug) Butterfly Valves:

1. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 150 psig.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
  - e. Seat: EPDM.
  - f. Stem: One- or two-piece stainless steel.
  - g. Disc: Nylon 11 coated ductile iron.

## **2.6 BRONZE LIFT CHECK VALVES**

A. Class 125, Lift Check Valve:

1. Description:
  - a. Standard: MSS SP-80.
  - b. CWP Rating: 200 psig.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- c. Body Design: Vertical flow.
- d. Body Material: ASTM B 61, ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze, Type 1.

## **2.7 BRONZE SWING CHECK VALVES**

- A. Class 150, Bronze Swing Check Valves with Bronze Disc:

- 1. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 300 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.

## **2.8 IRON SWING CHECK VALVES**

- A. Class 125, Iron Swing Check Valves with Metal Seats:

- 1. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
  - c. Body Design: Clear or full waterway.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Gasket: Asbestos free.
  - h. Standard: MSS SP-71, Type I.

## **2.12 BRONZE GLOBE VALVES**

- A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

- 1. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 300 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.
  - e. Stem: Bronze.
  - f. Disc: PTFE or TFE.
  - g. Packing: Teflon impregnated, asbestos free.
  - h. Handwheel: Malleable iron.

## **2.13 IRON GLOBE VALVES**

- A. Class 125, Iron Globe Valves:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Description:
  - a. Standard: MSS SP-85, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Stem: Brass alloy. OS &Y.
  - f. Disc: Renewable bronze seat.
  - g. Trim: Bronze.
  - h. Packing and Gasket: Teflon impregnated, asbestos free.
  - i. Handwheel: Cast iron

## **2.14 LUBRICATED PLUG VALVES**

- A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Description:
  - a. Standard: MSS SP-78, Type II.
  - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
  - c. Pattern: Regular or short.
  - d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
  - e. Plug: Cast iron or bronze with sealant groove.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. 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.
- F. Do not attempt to repair defective valves; replace with new valves.

### **3.2 VALVE INSTALLATION**

- A. Install valves as indicated, according to manufacturer's written instructions.

- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above center of pipe.
- F. Install valves in position to allow full stem movement.

### **3.3 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### **3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball or butterfly valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service except Steam: Globe valves.
  - 4. Throttling Service, Steam: Globe valves.
  - 5. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, metal-seat check valves.
  - 6. Drain Service (except Steam): Two-Piece, Full Port Bronze Ball Valves with Bronze Trim. To be installed with NPS  $\frac{3}{4}$  hose thread outlet and hose cap with chain.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 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.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

### **3.5 HEATING-WATER VALVE SCHEDULE**

- A. Pipe NPS 2 and Smaller:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  3. Ball Valves:
    - a. Piece: Two
    - b. Port: Full.
    - c. Material/Trim: Bronze with:
      - 1) Bronze trim.
  4. Bronze Swing Check Valves:
    - a. Class 150
    - b. Bronze disc.
  6. Bronze Globe Valves:
    - a. Class 125
    - b. Bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
    - a. 200 CWP,
    - b. Seat: EPDM.
    - c. Disc: Ductile-iron.
  3. Iron Swing Check Valves: Class 125, metal seats.
  4. Iron Globe Valves: Class 125.

**END OF SECTION 230523**

## **SECTION 230529**

### **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.
- B. Related Sections:
  - 1. Division 05 for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
  - 3. Section 233113 "Metal Ducts" for duct hangers and supports.

##### **1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

##### **1.4 PERFORMANCE REQUIREMENTS**

- A. 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. For all seismic items refer to Section 230548 "Vibration and Seismic Controls for HVAC."

##### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. Metal framing systems.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO/Michigan Hanger Co. ; ERISTRUT Div.
    - d. GS Metals Corp.
    - e. Hilti, Inc.insert manufacturer's name.
    - f. Power-Strut Div. Tyco International.
    - g. Thomas & Betts Corporation.
    - h. Tolco Inc.
    - i. Unistrut; an Atkore International company.
  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 inturned 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.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

7. Metallic Coating:
  - a. Electroplated zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International; a subsidiary of Mueller Water Products, Inc.
  - b. Empire Industries, Inc.
  - c. ERICO International Corporation.
  - d. Haydon Corporation.
  - e. NIBCO INC.
  - f. PHD Manufacturing, Inc.
  - g. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with 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. Coating:
  - a. Zinc.

## 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carpenter & Paterson, Inc.
  2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.
  5. PHS Industries, Inc.
  6. Pipe Shields Inc.
  7. Piping Technology & Products, Inc.
  8. Rilco Manufacturing Co., Inc.
  9. Value Engineered Products, Inc.
- 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 or ASTM C 552, Type II cellular glass 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 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36, 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, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- 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. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. 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.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. 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.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- J. 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.
  
- K. 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 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
  
- 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.

### **3.3 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.

### **3.4 PAINTING**

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### **3.5 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 and attachments for general service applications.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. 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.
- I. 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.
- J. 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.
- K. 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.
- L. 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.
- M. 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.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

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.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners instead of building attachments where required in concrete construction.

**END OF SECTION 230529**





## **SECTION 230548**

### **VIBRATION AND SEISMIC CONTROLS 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**

- A. Provide engineered vibration isolation and restraint systems in accordance with the requirements of this section including design, engineering, materials, testing, inspections and reports.
- B. Mechanical equipment with moving parts shall be mounted on or suspended from vibration isolators to reduce the transmission of vibration and mechanically transmitted sound to the building structure.
- C. All mechanical equipment, piping and ductwork shall be restrained as required by Federal, State and Local building codes to preserve the integrity of nonstructural building components during seismic events to minimize hazards to occupants and reduce property damage.

##### **1.3 SUMMARY**

- A. This Section includes the following:
  - 1. Elastomeric isolation pads.
  - 2. Elastomeric isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Open-spring isolators.
  - 5. Housed-spring isolators.
  - 6. Restrained-spring isolators.
  - 7. Housed-restrained-spring isolators.
  - 8. Pipe-riser resilient supports.
  - 9. Resilient pipe guides.
  - 10. Air-spring isolators.
  - 11. Restrained-air-spring isolators.
  - 12. Elastomeric hangers.
  - 13. Spring hangers.
  - 14. Snubbers.
  - 15. Restraint channel bracings.
  - 16. Restraint cables.
  - 17. Seismic-restraint accessories.
  - 18. Mechanical anchor bolts.
  - 19. Adhesive anchor bolts.
  - 20. Vibration isolation equipment bases.
  - 21. Restrained isolation roof-curb rails.
  - 22. Certification of seismic restraint designs.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

23. Installation supervision.
24. Design of attachment of housekeeping pads.
25. All components requiring IBC compliance and certification.
26. All inspection and test procedures for components requiring IBC compliance.
27. Restraint of all mechanical equipment, pipe and ductwork, within, on, or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.
28. Seismic certification of equipment

#### **1.4 DEFINITIONS**

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. ASCE: American Society of Civil Engineers
- D. OSHPD: Office of Statewide Health Planning and Development for the State of California.
- E. Ip: Importance Factor.
- F. ESSENTIAL FACILITIES, (Occupancy Category IV, IBC-2012)
  1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

#### **G. LIFE SAFETY**

1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels.
2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment, including all lighting, generators, transfer switches and transformers.
3. All medical and life support systems.
4. Hospital heating systems and air conditioning systems for maintaining normal ambient temperature.
5. Automated supply, exhaust, fresh air and relief air systems on emergency control sequence, including air handlers, duct, dampers, etc., or manually-operated systems used for smoke evacuation, purge or fresh air relief by the fire department.
6. Heating systems in any facility with Occupancy Category IV, IBC-2009 where the ambient temperature can fall below 32 degrees Fahrenheit.

#### **H. HIGH HAZARD**

1. All gases or fluids that must be contained in a closed system which are flammable or combustible. Any gas that poses a health hazard if released into the environment and vented Fuel Cells.

## **1.5 REFERENCE CODES AND STANDARDS**

- A. Codes and Standards: The following shall apply and conform to good engineering practices unless otherwise directed by the Federal, State or Local authorities having jurisdiction.
1. IBC
  2. ASCE 7
  3. NFPA 13 (National Fire Protection Association)
  4. IBC 2012 replaces all references to IBC 2006, 2009.
- B. The following guides may be used for supplemental information on typical seismic installation practices. Where a conflict exists between the guides and these construction documents, the construction documents will preside.
1. FEMA (Federal Emergency Management Agency) manuals 412, Installing Seismic Restraints for Mechanical Equipment and 414, Installing Seismic Restraints for Ductwork and Pipe.
  2. SMACNA (Sheet Metal and Air-conditioning Contractors' National Association) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd ed.
  3. ASHRAE (American Society for Heating, Refrigerating and Air-conditioning Engineers) A Practical Guide to Seismic Restraint
  4. MSS (Manufacturers Standardization Society of the Valve and Fittings Industry) MSS SP-127, Bracing for Piping Systems, Seismic – Wind – Dynamic, Design, Selection, Application.

## **1.6 ISOLATOR AND RESTRAINT MANUFACTURER'S RESPONSIBILITIES:**

- A. Provide project specific vibration isolation and seismic restraint design prepared by a registered design professional in the state where the project is being constructed, and manufacturer certifications that the components are seismically qualified.
1. Provide calculations to determine restraint loads resulting from seismic forces as required by IBC, Chapter 16 and ASCE 7, latest editions. Seismic calculations shall be certified by an engineer licensed in the state where the project is being constructed.
- B. Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.
1. Provide seismic restraint details with specific information relating to the materials, type, size, and locations of anchorages; materials used for bracing; attachment requirements of bracing to structure and component; and locations of transverse and longitudinal sway bracing and rod stiffeners.
  2. Provide seismic bracing layout drawings indicating the location of all seismic restraints.
    - a. Each piece of rotating isolated equipment shall be tagged to clearly identify quantity and size of vibration isolators and seismic restraints.
- C. Provide, in writing, the special inspection requirements for all Designated Seismic Systems as indicated in Chapter 17 of the IBC.
- D. Provide training for installation, operation and maintenance of isolation and restraint systems.

## **1.7 PERFORMANCE REQUIREMENTS**

- A. Flood-Restraint Loading: Per the structural drawings and specifications.
- B. Seismic-Restraint Loading:
  - 1. Site Class as Defined in the IBC: Per the structural drawings and specifications.
  - 2. Assigned Occupancy Category as Defined in the IBC: Per the structural drawings and specifications.
    - a. Component Importance Factor: 1.5.
      - 1) Life safety components required to function after an earthquake.
      - 2) Components containing hazardous or flammable materials in quantities that exceed the exempted amounts for an open system listed in Chapter 4.
      - 3) For structures with an Occupancy Category IV, components needed for continued operation of the facility or whose failure could impair the continued operation of the facility.
      - 4) Storage racks in occupancies open to the general public (e.g., warehouse retail stores).
    - b. Component Importance Factor: 1.0.
      - 1) All other components
    - c. Component Response Modification Factor: Per the structural drawings and specifications.
    - d. Component Amplification Factor: Per the structural drawings and specifications.
  - 3. Design Spectral Response Acceleration at Short Periods: Per the structural drawings and specifications.
  - 4. Design Spectral Response Acceleration at 1-Second Period: Per the structural drawings and specifications.

## **1.8 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Submittals shall include catalog cut sheets and installation instructions for each type of anchor and seismic restraint used on equipment or components being isolated and/or restrained.
  - 2. Submittals for mountings and hangers incorporating springs shall include spring diameter and free height, rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  - 4. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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. "Basis for Design" report: Statement from the registered design professional that the design complies with the requirements of the ASCE 7-05 Chapter 13, IBC 2009 chapter 1912 and ACI 318. In addition, the basis for compliance must also be noted, as listed below:
  - a. Project specific design documentation prepared and submitted by a registered design professional (ASCE 7, 13.2.1.1)
  - b. Submittal of the manufacturer's certification that the isolation equipment is seismically qualified by:
  - c. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
  - d. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
  - e. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
2. Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer. Copies of testing and calculations must be submitted as part of submittal documents. OSHPD pre-approved restraint systems are exempt from this requirement if their pre-approval is current and based upon the IBC 2009 (i.e. OPA-07 pre-approval numbers).
3. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
4. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
  - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
5. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
6. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
7. Seismic -Restraint Details:

- a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

## **1.9 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
  1. Submittal drawings and calculations must be stamped by a registered professional engineer in the State where the project is being constructed who is responsible for the seismic restraint design.
  2. Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control test reports.

## **1.10 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

## 1.11 SEISMIC CERTIFICATION OF EQUIPMENT

- A. Component Importance Factor. All plumbing and mechanical components shall be assigned a component importance factor. The component importance factor,  $I_p$ , shall be taken as 1.5 if any of the following conditions apply:
1. The component is required to function for life-safety purposes after an earthquake.
  2. The component contains hazardous materials.
  3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
- B. All other components shall be assigned a component importance factor,  $I_p$ , equal to 1.0.
- C. For equipment or components where  $I_p = 1.0$ .
1. Submit manufacturer's certification that the equipment is seismically qualified by:
    - a. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
    - b. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
    - c. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
  2. The equipment and components listed below are considered rugged and shall not require Special Seismic Certification:
    - a. Valves (not in cast-iron housings, except for ductile cast iron).
    - b. Pneumatic operators.
    - c. Hydraulic operators.
    - d. Motors and motor operators.
    - e. Horizontal and vertical pumps (including vacuum pumps).
    - f. Air compressors
    - g. Refrigerators and freezers.
    - h. Elevator cabs.
    - i. Underground tanks.
    - j. Equipment and components weighing not more than 20 lbs. supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with Chapter 13, ASCE 7.
  3. Rugged equipment and components in this section are for factory assembled discrete equipment and components only and do not apply to site assembled or field assembled equipment or equipment anchorage. The list is based in part on OSHPD Code Application Notice 2-1708A.5.
- D. Special Certification requirements for Designated Seismic Systems (i.e.  $I_p = 1.5$ ): Seismic Certificates of Compliance supplied by manufacturers shall be submitted for all components that are part of Designated Seismic Systems. In accordance with the ASCE 7, certification shall be via one of the following methods:
1. For active mechanical and electrical equipment that must remain operable following the design earthquake:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- a. Testing as detailed by part C.1.b above.
  - b. Experience data as detailed by part C.1.c above.
  - c. Equipment that is considered "rugged" per part C.2 above.
2. Components with hazardous contents shall be certified by the manufacturer as maintaining containment following the design earthquake by:
- a. Testing as detailed by part C.1.b above.
  - b. Experience data as detailed by part C.1.c above.
  - c. Engineering analysis utilizing dynamic characteristics and forces. Tanks (without vibration isolators) designed by a registered design professional in accordance with ASME Boiler and Pressure Vessel Code, and satisfying the force and displacement requirements of Sections 13.3.1 and 13.3.2 of ASCE 7 having an importance factor,  $I_p = 1.0$  shall be considered to satisfy the Special Seismic Certification requirements on the basis of ASCE 7 Section 13.6.9.

## **PART 2 - PRODUCTS**

### **2.1 VIBRATION ISOLATORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
  2. CalDyn (California Dynamics Corporation).
  3. ISAT (International Seismic Application Technology).
  4. Kinetics Noise Control.
  5. Mason Industries.
  6. Vibro-Acoustics
  7. VMC (Vibration Mountings & Controls, Inc.)
- B. Elastomeric Isolation Pads P1:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  2. Size: Factory or field cut to match requirements of supported equipment.
  3. Pad Material: Oil and water resistant with elastomeric properties.
  4. Surface Pattern: Ribbed pattern.
  5. Load-bearing metal plates adhered to pads.
- C. Double-Deflection, Elastomeric Isolation Mounts M1:
1. Mounting Plates:
    - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded, or with threaded studs or bolts.
    - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
  2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
- D. Restrained Elastomeric Isolation Mounts M2:



1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  - a. Housing: Cast-ductile iron or welded steel.
  - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
  
- E. Spring Isolators S1: Freestanding, laterally stable, open-spring isolators.
  1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
  6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
  
- F. Restrained Spring Isolators S2: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
  1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Baseplates shall limit floor load to 500 psig.
  2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  
- G. Housed Restrained Spring Isolators S3: Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
  1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
  2. Outside 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 pad: For high frequency absorption at the base of the spring.

H. Elastomeric Hangers H1:

1. Description: Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods
  - a. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
  - b. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

I. Spring Hangers H2: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and Insert in Compression.
  - a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  - g. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Spring Hangers with Vertical-Limit Stop H3: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and insert in Compression and vertical limit stop.
  - a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  - g. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.



- E. Lower Support Assembly: The lower support assembly shall be a formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- F. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch-thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
  - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic and wind restraint.
    - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
    - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
    - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch-thick.
- H. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

### **2.3 VIBRATION ISOLATION EQUIPMENT BASES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amber/Booth Company, Inc.
  - 2. CalDyn (California Dynamics Corporation).
  - 3. ISAT (International Seismic Application Technology).
  - 4. Kinetics Noise Control.
  - 5. Mason Industries.
  - 6. Vibro-Acoustics
  - 7. VMC (Vibration Mountings & Controls, Inc.)
- B. Steel Bases and Rails SB1: Factory-fabricated, welded, structural-steel bases and rails.
  - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Inertia Base IB1: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than [1-inch] 2-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
    - a. Include supports for suction and discharge elbows for pumps.
  2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
  4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

## 2.4 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
  2. CalDyn (California Dynamics Corporation).
  3. ISAT (International Seismic Application Technology).
  4. Kinetics Noise Control.
  5. Mason Industries.
  6. Vibro-Acoustics
  7. VMC (Vibration Mountings & Controls, Inc.)
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES..
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
  2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
  3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.
- D. Channel Support System: MFMA-4, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

- E. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Cables located in exterior or other wet locations such as wash-down areas shall be stainless steel.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- G. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- L. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
- M. All post installed anchors utilized in the seismic design must be qualified for use in cracked concrete and approved for use with seismic loads.
- N. Expansion anchors shall not be used for anchorage of equipment with motors rated over 10 HP with the exception of undercut expansion anchors. Spring or internally isolated equipment are exempt from this requirement.
- O. All beam clamps utilized for vertical support must also incorporate retention straps.
- P. All seismic brace arm anchorages to include concrete anchors, beam clamps, truss connections, etc., must be approved for use with seismic loads.

## **2.5 FACTORY FINISHES**

- A. Finish: Manufacturer's standard paint applied to factory-assembled and tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 COORDINATION**

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting vibration/seismically rated equipment. Concrete shall have a minimum compressive strength of 4,000 psi or as specified by the project engineer. Coordinate size, thickness, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint device manufacturer to ensure adequate space, embedment and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.
- C. Housekeeping pads shall have adequate space to mount equipment and seismic restraint devices.
- D. Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors and shall also be large enough and thick enough to ensure adequate edge distance and embedment depth for restraint anchor bolts to avoid housekeeping pad breakout failure. Refer seismic restraint manufacturer's written instructions.
- E. Coordinate with vibration/seismic restraint manufacturer and the structural engineer of record to locate and size structural supports underneath vibration/seismically restrained equipment (e.g. roof curbs, cooling towers and other similar equipment). Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions. Adjust isolators and restraints after piping systems have been filled and equipment is at its operating weight, following the manufacturer's written instructions.

#### **3.3 APPLICATIONS**

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES and per the seismic restraint manufacturer's design..

- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### **3.4 VIBRATION-CONTROL DEVICE INSTALLATION**

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.
- C. Isolate all mechanical equipment 0.75 hp and over per the isolator and seismic restraint schedule and these specifications. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections
- D. All isolation materials and seismic restraints shall be of the same vendor and shall be selected and certified using published or factory certified data
- E. Installation of all vibration isolation materials, flexible connectors and supplemental equipment bases specified in this section shall be accomplished as per the manufacturer's written instructions with mountings adjusted to level equipment. Any variance or non-compliance with the manufacturer's instructions shall be reviewed and approved in writing by the manufacturer or corrected by the contractor in an approved manner.
- F. Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- G. Locate isolation hangers as near to the overhead support structure as possible.
- H. No rigid connections between isolated components and the building structure shall be made that degrades the noise and vibration control system herein specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls. "Components" includes, but is not limited to, mechanical equipment, piping and ducts.
- I. Coordinate work with other trades to avoid rigid contact with the building.
- J. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- K. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- L. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.



- M. Use horizontal thrust restraints T1 to protect Air handling equipment and centrifugal fans against excessive displacement which results from high air thrust when thrust forces exceed 10% of the equipment weight.
- N. Isolated equipment, duct and piping located on roofs must be attached to the structure. Supports (e.g., sleepers) that are not attached to the structure will not be acceptable.
- O. On completion of installation of all isolation materials and before startup of isolated equipment all debris shall be cleared from areas surrounding and from beneath all isolated equipment, leaving equipment free to move on the isolation supports.
- P. All floor mounted isolated equipment shall be protected with specification M1, M2, S1, S2 or S3 isolator.
- Q. Horizontal Pipe Isolation: All HVAC pumped water, pumped condensate, glycol, and refrigerant piping size 1-1/4" and larger within mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50' or 100 pipe diameters from rotating equipment. For the first three (3) support locations from externally isolated equipment provide specification H2 or H3 hangers or specification S1, S2 or S3 mounts with the same deflection as equipment isolators (max 2"). All other piping within the equipment rooms shall be isolated with the same specification isolators with a 3/4" minimum deflection. Steam piping size 1-1/4" and larger which is within an equipment room and connected to rotating equipment shall be isolated for three (3) support locations from the equipment. Provide specification H2 or H3 hangers, or specification S1 or S2 mounts with the same deflection as equipment isolators but a minimum of 3/4".
- R. Install full line size flexible pipe connectors at the inlet and outlet of each pump, cooling tower, condenser, chiller, coiling connections and where shown on the drawings. All connectors shall be suitable for use at the temperature, pressure, and service encountered at the point of installation and operation. End fitting connectors shall conform to the pipefitting schedule. Control rods or protective braid must be used to limit elongation to 3/8". Flexible connectors shall not be required for suspended in-line pumps.
- S. All plumbing pumped water, piping size 1-1/4" and larger within mechanical rooms shall be isolated the same as HVAC piping above. Isolators are not required for any plumbing pumped water, pumped condensate, and steam piping outside of mechanical rooms unless listed in the isolation schedule.
- T. Pipe Riser Isolation: The operating weight of all variable temperature vertical pipe risers 1-1/4" and larger, requiring isolation where specifically shown and detailed on riser drawings shall be fully supported by specification M1, M2 or R1 supports. S1, S2, S3, H2 or H3 steel spring deflection isolators with minimum 3/4-inch minimum shall be in those locations where added deflection is required due to pipe expansion and contraction. Spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Height saving brackets used with isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. Specification R1 riser supports shall be installed near the center point of the riser to anchor the riser when spring isolation is used. Specification R2 riser guides may be used in conjunction with spring isolators per design calculations. Pipe risers up through 16" shall be supported at intervals of every third floor of the building. Pipe risers 18" and over, every second floor. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Horizontal take-offs and at upper and lower elbows shall be supported with spring isolators as required to accommodate anticipated movement. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include

certification that the riser system has been examined for excessive stresses and that none will exist if installed per design proposed.

- U. Where riser pipes pass through cored holes, core diameters shall be a maximum of 2" larger than pipe O.D. including insulation. Cored holes must be packed with resilient material or firestop as provided by other sections of this specification or local codes. Where seismic restraint is required specification isolator S3 shall support risers and provide longitudinal restraint at floors where thermal expansion is minimal and will not bind isolator restraints.
- V. Duct Isolation: Isolate all duct work with a static pressure 2" W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type H2 or H3 hangers or type S1 or S2 floor mounts.

### **3.5 SEISMIC-RESTRAINT DEVICE INSTALLATION**

#### **A. Equipment Restraints:**

1. On projects with Seismic Site Class A or B, seismic design or restraint is not required.
2. On projects with Seismic Design Category C: Components with an importance factor of 1.0 do not require seismic design or restraint.
3. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
4. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
5. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES. providing required submittals for component.
6. Suspended Equipment: All suspended equipment that meets any of the following conditions requires seismic restraints as specified by the supplier:
  - a. Rigidly attached to pipe or duct that is 75 lbs. and greater,
  - b. Items greater than 20 lbs and distribution systems weighing more than 5 lbs/lineal foot, with an importance factor of 1.0 hung independently or with flexible connections.
  - c. Possibility of consequential damage.
  - d. For importance factors greater than 1.0 all suspended equipment requires seismic restraint regardless of the above notes.
  - e. Wall mounted equipment weighing more than 20 lbs.
  - f. Exemptions:
    - 1) Equipment weighing less than 20 lbs and distribution systems weighing less than 5 lbs/lineal foot, with an  $I_p = 1.0$  and where flexible connections exist between the component and associated ductwork, piping or conduit.
7. Base Mounted Equipment: All base mounted equipment that meets any of the following conditions requires attachments and seismic restraints as specified by the supplier:
  - a. Connections to or containing hazardous material,
  - b. With an overturning moment.

- c. Weight greater than 400 lbs.
  - d. Mounted on a stand 4 ft. or more from the floor
  - e. Possibility of consequential damage.
  - f. For importance factors greater than 1.0 all base mounted items require seismic restraints regardless of the above notes.
  - g. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
  - h. Exemptions:
    - 1) Floor or curb-mounted equipment weighing less than 400 lbs and not resiliently mounted, where the Importance Factor,  $I_p = 1.0$ , the components are mounted at 4 feet or less above a floor level, flexible connections between the components and associated duct work, piping and conduit are provided and there is no possibility of consequential damage.
8. Roof Mounted Equipment:
- a. To be installed on a structural frame, seismically rated roof curb, or structural curb frame mechanically connected to the structure. Items shall not be mounted onto sleepers or pads that are not mechanically and rigidly attached to the structure. Restraint must be adequate to resist both seismic and wind forces.
  - b. Roof curbs shall be installed directly to building structural steel or concrete roof deck and not to top of steel deck or roofing material.
  - c. Exemptions:
    - 1) Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.
9. Rigid Mounted Equipment:
- a. Anchor floor and wall mounted equipment to the structure as per the stamped seismic certifications / drawings.
  - b. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
  - c. Suspended equipment shall be restrained using seismic cable restraints, or struts, and hanger rods as per the stamped seismic certifications / drawings.
10. Vibration Isolated Equipment:
- a. Seismic control shall not compromise the performance of noise control, vibration isolation or fire stopping systems.
  - b. Equipment supported by vibration-isolation hangers shall be detailed and installed with approximately a 1/8" gap between the isolation hangers and the structure. Isolators at restraint locations must be fitted with uplift limit stops.
- B. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- C. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

- E. Installation and adjustment of all seismic restraints specified in this section shall be accomplished as per the manufacturer's written instructions. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.
- F. Piping Restraints:
1. Comply with requirements in MSS SP-127.
  4. Seismically restrain piping, with an  $I_p = 1.0$ , located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is  $1\frac{1}{4}$ " I.D. and larger.
  5. Seismically restrain all other  $I_p = 1.0$  piping  $2\frac{1}{2}$ " diameter and larger.
  6. Seismically restrain all  $I_p = 1.5$  piping larger than 1" diameter.
  7. Branch lines may not be used to brace main lines.
  8. Exemptions:
    - a. All high deformability pipe 3" or less in diameter suspended by individual hanger rods where  $I_p = 1.0$ .
    - b. High deformability pipe or conduit in Seismic Design Category C, 2" or less in diameter suspended by individual hanger rods where  $I_p = 1.5$ .
    - c. High deformability pipe in Seismic Design Category D, E or F, 1" or less in diameter suspended by individual hanger rods where  $I_p = 1.5$ .
    - d. All clevis supported pipe runs installed less than 12" from the top of the pipe to the underside of the support point and trapeze supported pipe suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.
    - e. Piping systems, including their supports, designed and constructed in accordance with ASME B31.
    - f. Piping systems, including their supports, designed and constructed in accordance with NFPA, provided they meet the force and displacement requirements of Section 13.3.1 and 13.3.2 (ASCE 7).
- G. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.
- H. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.
- I. Where pipe sizes reduce below dimensions required for seismic, the final restraint shall be installed at the transition location.
- J. Restraint Spacing For Piping: Sizes shown are maximum. Actual spacing determined by calculation.
1. For non-ductile piping (e.g., cast iron, PVC) space transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
  2. For piping with hazardous material inside (e.g., natural gas, medical gas) space Transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
  3. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.
  4. For all other ductile piping see Table "A" below

- K. Seismic Restraint of Ductwork: Seismically restrain per specific code requirements, all ductwork listed below (unless otherwise indicated on the drawings), using seismic cable restraints: (Ductwork not meeting criteria listed below is to be "Exempt")
1. Restrain rectangular ductwork with cross sectional area of 6 square feet or larger. Duct with and an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.
  2. Restrain round ducts with diameters of 28" or larger. Duct with an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.
  3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
  4. Duct must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze. Additional reinforcing is not required if duct sections are mechanically fastened together with frame bolts and positively fastened to the duct support suspension system.
  5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
  6. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
  7. If ducts are supported by angles, channels or struts, ducts shall be fastened to it at seismic brace locations in lieu of duct reinforcement.
  8. All ductwork weighing more than 17 lb/ft.
  9. Exemptions:
    - a. Duct runs supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork. This exemption does not apply to ducts with an importance factor of 1.5.
  10. See Table "A" below for restraint spacing.
- L. Exemptions do not apply for:
1. Life Safety or High Hazard Components
    - a. Including gas, fire protection, medical gas, fuel oil and compressed air needed for the continued operation of the facility or whose failure could impair the facility's continued operation, Occupancy Category IV, IBC-2009 as listed in Section 1.3 B regardless of governing code for HVAC, Plumbing, Electrical piping or equipment. (A partial list is illustrated.) High Hazard is additionally classified as any system handling flammable, combustible or toxic material. Typical systems not excluded are additionally listed below.
  2. Piping
    - a. Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Fire Sprinkler Branch Lines must be end tied.
  3. Duct

Lehi Municipal Pool Building - Addition and Remodel  
 451 East 200 South  
 Lehi, Utah 84043

- a. Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override.

4. Equipment

- a. Previously excluded non life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers and humidifiers having a weight greater than 75 lbs require independent seismic bracing.

M. Spacing Chart For Suspended Components:

Table "A" Seismic Bracing (Maximum Allowable Spacing Shown- Actual Spacing to Be Determined by Calculation)			
Equipment	On Center Transverse	On Center Longitudinal	Change Of Direction
Duct			
All Sizes	30 Feet	60 Feet	4 Feet
Pipe Threaded, Welded, Soldered Or Grooved			
To 16"	40 Feet	80 Feet	4 Feet
18" – 28"	30 Feet	60 Feet	4 Feet
30" – 40"	20 Feet	60 Feet	4 Feet
42" & Larger	10 Feet	30 Feet	4 Feet

N. Roof mounted duct is to be installed on sleepers or frames mechanically connected to the building structure. Roof anchors and seismic cables or frames shall be used to resist seismic and wind loading. Wind loading factors shall be determined by the registered design professional.

O. Where duct sizes reduce below dimensions required for seismic restraint the final restraint shall be installed at the transition location.

P. Install cables so they do not bend across edges of adjacent equipment or building structure.

Q. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

R. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

S. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

T. Seismically Rated Beam Clamps are required where welding to or penetrations to steel beams are not approved.

U. Drilled-in Anchors:

- 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### **3.6 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION**

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

### **3.7 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
  1. A representative of the vibration isolation system manufacturer shall review the project installation and provide documentation indicating conformance to vibration isolation design intent
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.
  1. The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

### **3.8 IDENTIFICATION**

- A. Install identification tags at all seismic brace locations. Tags to include the following information:
  1. Specific seismic forces (g-force) the location was designed to resist.
  2. Maximum brace reaction at connection to structure.
  3. For single hung items, the maximum pipe/conduit size the brace location was designed to accommodate.
  4. For trapeze supported items, the maximum weight (lbs/lf) the brace location was designed to accommodate.

Lehi Municipal Pool Building - Addition and Remodel  
 451 East 200 South  
 Lehi, Utah 84043

5. For suspended equipment, the maximum unit operating weight (lbs) the brace location was designed to accommodate.
6. Location identifier cross matched to that on plan set layout.
7. Company name of installing contractor.

### 3.9 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
  1. Adjust active height of spring isolators.
- C. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

EQUIPMENT ISOLATION SCHEDULE									
LOCATION  EQUIPMENT (1)	A' CRITICAL (35'-50' SPAN)			B' UPPER STORY (20'-35' SPAN)			C' GRADE		
	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE
AIR HANDLING UNITS FLOOR MOUNTED UP TO 15 HP 20 HP & OVER	S3 S3	1.5 2.5	 SB1	S3 S3	0.75 1.5	 	S3 S3	0.75 0.75	 
SUSPENDED UP TO 15 HP 20 HP & OVER	H3 H3	1.75 2.5	 SB1	H3 H3	1 1.75	 	H3 H3	1 1	 
HIGH PRESSURE FAN SECTIONS UP TO 30 HP 40 HP & OVER	S1 S1	2.5 3.5	IB1 IB1	S3 S3	1.5 2.5	IB1 IB1	S3 S3	0.75 1.5	IB1 IB1
CENTRIFUGAL FANS CL. I & II UP TO 54-112" W.D. UPT015HP 20-50 HP 60 HP & OVER	S3 S1 S1	1.5 2.5 3.5	SB1 IB1 IB1	S3 S3 S1	0.75 1.5 2.5	SB1 IB1 IB1	S3 S3 S3	0.75 0.75 1.5	SB1 SB1 SB1
CL. I & II 60" W.D. & OVER I ALL CL. III FANS UPT015HP 20-50 H P 60 HP & OVER	S1 S1 S1	2.5 2.5 3.5	IB1 IB1 IB1	S3 S1 S1	1.5 2.5 2.5	IB1 IB1 IB1	S3 S3 S3	0.75 1.5 1.5	IB1 IB1 IB1
AXIAL FLOWFANS FLOOR MTD. UP TO 15 HP 20 HP & OVER	S3 S1	1.5 3.5	SB1 IB1	S3 S3	0.75 1.5	 	S3 S3	0.75 0.75	 
SUSPENDED UP TO 15 HP 20 HP & OVER	H3 H3	1.75 2.5	SB1 SB1	H3 H3	1 1.75	 SB1	H3 H3	1 1.5	 
VENT (UTILITY SETS) FLOOR MTD SUSPENDED	S3 H3	1.5 1.75	SB1 SB1	S3 H3	0.75 1	 	S3 H3	0.75 0.75	 
CABINET FANS, FANS SECTIONS FLOOR MTD. UP TO 15 HP 20 HP & OVER	S3 S1	1.5 2.5	 IB1	S3 S3	0.75 1.5	 	S3 S3	0.75 0.75	 
SUSPENDED UP TO 15 HP 20 HP & OVER	H3 H3	1.75 2.5	 SB1	H3 H3	1 1.75	 	H3 H3	0.75 1.75	 
PUMPS FLOOR MTD.									



Lehi Municipal Pool Building - Addition and Remodel  
 451 East 200 South  
 Lehi, Utah 84043

UP TO 15 HP	S3	0.75	IB1	S3	0.75	IB1	SRVD	0.4	IB1
7-112 HP & OVER	S3	1.5	IB1	S3	1.5	IB1	S3	0.75	IB1
SUSPENDED INLINE	H3	1.75		H3	1.75		H3	1	
REFRIGERATION UNITS									
RECIPROCATING COMPRESSORS	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	IB1
RECIPROCATING CONDENSING UNITS & CHILLERS	S1	2.5	IB1	S3	1.5		S3	0.75	
HERMETIC CENTRIFUGALS	S3	2.5		S3	1.5		P1	0.15	
OPEN CENTRIFUGALS	S1	2.5	IB1	S3	1.5	IB1	P1	0.15	
ABSORPTION MACHINES	S3	1.5		S3	0.75		P1	0.15	
AIR COMPRESSORS									
TANK TYPE (HORIZONTAL TANK)	S1	2.5	IB1	S3	1.5		S3	0.75	
TANK TYPE (VERTICAL TANK)	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	
COOLING TOWERS & CLOSED CIRCUIT COOLERS									
UP TO 500 TONS	S3	2.5		S3	0.75		P1	0.15	
OVER 500 TONS	S3	4.5		S3	2.5		P1	0.15	
AIR COOLED CONDENSERS									
UP TO 50 TONS	S3	1.5		S3	0.75		P1	0.15	
OVER 50 TONS	S3	2.5		S3	1.5		P1	0.15	
ROOFTOP AIR CONDITIONING UNITS									
REQUIRING WEATHER SEAL									
UP TO 5000 CFM (12 TON)	S1	1.5	RC1	S1	0.75	RC1			
OVER 5000 CFM (12 TON)	S3	2.5	RC1	S3	1.5	RC1			
OTHER TYPES									
UP TO 25 TONS	S3	1.5		S3	1.5				
OVER 25 TONS	S3	2.5		S3	1.5				
BOILER (PACKAGE TYPE)									
ALL SIZES	S3	1.5		S3	0.75		P1	0.15	
ENGINE DRIVEN GENERATORS									
UP TO 60 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	
75 HP & OVER	S1	3.5	IB1	S3	2.5	IB1	S3	0.75	

NOTES:

- 1) Thrust restraints required on all high-pressure fan section, suspended axial-flow fans and on floor-mounted axial fans operating at 3.0" S.P. or greater.

**END OF SECTION 230548**



**SECTION 230550**

**OPERATION AND MAINTENANCE OF HVAC SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. All pertinent sections of Division 21, 22, & 23 Mechanical General Requirements, are part of the work of this Section. Division 1 is part of this and all other sections of these specifications.
  - 1. Testing and Balancing is specified in section 230594.
  - 2. Training and Instructions to Owner's Representative is specified in section 230100.

**1.2 SCOPE OF WORK**

- A. Submission of Operating and Maintenance Manuals complete with Balancing reports. (Coordinate with Division 1).
- B. Coordination of work required for system commissioning.
- C. Provide a hard copy and an electronic copy of the O and M manual fully searchable in PDF format.

**1.3 SUBMITTALS**

- A. Submit product data in accordance with Division 1 and Section 230100. Submit the following:
  - 1. Sample of O and M manual outline.

**PART 2 - PRODUCTS**

**2.1 O & M MANUALS**

- A. The operating and maintenance manuals shall be as follows:
  - 1. Binders shall be red buckram with easy-view metal for size 8-1/2 x 11-inch sheets, with capacity expandable from 2 inches to 3-1/2 inches as required for the project. Construction shall be rivet-through with library corners. No. 12 backbone and lining shall be the same material as the cover. The front cover and backbone shall be foil-stamped in white as follows: (coordinate with Division 01 )

OPERATING AND MAINTENANCE  
MANUAL  
FOR THE

LEHI MUNICIPAL POOL BUILDING - ADDITION AND REMODEL

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

(INSERT PROJECT COMPLETION YEAR)

VOLUME No. ( )

VAN BOERUM & FRANK ASSOCIATES, INC.  
MECHANICAL ENGINEER

(INSERT ARCHITECT)

Binders shall be a manufactured by:

We R Memory Makers  
Attn: Melvin Hiller  
631 North 400 West  
Salt Lake City, Utah 84103  
801-539-5000

### **PART 3 - EXECUTION**

#### **3.1 OPERATING AND MAINTENANCE MANUALS:**

- A. Work under this section shall be performed in concert with the contractor performing the system testing and balancing. Six (6) copies of the manuals shall be furnished to the Architect for distribution to the owner.
- B. The "Start-Up and Operation" section is one of the most important in the manual. Information in this section shall be complete and accurately written and shall be verified with the actual equipment on the job, such as switches, starters, relays, automatic controls, etc. A step-by-step start-up procedure shall be described.
- C. The manuals shall include water-balancing reports, system commissioning procedures, start-up tests and reports, equipment and system performance test reports, warranties, and certificates of training given to the owner's representatives.

An index sheet typed on AICO Gold-Line indexes shall be provided in the front of the binder. The manual shall be include the following:

SYSTEM DESCRIPTIONS

START-UP PROCEDURE AND OPERATION OF SYSTEM

MAINTENANCE AND LUBRICATION TABLE

OPERATION AND MAINTENANCE BULLETINS

AUTOMATIC TEMPERATURE CONTROL DESCRIPTION OF OPERATION, INTERLOCK AND CONTROL DIAGRAMS, AND CONTROL PANELS.

AIR AND WATER SYSTEM BALANCING REPORTS

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

EQUIPMENT WARRANTIES AND TRAINING CERTIFICATES

SYSTEM COMMISSIONING REPORTS

EQUIPMENT START-UP CERTIFICATES

**END OF SECTION 230100**



**SECTION 230553**

**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.
  - 2. Danger, Warning and Caution signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Danger tags.
  - 8. Warning tags.
  - 9. Caution tags.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

**1.4 COORDINATION**

- 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.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT LABELS**

A. Metal Labels for Equipment:

1. Material and Minimum Thickness, predrilled or stamped holes for attachment hardware:
  - a. Brass, 0.032-inch .
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. 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-fourths the size of principal lettering.
4. Fasteners: Stainless-steel;
  - a. Rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, and having predrilled holes for attachment hardware, 1/16 inch thick.
2. Letter Color:
  - a. Black.
3. Background Color:
  - a. White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. 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-fourths the size of principal lettering.
7. Fasteners: Stainless-steel;
  - a. Rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. 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), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

### **2.2 DANGER, WARNING AND CAUTION SIGNS AND LABELS**

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; 1/16 inch thick.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Danger signs, colors:
  - 1. Letter Color:
    - a. White.
  - 2. Background Color:
    - a. Red.
- C. Warning signs, colors:
  - 1. Letter Color:
    - a. Black.
  - 2. Background Color:
    - a. Orange.
- D. Caution signs, colors:
  - 1. Letter Color:
    - a. Black.
  - 2. Background Color:
    - a. Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. 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-fourths the size of principal lettering.
- H. Fasteners: Stainless-steel;
  - 1. Rivets.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information, plus emergency notification instructions.

### **2.3 PIPE LABELS**

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 incheshigh.

## **2.4 DUCT LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; 1/16 inch thick.
- B. Letter Color:
  - 1. Black .
- C. Background Color:
  - 1. Black .
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. 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-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel;
  - 1. Rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## **2.5 STENCILS**

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material:
    - a. Aluminum .
  - 2. Stencil Paint:
    - a. Exterior, gloss, alkyd enamel black unless otherwise indicated.
    - b. Paint may be in pressurized spray-can form.
  - 3. Identification Paint:
    - a. Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

## **2.6 VALVE TAGS**

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Tag Material, predrilled or stamped holes for attachment hardware, minimum thickness:
  - a. Brass, 0.032-inch
2. Fasteners: Brass;
  - a. Wire-link or beaded chain; or S-hook

B. Valve Schedules:

1. For each piping system, on 8-1/2-by-11-inch bond paper, tabulate;
  - a. Valve number.
  - b. Piping system.
  - c. System abbreviation (as shown on valve tag).
  - d. Location of valve (room or space).
  - e. Normal-operating position (open, closed, or modulating).
  - f. Variations for identification.
  - g. Mark valves for emergency shutoff and similar special uses.
2. Valve-tag schedule:
  - a. Shall be included in operation and maintenance data.

## 2.7 DANGER TAGS

- A. Danger Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size:
    - a. 3 by 5-1/4 inches minimum
  2. Fasteners:
    - a. Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "DANGER," and "DO NOT OPERATE."
  4. Color: Red background with white lettering.

## 2.8 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size:
    - a. 3 by 5-1/4 inches minimum
  2. Fasteners:
    - a. Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "WARNING" and "DO NOT OPERATE."
  4. Color: Yellow background with black lettering.

## 2.9 CAUTION TAGS

- A. Caution Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size:
    - a. 3 by 5-1/4 inches minimum

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. Fasteners:
  - a. Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "CAUTION," and "DO NOT OPERATE."
4. Color: Orange background with black lettering.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.2 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.3 PIPE LABEL INSTALLATION**

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Stenciled Pipe Label Option:
  1. Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option.
  2. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule: (See Drawing Schedules)

**3.4 DUCT LABEL INSTALLATION**

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue : For cold-air supply ducts.
  - 2. Yellow : For hot-air supply ducts.
  - 3. Green : For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
  
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

**3.5 VALVE-TAG INSTALLATION (See Drawing Schedules.)**

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

**3.6 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 230553**



**SECTION 230593**

**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 SUMMARY**

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
  - 2. Balancing Hydronic Piping Systems:
    - a. Constant-flow hydronic systems.
  - 3. Various HVAC Equipment.
    - a. Motors.
    - b. Condensing Units or Rooftop Units.
    - c. Boilers.
    - d. Heat Transfer Coils.
  - 4. Existing Systems.

**1.3 DEFINITIONS**

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: Within the following number of days of the Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article;
  - 1. 30 days.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Certified TAB reports.
- C. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

## **1.5 QUALITY ASSURANCE**

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
  - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB and shall be the same as the TAB Contractor.
  - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician and shall be the same as the TAB Contractor.
- B. Certify TAB field data reports and perform the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by:
  - 1. Architect .
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

## **1.6 PROJECT CONDITIONS**

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## **1.7 COORDINATION**

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on the following distribution systems have been satisfactorily completed:
  - 1. Air .
  - 2. Water .



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

**PART 3 - EXECUTION**

**3.1 TAB SPECIALISTS**

- A. Subject to compliance with requirements, engage one of the following:
  - 1. BTC Service.
  - 2. Certified Test & Balance.
  - 3. Diamond Test & Balance.
  - 4. RS Analysis.
  - 5. Test & Balance Inc.
  - 6. Payson Sheetmetal.
  - 7. Tempco.

**3.2 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, 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 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:
  - 1. Ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in:
    - a. Section 233113 "Metal Ducts"
  - 2. Verify ceiling plenums and underfloor air plenums used for supply, return or relief air are properly separated from adjacent areas.
  - 3. 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 filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. 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.

### **3.3 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

### **3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in this section and:
  - 1. AABC's "National Standards for Total System Balance"
- 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. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- 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) .

### **3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

### **3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  2. Measure fan static pressures as follows to determine actual static pressure:

- a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
  - b. Measure static pressure directly at the fan outlet or through the flexible connection.
  - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
  - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  5. 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.
  6. Obtain approval from one of the following entities 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:
    - a. Architect .
  7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS**

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check liquid level in expansion tank.
  3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### **3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS**

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from the following entity and comply with requirements in Section 232123 "Hydronic Pumps." :
      - 1) Architect .
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake

- horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
  - C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
  - D. Set calibrated balancing valves, if installed, at calculated presettings.
  - E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
    1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
  - F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
  - G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
    1. Determine the balancing station with the highest percentage over indicated flow.
    2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
    3. Record settings and mark balancing devices.
  - H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
  - I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
  - J. Check settings and operation of each safety valve. Record settings.

### **3.9 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. Efficiency rating.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

**3.10 PROCEDURES FOR CONDENSING UNITS and ROOFTOP UNITS**

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.
- D. For Rooftop Units also use procedures for Heat Transfer Coils.

**3.11 PROCEDURES FOR BOILERS**

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.
- B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

**3.12 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Measure, adjust, and record the following data for each refrigerant coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.
  - 4. Air pressure drop.
  - 5. Refrigerant suction pressure and temperature.

**3.13 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS**

- A. Perform a preconstruction inspection of existing air-side equipment including exhaust fans that are to remain and be reused. See Demolition drawings.
  - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
  - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  - 3. Check the condition of filters.
  - 4. Check the operation of the drain pan and condensate-drain trap.
  - 5. Check bearings and other lubricated parts for proper lubrication.
  - 6. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
  - 1. New filters are installed.
  - 2. Coils are clean and fins combed.
  - 3. Drain pans are clean.
  - 4. Fans are clean.
  - 5. Bearings and other parts are properly lubricated.
  - 6. Deficiencies noted in the preconstruction report are corrected.

- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
  - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  - 4. Balance each air outlet.
  
- D. Perform a preconstruction inspection of existing boiler-pool-heater loop. Measure and record the operating speed, GPM, and static pressure of each pump.
  - 1. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  - 2. Check bearings and other lubricated parts for proper lubrication.
  - 3. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

### **3.14 TOLERANCES**

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent .
  - 2. Air Outlets and Inlets: Plus or minus 10 percent .
  - 3. Heating-Water Flow Rate: Plus or minus 10 percent .
  - 4. Cooling-Water Flow Rate: Plus or minus 10 percent .

### **3.15 REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
  
- B. Status Reports: Prepare progress reports on the following interval to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors;
  - 1. Weekly.

### **3.16 FINAL REPORT**

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.



2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
  2. Fan curves.
  3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.
  5. Other information relative to equipment performance; 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 contractor.
  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. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump 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. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.

E. Rooftop-Unit Test Reports: For rooftop 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. 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 air flow 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.

F. Apparatus-Coil Test Reports:

1. Coil Data (refrigerant):
  - a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch o.c.
  - f. Make and model number.
  - g. Face area in sq. ft..
  - h. Tube and fin materials.
  - i. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

G. Gas- Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.
- g. Air static-pressure differential in inches wg.
- h. Low-fire fuel input in Btu/h.
- i. High-fire fuel input in Btu/h.
- j. Manifold pressure in psig.
- k. High-temperature-limit setting in deg F.
- l. Operating set point in Btu/h.
- m. Motor voltage at each connection.
- n. Motor amperage for each phase.
- o. Heating value of fuel in Btu/h.

3. Test Data (Indicated and Actual Values):

- a. Heat output in Btu/h.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- b. Air flow rate in cfm.
- c. Air velocity in fpm.
- d. Entering-air temperature in deg F.
- e. Leaving-air temperature in deg F.
- f. Voltage at each connection.
- g. Amperage for each phase.

H. 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.

I. 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 air flow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual air flow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

J. Air-Terminal-Device Reports:

1. Unit Data:
  - a. System and air-handling unit identification.
  - b. Location and zone.
  - c. Apparatus used for test.
  - d. Area served.
  - e. Make.
  - f. Number from system diagram.
  - g. Type and model number.
  - h. Size.
  - i. Effective area in sq. ft..
2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm.
  - b. Air velocity in fpm.
  - c. Preliminary air flow rate as needed in cfm.
  - d. Preliminary velocity as needed in fpm.
  - e. Final air flow rate in cfm.
  - f. Final velocity in fpm.
  - g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
  - a. System and air-handling-unit identification.
  - b. Location and zone.
  - c. Room or riser served.
  - d. Coil make and size.
  - e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm.
  - b. Entering-water temperature in deg F.
  - c. Leaving-water temperature in deg F.
  - d. Water pressure drop in feet of head or psig.
  - e. Entering-air temperature in deg F.
  - f. Leaving-air temperature in deg F.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
  - a. Unit identification.
  - b. Location.
  - c. Service.
  - d. Make and size.
  - e. Model number and serial number.
  - f. Water flow rate in gpm.
  - g. Water pressure differential in feet of head or psig.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

### 3.17 INSPECTIONS

A. Initial Inspection:

- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
- 2. Check the following for each system:
  - a. Measure airflow of at least 10 percent of air outlets.
  - b. Measure water flow of at least 5 percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Verify that balancing devices are marked with final balance position.
  - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by:
    - a. Architect .
  2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of:
    - a. Architect .
  3. The following entity shall 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:
    - a. Architect .
  4. 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."
  5. 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.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. 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 contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

### **3.18 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 230593**





## **SECTION 230713**

### **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 and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
- B. Related Sections:
  - 1. Section 230716 "HVAC Equipment Insulation."
  - 2. Section 230719 "HVAC Piping Insulation."
  - 3. Section 233113 "Metal Ducts" for duct liners.

##### **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. 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 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 in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- 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.
- C. Coordinate installation and testing of heat tracing.

## **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," and "Aboveground, Outdoor 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.
- 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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ . Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.

## 2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
1. Products: Subject to compliance with requirements, provide one of the following :
    - a. CertainTeed Corp.; FlameChek.
    - b. Johns Manville; Firetemp Wrap.
    - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
    - d. Thermal Ceramics; FireMaster Duct Wrap.
    - e. 3M; Fire Barrier Wrap Products.
    - f. Unifrax Corporation; FyreWrap.

## 2.3 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. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aeroseal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- d. Mon-Eco Industries, Inc.; 22-25.
  2. 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).
  3. Adhesive 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."
- D. FSK Jacket Adhesive, and ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive 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."

## 2.4 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. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  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.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
  - b. Eagle Bridges - Marathon Industries; 550.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
  - d. Mon-Eco Industries, Inc.; 55-50.
  - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.

## 2.5 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. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    - c. Vimasco Corporation; 713 and 714.
  3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  4. Service Temperature Range: 0 to plus 180 deg F.
  5. Color: White.

## 2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Eagle Bridges - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - d. Mon-Eco Industries, Inc.; 44-05.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg F.
  5. Color: Aluminum.
  6. 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).

7. 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."

## 2.7 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.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper .
    - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper .

## 2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fason 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 488 AWF.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fason 0800.
  - c. Compac Corporation; 120.
  - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## 2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal .
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

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.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
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.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CHP-1.
    - 2) GEMCO; Cupped Head Weld Pin.



- 3) Midwest Fasteners, Inc.; Cupped Head.
  - 4) Nelson Stud Welding; CHP.
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. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened 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. Products: Subject to compliance with requirements, provide one of the following:
    - 1) GEMCO; Nylon Hangers.
    - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
  - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
  - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
    - 2) GEMCO; Peel & Press.
    - 3) Midwest Fasteners, Inc.; Self Stick.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel , fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.

### 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 2 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.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- 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. Comply with requirements in Section 078413 "Penetration Firestopping."

### **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 MINERAL-FIBER 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



inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. 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 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; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.

### **3.8 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. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

### **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."

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

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 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 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.

### **3.11 DUCT INSULATION SCHEDULE, GENERAL**

- A. Plenums and Ducts Requiring Insulation:
  1. Indoor, concealed supply and outdoor air.
  2. Indoor, exposed supply and outdoor air.
  3. Indoor, concealed return located in unconditioned space.
  4. Indoor, exposed return located in unconditioned space.
- B. Items Not Insulated:
  1. Fibrous-glass ducts.
  2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  3. Factory-insulated flexible ducts.
  4. Factory-insulated plenums and casings.
  5. Flexible connectors.
  6. Vibration-control devices.
  7. Factory-insulated access panels and doors.

### **3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE**

- A. Concealed, round, supply-air duct insulation shall be one of the following:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Concealed, round, return-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- C. Concealed, round, outdoor-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- D. Concealed, round, exhaust-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- E. Concealed, rectangular, supply-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- F. Concealed, rectangular, return-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- G. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- H. Exposed, round, supply-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
  3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- I. Exposed, round, return-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
  3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- J. Exposed, round, outdoor-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
  3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- K. Exposed, rectangular, supply-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
  3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- L. Exposed, rectangular, return-air duct insulation shall be one of the following:
  - 1. Flexible Elastomeric: 1 inch thick.
  - 2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
  - 3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
  
- M. Exposed, rectangular, outdoor-air duct insulation shall be one of the following:
  - 1. Flexible Elastomeric: 1 inch thick.
  - 2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
  - 3. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

**END OF SECTION 230713**



**SECTION 230800**  
**COMMISSIONING OF HVAC**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
  - 1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements.

**1.3 DEFINITIONS**

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

**1.5 ALLOWANCES**

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 012100 "Allowances."

**1.6 UNIT PRICES**

- A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Section 012200 "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

**1.7 CONTRACTOR'S RESPONSIBILITIES**

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

**1.8 CxA'S RESPONSIBILITIES**

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

**1.9 COMMISSIONING DOCUMENTATION**

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
  - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
  - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
  - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
  - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
  - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
  - 6. Test and inspection reports and certificates.
  - 7. Corrective action documents.

8. Verification of testing, adjusting, and balancing reports.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 TESTING PREPARATION**

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

### **3.2 TESTING AND BALANCING VERIFICATION**

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
  1. The CxA will notify testing and balancing Contractor days in advance of the date of field verification. Notice will not include data points to be verified.
  2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.

4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

### **3.3 GENERAL TESTING REQUIREMENTS**

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
  1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

2. Description of equipment for flushing operations.
  3. Minimum flushing water velocity.
  4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- C. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of gas systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.
- G. Rooftop Unit and System: Gas heat, direct expansion refrigeration cooling, blower and all associated ductwork.

**END OF SECTION 230800**





**SECTION 231123**

**FACILITY NATURAL-GAS 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. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Pressure regulators.
  - 6. Mechanical sleeve seals.
  - 7. Grout.
  - 8. Concrete bases.
  - 9. This division is to pay all costs associated with the gas meter that are required by the local gas company/authority.

**1.3 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 2 psig but not more than 5 psig, and is reduced to secondary pressure of more than 0.5 psig but not more than 2 psig.

- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

## **1.5 SUBMITTALS**

- A. Product Data: For each type of the following:
  - 1. Piping specialties.
  - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 3. Pressure regulators. Indicate pressure ratings and capacities.
  - 4. Dielectric fittings.
  - 5. Mechanical sleeve seals.
  - 6. Escutcheons.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
  - 1. Shop Drawing Scale: 1/4 inch per foot.
- C. Delegated-Design Submittal: For natural-gas piping and equipment 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 seismic restraints.
  - 2. Design Calculations: Calculate requirements for selecting seismic restraints.
- D. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- F. Qualification Data: For qualified professional engineer.
- G. Welding certificates.
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

## **1.6 QUALITY ASSURANCE**

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- 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.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

## **1.8 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

## **PART 2 - PRODUCTS**

### **2.1 PIPES, TUBES, AND FITTINGS**

- A. Steel Pipe: ASTM A 53, black steel, Schedule 40, Type E or S, Grade B.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  - 2. Wrought-Steel Welding Fittings: ASTM A 234 for butt welding and socket welding.
  - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

### **2.2 PIPING SPECIALTIES**

- A. Appliance Flexible Connectors:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
  2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
  3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
  4. Corrugated stainless-steel tubing with polymer coating.
  5. Operating-Pressure Rating: 0.5 psig.
  6. End Fittings: Zinc-coated steel.
  7. Threaded Ends: Comply with ASME B1.20.1.
  8. Maximum Length: 72 inches.
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
  2. Nitrile seals.
  3. Hand operated with automatic shutoff when disconnected.
  4. For indoor or outdoor applications.
  5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
  3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## **2.3 JOINING MATERIALS**

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## **2.4 MANUAL GAS SHUTOFF VALVES**

- A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
  2. Threaded Ends: Comply with ASME B1.20.1.
  3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
  - a. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Lee Brass Company.
  - b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

- a. McDonald, A. Y. Mfg. Co.
- b. Mueller Co.; Gas Products Div.
- c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flowserve.
  - b. Homestead Valve; a division of Olson Technologies, Inc.
  - c. McDonald, A. Y. Mfg. Co.
  - d. Milliken Valve Company.
  - e. Mueller Co.; Gas Products Div.
  - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

## 2.5 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - a. Vanguard Valves, Inc.
2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 5 psig.
4. Cast-aluminum body with nickel-plated chrome steel internal parts.
5. Nitrile-rubber valve washer.
6. Sight windows for visual indication of valve position.
7. Threaded end connections complying with ASME B1.20.1.
8. Wall mounting bracket with bubble level indicator.

B. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Pacific Seismic Products, Inc.
2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: [0.5 psig] [7 psig] [60 psig].
4. Cast-aluminum body with stainless-steel internal parts.
5. Nitrile-rubber, reset-stem o-ring seal.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

## **2.6 PRESSURE REGULATORS**

### **A. General Requirements:**

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

### **B. Line Pressure Regulators: Comply with ANSI Z21.80.**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Eclipse Combustion, Inc.
  - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - e. Invensys.
  - f. Maxitrol Company.
  - g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

## **2.7 DIELECTRIC FITTINGS**

### **A. Dielectric Unions:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  - f. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
  3. Combination fitting of copper alloy and ferrous materials.
  4. Insulating materials suitable for natural gas.
  5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.
- B. Dielectric-Flange Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  2. Minimum Operating-Pressure Rating: 150 psig.
  3. Companion-flange assembly for field assembly.
  4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
  5. Insulating materials suitable for natural gas.
  6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

## 2.8 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## 2.9 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
  2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

## **2.10 ESCUTCHEONS**

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
  1. Finish: Polished chrome-plated or rough brass.
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
  1. Finish: Polished chrome-plated or rough brass.
- E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

## **2.11 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## **2.12 LABELING AND IDENTIFYING**

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

#### **3.3 INDOOR PIPING INSTALLATION**

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install escutcheons at penetrations of interior walls, ceilings, and floors.
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

- b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - d. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
  - e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
  - f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - g. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw or spring clips.
  - h. Piping in Equipment Rooms: One-piece, cast-brass type.
  - i. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
  - j. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- M. Verify final equipment locations for roughing-in.
- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
- 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
- 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
  - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
  - 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.

4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
  - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
5. Prohibited Locations:
  - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
  - b. Do not install natural-gas piping in solid walls or partitions.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- T. Connect branch piping from top or side of horizontal piping.
- U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- V. Do not use natural-gas piping as grounding electrode.
- W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

### **3.4 VALVE INSTALLATION**

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

### **3.5 PIPING JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Welded Joints:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Construct joints according to AWS D10.12, using qualified processes and welding operators.
  2. Bevel plain ends of steel pipe.
  3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- D. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

### **3.6 HANGER AND SUPPORT INSTALLATION**

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
  5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

### **3.7 CONNECTIONS**

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### **3.8 LABELING AND IDENTIFYING**

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### **3.9 PAINTING**

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel (semigloss).
    - d. Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
    - a. Prime Coat: Quick-drying alkyd metal primer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (flat).
    - d. Color: Gray.
  - 2. Alkyd System: MPI INT 5.1E.
    - a. Prime Coat: Quick-drying alkyd metal primer.
    - b. Intermediate Coat: Interior alkyd matching topcoat.
    - c. Topcoat: Interior alkyd (flat).
    - d. Color: Gray.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### **3.10 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Use 3000-psi 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

**3.11 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

**3.12 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

**3.13 INDOOR PIPING SCHEDULE**

- A. Aboveground, piping NPS 2 and smaller shall be the following:
  - 1. Steel pipe with wrought-steel fittings and welded or threaded joints.
- B. Aboveground, piping NPS 2-1/2" and larger shall be the following:
  - 1. Steel pipe with wrought-steel fittings and welded joints.
- C. Underground, below building, piping shall be the following:
  - 1. Steel pipe with wrought-steel fittings and welded joints in a vented conduit.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

**3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE**

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
  - 1. Bronze plug valve.
  - 2. Cast-iron, nonlubricated plug valve.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**END OF SECTION 231123**



## **SECTION 233001**

### **COMMON DUCT REQUIREMENTS**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. General procedures and requirements for ductwork.
  - 2. Repair leaks in ductwork, as identified by smoke test, at no additional cost to Owner.
  - 3. Soundproofing procedures for duct penetrations of walls, ceilings, and floors in mechanical equipment rooms.
  
- B. Related Sections:
  - 1. Division 07: Quality of Acoustic Sealant.
  - 2. Section 23 0500: Common Work Results for HVAC
  - 3. Section 23 0593: Testing Adjusting and Balancing for HVAC.

##### **1.2 SUBMITTALS**

- A. Samples: Sealer and gauze proposed for sealing ductwork.
  
- B. Quality Assurance / Control:
  - 1. Manufacturer's installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
  - 2. Specification data on sealer and gauze proposed for sealing ductwork.

##### **1.3 QUALITY ASSURANCE**

- A. Requirements: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.
  
- B. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.

#### **PART 2 - PRODUCTS**

##### **2.1 FINISHES,**

- A. Where Applicable: Colors as selected by Architect.

## **2.2 DUCT HANGERS:**

- A. One inch by 18 ga galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches apart. Do not use wire hangers.
  - 1. Attaching screws at trusses shall be 2 inch No. 10 round head wood screws. Nails not allowed.
  - 2. Attach threaded rod to steel joist with Grinnell Steel washer plate Fig. 60 - ph-1. Double nut connection.

## **2.3 PENETRATION SOUNDPROOFING MATERIALS:**

- A. Insulation for Packing: Fiberglass.
- B. Calking: Polysulphide.
- C. Escutcheon Frame: 22 ga galvanized iron 2 inches wide.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.
- B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.
- C. Hangers And Supports:
  - 1. Install pair of hangers close to each transverse joint and elsewhere as required by spacing indicated in table on Drawings.
  - 2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
  - 3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
  - 4. Where hangers are secured to forms before concrete slabs are poured, cut off flush all nails, strap ends, and other projections after forms are removed.
  - 5. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.
- D. Penetration Soundproofing
  - 1. Pack space between ducts and structure full of fiberglass insulation of sufficient thickness to be wedged tight, allowing space for application of calking.
  - 2. Provide calking at least 2 inches thick between duct and structure on both ends of opening through structure.
  - 3. Provide metal escutcheon on Equipment Room side. Secure escutcheon to wall.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**3.2 CLEANING**

- A. Clean interior of duct systems before final completion.

**END OF SECTION 233001**



## **SECTION 233113**

### **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. Duct liner.
  - 5. Sealants and gaskets.
  - 6. Hangers and supports.
- B. Related Sections:
  - 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
  - 3. Section 230713 "Duct Insulation" for duct insulation and fire wrap.

##### **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. Seismic Performance: Duct hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- 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. Liners and adhesives.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.
6. Seismic: For all seismic items refer to Section 230548 "Vibration and Seismic Controls for HVAC."

## 1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including, but not limited to the following:
  - a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Perimeter moldings.

B. Welding certificates.



- C. Field quality-control reports.

## **1.6 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D1.2, "Structural Welding Code - Aluminum," for aluminum supports.
  - 3. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## **PART 2 - PRODUCTS**

### **2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 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: Not allowed.

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.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

D. Reinforcement Shapes and Plates: ASTM A 36, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. 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.

## **2.4 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: Subject to compliance with requirements, provide products by one of the following:
  - a. CertainTeed Corporation; Insulation Group.
  - b. Johns Manville.
  - c. Knauf Insulation.
  - d. Owens Corning.
2. Maximum Thermal Conductivity:

- a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
3. 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.
  4. Water-Based Liner Adhesive:
    - a. Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - b. 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. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA Inc.
    - b. Armacell LLC.
    - c. Rubatex International, LLC
  2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
    - a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, , length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
    - a. 0.135-inch-diameter shank.
  2. Insulation-Retaining Washers: With beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Self-locking washers formed from 0.016-inch-thick aluminum.
- D. 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 build-outs (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).
- 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.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

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, 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. 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).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

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.
6. 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).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 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.

## **2.7 SEISMIC-RESTRAINT DEVICES**

- A. For all seismic items refer to Section 230548 "Vibration and Seismic Controls for HVAC."

## **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 in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines" .

### **3.2 INSTALLATION OF EXPOSED DUCTWORK**

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### **3.3 DUCT SEALING**

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Outdoor, Exhaust Ducts: Seal Class A.
  - 4. Outdoor, Return-Air Ducts: Seal Class A.
  - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.
  - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 7. Unconditioned Space, Exhaust Ducts: Seal Class A.
  - 8. Unconditioned Space, Return-Air Ducts: Seal Class A.
  - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.

10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
11. Conditioned Space, Exhaust Ducts: Seal Class A.
12. Conditioned Space, Return-Air Ducts: Seal Class A.

### **3.4 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 inchesthick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inchesthick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- 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.

### **3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION**

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  1. Comply with ASCE/SEI 7.

### **3.6 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.



### **3.7 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. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### **3.8 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: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
    - b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, 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.
3. Any liner showing evidence that it has wet at any time shall be removed and replaced with new liner.
  - a. Disinfect affected sheet metal, and pins.
  - b. Install new liner per specifications
  - c. Seal friable edges and seams of repaired liner.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.9 DUCT CLEANING**

- A. Clean new duct system 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. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  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.

### **3.10 START UP**

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### **3.11 DUCT SCHEDULE**

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Ductwork running in areas where there are no ceilings or when noted on the drawings shall be doubled wall duct and shall meet the requirements indicated below.
- C. Supply Ducts:
  1. Ducts Connected to Constant-Volume Air-Handling Units:
    - a. Pressure Class: Positive 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round: 4.
  2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
    - a. Pressure Class: Positive 6-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.
    - d. SMACNA Leakage Class for Round: 2.
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 4-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round: 2.

D. Return Ducts:

1. Ducts Connected to Air-Handling Units:

- a. Pressure Class: Positive or negative 2-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 16.
- d. SMACNA Leakage Class for Round: 8

2. Ducts Connected to Equipment Not Listed Above:

- a. Pressure Class: Positive or negative 3-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 8.
- d. SMACNA Leakage Class for Round: 4.

E. 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.
- c. SMACNA Leakage Class for Rectangular: 16.
- d. SMACNA Leakage Class for Round: 4.

2. Ducts Connected to Equipment Not Listed Above:

- a. Pressure Class: Positive or negative 4-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 4 .
- d. SMACNA Leakage Class for Round: 2 .

F. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Air-Handling Units:

- a. Pressure Class: Positive or negative 3-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 8.
- d. SMACNA Leakage Class for Round: 4.

2. Ducts Connected to Equipment Not Listed Above:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- a. Pressure Class: Positive or negative 3-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 8.
- d. SMACNA Leakage Class for Round: 4.

G. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:
  - a. Exposed to Airstream: Match duct material.
  - b. Not Exposed to Airstream: Match duct material.
3. Stainless-Steel Ducts:
  - a. Exposed to Airstream: Match duct material.
  - b. Not Exposed to Airstream: Match duct material.
4. Aluminum Ducts: Aluminum.

H. Liner:

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
3. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick.
4. Supply Fan Plenums: Fibrous glass, Type I, 1 inch thick.
5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 1 inch thick.
6. Transfer Ducts: Fibrous glass, Type I [or flexible elastomeric], 1 inch thick.

I. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: 1 inch thick.
2. Return Air Ducts: 1 inch thick.
3. Exhaust Air Ducts: 1 inch thick.

J. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- K. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry high efficiency take-off.
    - b. Rectangular Main to Round Branch: 45-degree entry high efficiency take-off.
  2. Round:
    - a. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
    - b. Velocity 1000 to 1500 fpm: 45-degree entry high efficiency tap.
    - c. Velocity 1500 fpm or Higher: 45-degree lateral.

**END OF SECTION 233113**

## **SECTION 233300**

### **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. Backdraft dampers.
  - 2. Manual volume dampers.
  - 3. Turning vanes.
  - 4. Flexible connectors.
  - 5. Flexible ducts.
  - 6. Duct accessory hardware.
- B. Related Requirements:
  - 1. Division 23 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
  - 2. Division 23 "Diffusers, Registers and Grilles".

##### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Control-damper installations.
    - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, pressure relief-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    - e. Wiring Diagrams: For power, signal, and control wiring.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For air duct accessories to include in 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

### **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.
  - 1. Galvanized Coating Designation: G90.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- C. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. 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 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
  2. Greenheck Fan Corporation.
  3. Nailor Industries Inc.
  4. Pottorff.
  5. Ruskin Company.
- B. Function:
1. Designed to allow airflow in one direction and prevent reverse airflow.
  2. Keeps outside air out of the space by sensing and closing against mass flow.
- C. Description:
1. Gravity balanced.
- D. Maximum Air Velocity:
1. 1000 fpm
- E. Maximum System Pressure:
1. 3-inch wg.
  2. 4-inch wg.
- F. Frame: Hat-shaped, with welded corners or mechanically attached and mounting flange:
1. 16GA 0.063-inch- thick extruded aluminum.
- G. Blades: Multiple single-piece blades, maximum 6-inch width noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges:
1. Center pivoted: 16GA 0.050-inch- thick aluminum sheet.
- H. Blade Action: Parallel.
- I. Blade Seals: Mechanically locked.
1. Neoprene.
- J. Blade Axles: 0.20 inch diameter:
1. Material: Nonferrous metal.
- K. Tie Bars and Brackets:
1. Aluminum .
- L. Return Spring: Adjustable tension.
- M. Bearings:
1. Synthetic pivot bushings .
- N. Accessories.
1. Adjustment device to permit setting for varying differential static pressure.
  2. Counterweights and spring-assist kits for vertical airflow installations.
  3. Screen Mounting: Front mounted in sleeve.
    - a. Sleeve Thickness: 20 gage minimum.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- b. Sleeve Length: 6 inches minimum.
- 4. Screen Mounting: Rear mounted.
- 5. Screen Material:
  - a. Aluminum.
- 6. Screen Type:
  - a. Bird
- 7. 90-degree stops.

## 2.4 MANUAL VOLUME DAMPERS

### A. Standard, Steel, Manual Volume Dampers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Warming and Ventilating; a division of Mestek, Inc.
  - b. McGill AirFlow LLC.
  - c. Nailor Industries Inc.
  - d. Pottorff.
  - e. Ruskin Company.
- 2. Standard leakage rating , with linkage outside airstream .
- 3. Suitable for horizontal or vertical applications.
- 4. Frames: Hat-shaped, Mitered and welded corners. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - a. 16GA 0.064-inch thick, galvanized sheet steel.
- 5. Blades:
  - a. Multiple or single blade. Parallel- or opposed-blade design. Stiffened damper blades for stability.
  - b. Material:
    - 1) Galvanized -steel, 16GA 0.064 inch thick.
- 6. Blade Axles:
  - a. Nonferrous metal
  - b. Shall extend full length of damper blades in ducts with pressure classes of 3-inch wg or more.
- 7. Bearings:
  - a. Material:
    - 1) Molded synthetic.
  - b. Bearings at both ends of damper operating shafts in ducts with pressure classes of 3-inch wg or more.
- 8. Tie Bars and Brackets: Galvanized steel.

### B. Standard, Aluminum, Manual Volume Dampers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Warming and Ventilating; a division of Mestek, Inc.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- b. McGill AirFlow LLC.
  - c. Nailor Industries Inc.
  - d. Pottorff.
  - e. Ruskin Company.
2. Standard leakage rating.
  3. Suitable for horizontal or vertical applications.
  4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
    - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
  6. Blade Axles: Galvanized steel.
  7. Bearings:
    - a. Oil-impregnated bronze.
    - b. Dampers in ducts with pressure classes of 3-inch wg or more shall have axles full length of damper blades and bearings at both ends of operating shaft.
  8. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
1. Size:
    - a. 1-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.
- D. 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.

## 2.5 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. METALAIRE, Inc.
  2. SEMCO Incorporated.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. 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.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Fabricate single blade vanes to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."
  2. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. 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.
- D. 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."
- E. Vane Construction: [Single] [Double] wall.
- F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.6 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Ventfabrics, Inc.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a wide fabric strip attached to two narrower metal strips. Provide strips of metal compatible with connected ducts.
1. Wide Strip:
    - a. 3-1/2 inches.
  2. Narrow Strips:
    - a. 0.028-inch- thick, galvanized sheet steel.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..
  2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  3. Service Temperature: Minus 40 to plus 200 deg F.
- F. 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.

## **2.7 FLEXIBLE DUCTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Ducts shall conform to the requirements for Class I connectors when tested in accordance with "Standard for Factory Made Air Ducts Materials and Air Duct Connectors" (UL 181).
- C. Ducts shall also pass the 15 minute U.L. flame penetration test as specified in the UL 181 Standard.
- D. Insulated, Flexible Duct: Two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized 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.
- E. Flexible Duct Connectors:
  - 1. Clamps: in sizes 3 through 18 inches, to suit duct size.
    - a. Material: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action .

## **2.8 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.
- C. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- D. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

#### General

- 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. Use the Remote Damper Operator when they are called out on the drawings or when the damper cannot be easily accessed.

Flexible Ducts / Flexible Duct Connectors

- D. Install flexible connectors to connect ducts to equipment.
- E. Flexible duct connections from the main trunk ducts to diffuser boots shall be furnished and installed as shown on the drawings. Flexible ductwork shall only be used as indicated on the drawings.
- F. Where flexible duct is indicated, use insulated flexible duct for supply air return and exhaust air.
- G. Flexible ductwork shall be run in straight lengths.
- H. Provide support in flexible duct every three feet.
- I. Flexible ducts shall have compression fittings on both ends.
- J. Flexible ductwork is not allowed to bend 90 degrees. If a bend is needed use sheet-metal hard elbows. Hard turns, offsets, or kinks will not be allowed.
- K. Flexible ducts shall connect to trunk duct with high efficiency takeoffs.
- L. Connect flexible ducts to metal ducts with draw bands.
- M. Connect ducts to duct silencers:
  - 1. With flexible duct connectors.
- N. Connect terminal units to supply ducts:
  - 1. With maximum 12-inch lengths of flexible duct.
- O. Do not use flexible ducts to change directions.
- P. Connect diffusers or light troffer boots to ducts:
  - 1. With maximum 60-inch lengths of flexible duct clamped or strapped in place.

Backdraft/Control/Pressure Relief Dampers

- Q. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- R. Install pressure relief damper immediately upstream of main fire damper.

Volume Damper

- S. 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.
- T. Set dampers to fully open position before testing, adjusting, and balancing. Exception: Pressure relief damper.
- U. A balance damper with locking quadrant will be provided downstream of take-off from trunk duct.

#### Fans And Test Holes

- V. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- W. 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.
- X. Install duct test holes where required for testing and balancing purposes.
- Y. Install test holes at fan inlets and outlets and elsewhere as indicated.

#### FIRE, SMOKE AND FIRE-SMOKE DAMPERS

- Z. Install fire and smoke dampers according to UL listing.
  - 1. Install fusible links in fire dampers.
- AA. For round ductwork 24-inch and smaller a true round fire damper with the same rating may be used.

#### Access Doors

- BB. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. 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 standard access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 7. At each change in direction and at maximum 50-foot spacing.
  - 8. Upstream from turning vanes.
  - 9. Upstream or downstream from duct silencers.
  - 10. Control devices requiring inspection.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

11. Elsewhere as indicated.

CC. Install access doors with swing against duct static pressure.

DD. 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.

EE. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

### **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.

### **3.3 ADJUSTING**

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

**END OF SECTION 233300**



## **SECTION 233423**

### **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. Ceiling-mounted ventilators.

##### **1.3 PERFORMANCE REQUIREMENTS**

- A. Project Altitude: Base fan-performance ratings on:
  - 1. Actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.
- C. Fan Schedule: Fan characteristics and performance data are described in an equipment schedule on the drawings including:
  - 1. Fan arrangement with wheel configuration, inlet and discharge configurations, and required accessories.
  - 2. Capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

##### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, shipping weights, operating weights, 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.
- B. 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.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

2. Wiring Diagrams: For power, signal, and control wiring.
  - a. Detail all wiring systems and differentiate clearly between manufacturer-installed and field-installed wiring.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  1. Roof framing and support members relative to duct penetrations.
  2. Ceiling suspension assembly members.
  3. Size and location of initial access modules for acoustical tile.
  4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control Reports

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

#### **1.7 MATERIALS MAINTENANCE 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. Belts: One set for each belt-driven unit.

#### **1.8 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. NEMA Compliance: Power ventilator electrical components shall comply with applicable NEMA standards.
- D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

#### **1.9 COORDINATION**

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.

- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCTS FURNISHED BUT NOT INSTALLED**

- A. Products furnished, but not installed, under this Section include roof curbs for roof-mounted exhaust fans. Roof curbs to be installed by Division 07, section "Roof Accessories".

### **2.2 CEILING-MOUNTED VENTILATORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Loren Cook Company.
  - 3. PennBarry.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: With flange on intake and thumbscrew attachment to fan housing.
  - 1. Painted steel.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

### **2.3 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.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
- B. Enclosure Type: Totally enclosed;
  - 1. Fan cooled

### **2.4 FACTORY FINISH**

- A. Metal Parts: All assembly parts shall be protected from rust and corrosion.
  - 1. Stainless steel, aluminum, and other non-corroding materials require no protective finish.
  - 2. Non-galvanized sheet metal parts shall be prime coated or powder coated before final assembly.

3. Prime coated parts shall receive baked enamel finish coat after assembly.

## **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 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

### **3.2 PROJECT CONDITIONS**

- A. Field Measurements: Verify dimensions by field measurements. Verify clearances.
- B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

### **3.3 INSTALLATION**

- A. Install power ventilators level and plumb according to manufacturer's written instructions.
- B. Base Mounted Equipment:
  1. Install power ventilators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in:
    - a. Division 33 "Cast-in-Place Concrete."
- C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
- D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- E. Support Steel: Support suspended units from structure using threaded steel as specified in Division 23 "Vibration and Seismic Controls for HVAC."
- F. Label units according to requirements specified in Division 23 "Identification for HVAC Piping and Equipment."
- G. Install power ventilators with factory recommended and code required clearances for service and maintenance.

### **3.4 CONNECTIONS**

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."
  - 1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Connect wiring according to Division 26 "Low-Voltage Electrical Power Conductors and Cables."
  - 1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.5 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.

### **3.6 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Division 23 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

### **3.7 CLEANING**

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

### **3.8 DEMONSTRATION**

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."
- C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.
- D. Demonstrate operation of power ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

**END OF SECTION 233423**

## **SECTION 233713**

### **DIFFUSERS, REGISTERS, AND GRILLES**

#### **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 ceiling- and wall-mounted diffusers, registers, and grilles.
- 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.
  - 2. Section 230593 "Testing, Adjusting and Balancing" for balancing 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.

##### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.
- B. Source quality-control reports.

##### **1.5 QUALITY ASSURANCE**

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

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

1. Air Factors
2. Carnes.
3. Kruegar.
4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. Price Industries.
7. Titus.
8. Tuttle & Bailey.

### **2.2 REGISTERS, GRILLES, & DIFFUSERS**

- A. General: The frames for all registers, grilles, and diffusers shall match type of ceiling where they are to be installed. Special frames shall be provided for narrow T-bar ceilings. Refer to reflected ceiling plan and other specification divisions for ceiling type. See drawings AND schedules for additional information.

### **2.3 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## **PART 3 - EXECUTION**

### **3.1 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, according to manufacturer's written instructions, coordination drawings, original design, and referenced standards.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- 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.

### **3.4 CLEANING**

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

**END OF SECTION 233713**



## **SECTION 233723**

### **HVAC GRAVITY 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. Goosenecks.
- B. Products furnished, but not installed, under this Section include roof curbs for roof-mounted exhaust fans.

##### **1.3 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Ventilators, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. For all seismic items refer to Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

##### **1.4 ACTION SUBMITTALS**

- A. Product Data:
  - 1. For each type of product indicated.
  - 2. Drawings from each manufacturer detailing equipment assemblies. Indications of dimensions, loadings, required clearances, method of field assembly, components and location and size of each field connection.
  - 3. Rated capacities of each unit, weights (shipping, installed and operating), furnished specialties, accessories and the following:
    - a. Material gages and finishes, including color charts.
    - b. Dampers, including housings, linkages and operators.
- B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
  - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Delegated-Design Submittal: For shop-fabricated ventilators 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 shop-fabricated ventilators.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members to which roof curbs and ventilators will be attached.
  - 2. Sizes and locations of roof openings.
- B. Seismic Qualification Certificates: For ventilators, accessories, and components, from manufacturer.
  - 1. For all seismic items refer to Section 230548 "Vibration and Seismic Controls for HVAC."
- C. Welding certificates.

## **1.6 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.2, "Structural Welding Code - Aluminum."
  - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

## **1.7 COORDINATION**

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
  - 1. Use types and sizes to suit unit installation conditions.
  - 2. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.

- D. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.2 FABRICATION, GENERAL

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

## 2.3 GOOSENECKS

- A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 6-5; with a minimum of 0.052-inch- thick, galvanized-steel sheet.
- B. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
  - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
  - 2. Overall Height: 16 inches .
- C. Bird Screening: Galvanized-steel, 1/4-inch- square mesh, 0.041-inch wire.
- D. Galvanized-Steel Sheet Finish:
  - 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
  - 2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
  - 3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
    - a. Color and Gloss: As indicated by manufacturer's designations.
- E. Capacities and Characteristics:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Free Area: Not less than 6.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
2. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area exhaust velocity.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Install gravity ventilators with clearances for service and maintenance.
- C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.
- E. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

#### **3.3 CONNECTIONS**

- A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

#### **3.4 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.

#### **3.5 CLEANING**

- A. Clean interiors to remove foreign material, dirt and construction debris.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**3.6 DEMONSTRATION**

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventative maintenance.
- B. Review data in the operation and maintenance manuals.
- C. Schedule training with Owner, through Architect with at least seven (7) days' advance notice.

**END OF SECTION 233723**





## **SECTION 235233**

### **FINNED WATER-TUBE BOILERS**

#### **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 packaged, factory-fabricated and -assembled, gas-fired, finned water-tube boilers, trim, and accessories for generating hot water to be used within municipal swimming pool.
- B. This Section includes packaged, water-tube boilers, trim, and accessories for generating hot water with the following configurations, burners, and outputs:
  - 1. Forced-draft gas burner.
  - 2. Low temperature protection system to eliminate condensing in flue gases.

##### **1.3 SUBMITTALS**

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
    - a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
    - b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.
  - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Source quality-control test reports.
- E. Field quality-control test reports.

- F. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.
- H. Other Informational Submittals:
  - 1. ASME "A" Stamp Certification and Report: Submit "A" stamp certificate of authorization as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
  - 2. Startup service reports.

#### **1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."
- E. I=B=R Compliance: Boilers shall be tested and rated according to HI's "Rating Procedure for Heating Boilers" and "Testing Standard for Commercial Boilers," with I=B=R emblem on a nameplate affixed to boiler.

#### **1.5 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.

#### **1.6 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchangers damaged by thermal shock and vent dampers of boilers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Heat Exchangers: 20 years from date of Substantial Completion.
  - 2. Warranty Period for Vent Dampers: Five years from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace drums, tubes, headers, cabinets, atmospheric gas burners, and pressure vessels of boilers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Drums, Tubes, Headers, Cabinets, Five years from date of Substantial Completion, pro rata.

2. Warranty Period for Pressure Vessel: 20 years from date of Substantial Completion, for thermal shock.

## **PART 2 - PRODUCTS**

### **2.1 FINNED WATER-TUBE BOILERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Laars Heating Systems; a division of Waterpik Technologies, Inc.
  2. Lochinvar Corporation.
  3. Raypak.
- B. Description: Factory-fabricated, -assembled, and -tested boiler with tubes sealed into headers pressure tight, and set on a steel base; including insulated jacket, flue-gas vent, combustion-air intake connections, water supply and return connections, and controls.
- C. Heat Exchanger:
  1. Finned copper tubing with stainless-steel baffles.
  2. Tubes shall be sealed in header by welding or by mechanically rolling tubes in header.
- D. Combustion Chamber Internal Insulation: Interlocking panels of refractory insulation, high-temperature cements, mineral fiber, and ceramic refractory tile for service temperatures to 2000 deg F.
- E. Casing:
  1. Jacket: Sheet metal, with snap-in or interlocking closures.
  2. Control Compartment Enclosure: NEMA 250, Type 1A.
  3. Finish: Baked enamel over primer.
  4. Insulation: Minimum 2-inch- thick, mineral-fiber insulation surrounding the heat exchanger.
  5. Draft Hood: Integral.
  6. Combustion-Air Connection: Inlet duct collar and sheet metal closure over burner compartment.
  7. Mounting base to secure boiler with accessory for mounting on combustible surface.
    - a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when mounting base is anchored to building structure.
- F. Burner:
  1. Burner Tubes and Orifices: Stainless steel, for natural gas. Mount burner tubes in a slide-out burner drawer for ease of inspection.
    - a. Sealed Combustion: Factory-mounted centrifugal fan to draw outside air into boiler and discharge into burner compartment.

- b. Direct Vent: Factory-mounted centrifugal fan to draw flue gas out of boiler and discharge into boiler vent.
  2. Vertical Burner:
    - a. High-temperature stainless steel or Ceramic to fire in a 360-degree pattern.
    - b. Burner shall have a viewing port for observation of burner operation and a factory-mounted centrifugal fan to supply outside air through a replaceable 99 percent efficient (1-micrometer particles) filter to boiler burner.
    - c. Fan shall be controlled to prepurge and postpurge the combustion chamber before firing.
  3. Gas Train: Per commercial configuration, control devices and full-modulation proportional control sequence shall comply with requirements in ASME CSD-1. In addition to these requirements, include shutoff cock, pressure regulator, and control valve.
  4. Pilot: Intermittent-electric-spark pilot ignition with 100 percent main-valve and pilot-safety shutoff with electronic supervision of burner flame.
  5. Flue-Gas Recirculation Fans: Centrifugal fans on burner assembly to recirculate flue gas to decrease oxides of nitrogen emissions to less than 30 ppm.
    - a. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- G. Trim:
  1. Aquastat Controllers: Operating firing rate and high limit.
  2. Safety Relief Valve: ASME rated.
  3. Pressure and Temperature Gage: Minimum 3-1/2-inch- diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.
  4. Boiler Air Vent: Automatic.
  5. Drain Valve: Minimum NPS 3/4 hose-end gate valve.
  6. Integrated Circulation Pump:
    - a. Mounted at inlet side.
    - b. Factory wired.
    - c. Motor:
      - 1) Non-overloading.
      - 2) In-line.
      - 3) Split-capacitor motor.
      - 4) Thermal-overload protection.
      - 5) Lubricated bearings.
      - 6) Designed to operate at specified boiler pressures and temperatures.
  7. Low Temperature Protection against vent gases within condensing state:
    - a. Mixing system:
      - 1) Capable of diverting some of the water being supplied to the pool for the purpose of pre-heating the return water.
      - 2) Manufacturer to provide mixing valve and controls.
- H. Controls:
  1. Boiler operating controls shall include the following devices and features:
    - a. Control transformer.

- b. Motorized Vent Damper: Interlocked with burner to open before burner starts. If damper fails to open, stop burner operation.
  - c. Set-Point Adjust: Set points shall be adjustable.
  - d. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain space temperature in response to thermostat with heat anticipator located in heated space.
  - e. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
2. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
- a. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
  - b. Water Flow Switch: Automatic-reset paddle-switch shall prevent burner operation on low water flow.
  - c. Blocked Vent Safety Switch: Manual-reset switch factory mounted on draft diverter.
  - d. Rollout Safety Switch: Factory mounted on boiler combustion chamber.
  - e. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
3. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.
- a. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

## **2.2 ELECTRICAL POWER**

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.
- B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
  - 1. House in NEMA 250, Type 1 enclosure.
  - 2. Wiring shall be numbered and color-coded to match wiring diagram.
  - 3. Install factory wiring outside of an enclosure in a metal raceway.
  - 4. Field power interface shall be to fused disconnect switch with a circuit breaker.
  - 5. Provide branch power circuit to each motor and to controls with disconnect switch or circuit breaker.
  - 6. Provide each motor with overcurrent protection.

### **2.3 VENTING KITS**

- A. Vent Damper: Motorized, UL listed for use on atmospheric burner boiler equipped with draft hood; motor to open and close damper; stainless-steel vent coupling and damper blade; keyed wiring harness connector plug; and dual-position switches to permit burner operation.
- B. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap, and sealant.
- C. Combustion-Air Intake: Stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

### **2.4 SOURCE QUALITY CONTROL**

- A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.
- B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
  - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 BOILER INSTALLATION**

- A. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- B. Vibration Isolation: Elastomeric isolator pads with a minimum static deflection of 0.25 inch . Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install gas-fired boilers according to NFPA 54.

- D. Assemble boiler tubes in sequence and seal each tube joint.
- E. Assemble and install boiler trim.
- F. Install electrical devices furnished with boiler but not specified to be factory mounted.
- G. Install control wiring to field-mounted electrical devices.

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- D. Connect hot-water piping to supply- and return-boiler tapplings with shutoff valve and union or flange at each connection.
- E. Install piping from safety relief valves to nearest floor drain.
- F. Install piping from safety valves to drip-pan elbow and to nearest floor drain.
- G. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- H. Boiler Flue Venting:
  - 1. Install venting kit and combustion-air intake.
  - 2. Connect full size to boiler connections.
- I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Division 26 Section "Low-Voltage, Electrical Power Conductors and Cables."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
  - b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
  - c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.
- E. Performance Tests:
  1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
  2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment in order to comply.
  3. Perform field performance tests to determine the capacity and efficiency of the boilers.
    - a. For dual-fuel boilers, perform tests for each fuel.
    - b. Test for full capacity.
  4. Repeat tests until results comply with requirements indicated.
  5. Provide analysis equipment required to determine performance.
  6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
  7. Notify Architect in advance of test dates.
  8. Document test results in a report and submit to Architect.
  9. Test the Low Temperature protection system:
    - a. Record the pool return water temperature.
    - b. Record the pool supply water temperature.
    - c. Record the boiler mixed water temperature.
    - d. Recored the flue gas temperature.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION 235233**



**SECTION 237413**

**PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS**

**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 packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
  - 1. Direct-expansion cooling.
  - 2. Gas furnace.
  - 3. Economizer outdoor- and return-air damper section.
  - 4. Integral, space temperature controls.
  - 5. Roof curbs.

**1.3 DEFINITIONS**

- A. ECM: Electrically commutated motor.
- B. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- C. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- D. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- E. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- F. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to SEI/ASCE 7. For all seismic items refer to Section 230548 "Vibration and Seismic Controls for HVAC."

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations:
    - a. Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
  - 2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  - 3. For all seismic items refer to Section 230548 "Vibration and Seismic Controls for HVAC."

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Structural members to which RTUs will be attached.
  - 2. Roof openings
  - 3. Roof curbs and flashing.
- B. Manufacturer Seismic Qualification Certification: Submit certification that RTUs, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."
- C. Field quality-control test reports.
- D. Warranty: Special warranty specified in this Section.

#### **1.7 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

## **1.8 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fan Belts: One set for each belt-driven fan.
  - 2. Filters: One set of filters for each unit.

## **1.9 QUALITY ASSURANCE**

- A. ARI Compliance:
  - 1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
  - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
  - 1. Comply with ASHRAE 15 for refrigeration system safety.
  - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
- C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- D. UL Compliance: Comply with UL 1995.
- E. 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.

## **1.10 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than:
    - a. Five years from date of Substantial Completion.
  - 2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than;
    - a. Five years from date of Substantial Completion.
  - 3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than;
    - a. Three years from date of Substantial Completion.
  - 4. Warranty Period for Control Boards: Manufacturer's standard, but not less than;
    - a. Three years from date of Substantial Completion.

## **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:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation.
  2. Lennox Industries Inc.
  3. McQuay International; Daikin Industries.
  4. Trane.
  5. York International Corporation.

## 2.2 CASING

- A. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
1. Exterior Casing Thickness:
    - a. 0.052 inch thick. (18GA)
- B. Inner Casing Fabrication Requirements:
1. Inside Casing: Galvanized steel:
    - a. 0.034 inch thick. (22GA)
- C. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
1. Materials: ASTM C 1071, Type I.
  2. Thickness:
    - a. 1/2 inch.
    - b. 1 inch.
  3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
  4. Liner Adhesive: Comply with ASTM C 916, Type I.
- D. Condensate Drain Pans:
1. Material:
    - a. Formed sections of galvanized-steel sheet, a minimum of 2 inches deep.
  2. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
  3. Drain Connections:
    - a. Threaded nipple.
    - b. Threaded nipple both sides of drain pan.

## 2.3 FANS

- A. Direct-Driven Supply-Air Fans:
1. Wheel, Double width, centrifugal. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls;
    - a. Forward curved.
  2. Motor: Permanently lubricated, resiliently mounted in the fan inlet;
    - a. ECM.
- B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Relief-Air Fan:
  - 1. Forward curved, shaft mounted on permanently lubricated motor.
  
- D. Seismic Fabrication Requirements: For all seismic issues see Section 230548 "Vibration and Seismic Controls for HVAC" when fan-mounted frame and RTU-mounted frame are anchored to building structure.
  
- E. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

## **2.4 COILS**

- A. Supply-Air Refrigerant Coil:
  - 1. Material:
    - a. Aluminum-plate .
  - 2. Tubing:
    - a. Seamless internally grooved copper tube in steel casing.
  - 3. Equalizing-type vertical distributor.
  - 4. Coil Split: Interlaced.
  - 5. Condensate Drain Pan:
    - a. Galvanized steel with corrosion-resistant coating.
  
- B. Outdoor-Air Refrigerant Coil:
  - 1. Material:
    - a. Aluminum-plate .
  - 2. Tubing:
    - a. Seamless internally grooved copper tube in steel casing.
  - 3. Equalizing-type vertical distributor.

## **2.5 REFRIGERANT CIRCUIT COMPONENTS**

- A. Number of Refrigerant Circuits:
  - 1. One, with dual stage compressor.
  
- B. Compressor: Mounted on vibration isolators, with internal overcurrent and high-temperature protection, internal pressure relief. Type;
  - 1. Hermetic, scroll.
  - 2. With crankcase heater.
  
- C. Refrigeration Specialties:
  - 1. Refrigerant: R-407C or R-410A.
  - 2. Expansion valve with replaceable thermostatic element.
  - 3. Refrigerant filter/dryer.
  - 4. Manual-reset high-pressure safety switch.
  - 5. Automatic-reset low-pressure safety switch.
  - 6. Minimum off-time relay.
  - 7. Automatic-reset compressor motor thermal overload.
  - 8. Brass service valves installed in compressor suction and liquid lines.
  - 9. Low-ambient kit high-pressure sensor and control.
  - 10. Crankcase heater.

## **2.6 AIR FILTRATION**

- A. 30% filters.

## **2.7 GAS FURNACE**

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
  - 1. CSA Approval: Designed and certified by and bearing label of CSA.
- B. Burners: Stainless steel.
  - 1. Fuel:
    - a. Natural gas.
  - 2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
  - 3. High-Altitude capability: For Project elevations more than 2000 feet above sea level;
    - a. Capability to be provided by modifying the furnace and adding a manufacturer's Kit.
    - b. Capability to be provided as an integral part of the manufacturer's Model.
- C. Heat-Exchanger and Drain Pan: Stainless steel.
- D. Venting:
  - 1. Gravity vented.
- E. Safety Controls:
  - 1. Gas Control Valve:
    - a. Two stage .
  - 2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

## **2.8 DAMPERS**

- A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with;
  - 1. Manual damper filter.
- B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
  - 1. Damper Motor: Modulating with adjustable minimum position.

## **2.9 ELECTRICAL POWER CONNECTION**

- A. Provide for single connection of power to unit with control-circuit transformer with built-in overcurrent protection.
- B. Provide with unit-mounted disconnect switch accessible from outside.
- C. Provide with RTU a factory installed and factory wired 110 volt outlet for maintenance and utility.

## **2.10 CONTROLS**

### A. Basic Unit Controls:

1. Control-voltage transformer.
2. Wall-mounted thermostat or sensor with the following features:
  - a. Heat-cool-off switch.
  - b. Fan on-auto switch.
  - c. Fan-speed switch.
  - d. Changeover:
    - 1) Automatic changeover.
  - e. Adjustable deadband.
  - f. Setpoint:
    - 1) Concealed set point.
  - g. Indication, by Degree F:
    - 1) Concealed.
  - h. Unoccupied-period-override push button.
  - i. Data entry and access port to:
    - 1) Input temperature set points.
    - 2) Input occupied and unoccupied periods.
    - 3) Output room temperature.
    - 4) Output supply-air temperature.
    - 5) Output operating mode.
    - 6) Output status.
3. Programmable Thermostat.
  - a. Economizer Modulating capability.
4. **Unit-Mounted Annunciator Panel for Each Unit:**
  - a. Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
  - b. Display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.

## **2.11 ACCESSORIES**

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required.[ Outlet shall be energized even if the unit main disconnect is open.]
- B. Low-ambient kit using condenser fan cycling for operation down to 32 deg F .
- C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- D. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

## **2.12 ROOF CURBS**

- A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Curb Height:
  - 1. 14 inches.
  
- C. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for wind-load requirements.

## **2.13 CAPACITIES AND CHARACTERISTICS (See Drawing Schedules)**

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Equipment Mounting:
  - 1. Install RTUs on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03.
  - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Unit Support:
  - 1. Install unit level on structural curbs.
  - 2. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

#### **3.3 CONNECTIONS**

- A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- B. Install piping adjacent to RTUs to allow service and maintenance.
  - 1. Gas Piping:
    - a. Comply with applicable requirements in;
      - 1) Section 231123 "Facility Natural-Gas Piping."



- b. Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
1. Install ducts to termination at top of roof curb.
  2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
  4. Install return-air duct continuously through roof structure.
  5. Install normal-weight, 3000-psi, compressive strength (28-day) concrete mix inside roof curb, 4 inches thick. Concrete, formwork, and reinforcement are specified with concrete.

### **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. Report results in writing.
- B. Tests and Inspections:
1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
  2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

### **3.5 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
- B. Factory-authorized service representative to complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Inspect for visible damage to unit casing.
  2. Inspect for visible damage to furnace combustion chamber.
  3. Inspect for visible damage to compressor, coils, and fans.
  4. Inspect internal insulation.
  5. Verify that labels are clearly visible.
  6. Verify that clearances have been provided for servicing.
  7. Verify that controls are connected and operable.
  8. Verify that filters are installed.
  9. Clean condenser coil and inspect for construction debris.
  10. Remove packing from vibration isolators.
  11. Verify lubrication on fan and motor bearings.
  12. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  13. Adjust fan belts to proper alignment and tension.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

14. Start unit according to manufacturer's written instructions.
  - a. Start refrigeration system.
  - b. Do not operate below recommended low-ambient temperature.
  - c. Complete startup sheets and attach copy with Contractor's startup report.
15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Calibrate thermostats.
18. Adjust and inspect high-temperature limits.
19. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
20. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
  - a. Coil leaving-air, dry- and wet-bulb temperatures.
  - b. Coil entering-air, dry- and wet-bulb temperatures.
  - c. Outdoor-air, dry-bulb temperature.
  - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
21. Program the thermostat.
  - a. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
  - b. Set-up the economizer to modulate per engineer's instructions.
22. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
  - a. Supply-air volume.
  - b. Return-air volume.
  - c. Relief-air volume.
  - d. Outdoor-air intake volume.
23. Simulate maximum cooling demand and inspect the following:
  - a. Compressor refrigerant suction and pressures.
  - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
24. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
  - a. High-temperature limit on gas-fired heat exchanger.
  - b. Low-temperature safety operation.
  - c. Filter high-pressure differential alarm.
  - d. Economizer to minimum outdoor-air changeover.
  - e. Relief-air fan operation.
  - f. Smoke and firestat alarms.
25. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**3.6 CLEANING AND ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

**3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

**END OF SECTION 237413**



**DIVISION 25 – INTEGRATED AUTOMATION**

Not Used



## **DIVISION 26 – ELECTRICAL**

- 26 0500 - Common Work Results for Electrical
- 26 0519 - Low-Voltage Electrical Power Conductors and Cables
- 26 0526 - Grounding and Bonding for Electrical Systems
- 26 0529 - Hangers and Supports for Electrical Systems
- 26 0533 - Raceway and Boxes for Electrical Systems
- 26 0548 - Vibration and Seismic Controls for Electrical Systems
- 26 0553 - Identification for Electrical Systems
- 26 0923 - Lighting Control System
- 26 0924 - Lighting and Control Devices
- 26 2416 - Panelboards
- 26 2726 - Wiring Devices
- 26 2813 - Fuses
- 26 2913 - Enclosed Controllers





## SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARYs

- A. Section Includes:
  - 1. Sleeves for raceways and cables.
  - 2. Sleeve seals.
  - 3. Grout.
  - 4. Common electrical installation requirements.

#### 1.2 SUBMITTALS

- A. Product Data: For sleeve seals.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

#### 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

- a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Metraflex Co.
  - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  3. Pressure Plates: Stainless steel. Include two for each sealing element.
  4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

## SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
  - 3. Sleeves and sleeve seals for cables.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

#### 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.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN

#### 2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.

2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

### 2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

### 2.4 SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  2. Pressure Plates: Stainless steel. Include two for each sealing element.
  3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- 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, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: 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.
  - 1. MC Cable with ground is only allowed in concealed areas and for branch circuits from homeruns to the devices. All homeruns shall be in ¾" minimum conduits.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Type THHN-THWN, in raceway

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- 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. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

#### 3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- D. Cut sleeves to length for mounting flush with both wall surfaces.
- E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.



- L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

### 3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
    - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

## SECTION 260526- GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

#### 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: 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.

## 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; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

## 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. Bury at least 24 inches (600 mm) below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- 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 EQUIPMENT GROUNDING

- A. 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. 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.
  8. 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.
- B. 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.
- C. 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.
- D. 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 (6-by-50-by-300-mm) grounding bus.
  2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- E. 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.

### 3.3 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.
- 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.

### 3.4 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 ground test wells.
  - 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.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10
2. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

## SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. 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.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

### 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. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  3. 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 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. Manufacturers: Subject to compliance with requirements, provide products by one of 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, zinc-coated 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. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
      - 6)
  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 NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) 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
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry 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 (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To Wood: Fasten with lag screws or through bolts.

2. To 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 (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  6. To Light Steel: Sheet metal screws.
  7. 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 by means that meet seismic-restraint strength and anchorage requirements
- D. 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 (100 mm) 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 (20.7-MPa) 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03
- 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 (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529



## SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. See Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks and manholes, and underground handholes, boxes, and utility construction.

#### 1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

#### 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.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. IMC: ANSI C80.6.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- B. LFNC: UL 1660.
- C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.
- D. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 unless otherwise indicated.
- 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. Wireway Covers: Hinged type
- E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Metal Floor Boxes fully adjustable rectangular.
- E. Nonmetallic Floor Boxes: Nonadjustable, round.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- I. Cabinets:
  - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

- A. Apply raceway products as specified below, unless otherwise indicated:
  - 1. Exposed Conduit: Rigid steel conduit
  - 2. Concealed Conduit, Aboveground: EMT. MC Cable is only allowed in concealed areas from homeruns to the devices.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried. Utilize wrapped rigid steel elbows.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R
- B. Comply with the following indoor applications, unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT
  - 2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit Includes raceways in the following locations:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 5. Damp or Wet Locations: Rigid steel conduit
  - 6. Raceways for Optical Fiber or Communications Cable: EMT
  - 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. 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.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- G. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- I. 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.
- J. Raceways for Optical Fiber and Communications Cable: Install as follows:
  - 1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
  - 2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
  - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.



- K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where otherwise required by NFPA 70.
- L. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
  - 1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    - d. Attics: 135 deg F (75 deg C) temperature change.
  - 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
  - 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- O. Set metal floor boxes level and flush with finished floor surface.
- P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
  - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

### 3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260533

## SECTION 260548 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
1. Isolation pads.
  2. Spring isolators.
  3. Restrained spring isolators.
  4. Channel support systems.
  5. Restraint cables.
  6. Hanger rod stiffeners.
  7. Anchorage bushings and washers.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
1. Site Class as Defined in the IBC: (to match architectural specification)
  2. Assigned Seismic Use Group or Building Category as Defined in the IBC: (to match architectural specification)
    - a. Component Importance Factor: 1.5.
    - b. Component Response Modification Factor: 5.0.
    - c. Component Amplification Factor: 2.5
  3. Design Spectral Response Acceleration at Short Periods (0.2 Second):
  4. Design Spectral Response Acceleration at 1.0-Second Period.

#### 1.3 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- C. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
  2. Amber/Booth Company, Inc.
  3. California Dynamics Corporation.
  4. Isolation Technology, Inc.
  5. Kinetics Noise Control.
  6. Mason Industries.
  7. Vibration Eliminator Co., Inc.
  8. Vibration Isolation.
  9. Vibration Mountings & Controls, Inc.

### 2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
  2. California Dynamics Corporation.
  3. Cooper B-Line, Inc.; a division of Cooper Industries.
  4. Hilti Inc.
  5. Loos & Co.; Seismic Earthquake Division.
  6. Mason Industries.
  7. TOLCO Incorporated; a brand of NIBCO INC.
  8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
  - 1. Install restrained isolators on electrical equipment.
  - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds **0.125 inch (3.2 mm)**.
  - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### 3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  1. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  2. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 3.
  4. Measure isolator restraint clearance.
  5. Measure isolator deflection.
  6. Verify snubber minimum clearances.
  7. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548





## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Identification for raceways.
  2. Identification of power and control cables.
  3. Identification for conductors.
  4. Underground-line warning tape.
  5. Warning labels and signs.
  6. Instruction signs.
  7. Equipment identification labels.
  8. Miscellaneous identification products.

#### 1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

#### 1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

### PART 2 - PRODUCTS

#### 2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.
  - C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
  - D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
  - E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
  - F. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
    1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - G. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
  - H. Colors for Raceways Carrying Circuits at 600 V and Less:
    1. Black letters on an orange field
    2. Legend: Indicate voltage and system or service type.
  - I. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
  - J. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.
- 2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS
- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
  - B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
    1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
    2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

### 2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

### 2.4 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

### 2.5 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,
  - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

## 2.6 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:
  - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 3. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs:
  - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
  - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 3. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. 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 (915 MM)."

## 2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) 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.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

### 3.2 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
    - c. Colors for 480/277-V Circuits:
      - 1) Phase A: Brown.
      - 2) Phase B: Orange.
      - 3) Phase C: Yellow.
- B. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
  2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- C. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels
1. Comply with 29 CFR 1910.145.
  2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For 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.
- E. Operating Instruction Signs: 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.
- F. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer >.
- G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. 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: Adhesive film label Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

**SECTION 26 0923**  
**LIGHTING CONTROL SYSTEM**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install automatic low voltage switching system for lighting as described in Contract Documents.
- B. Related Sections:
  - 1. Section 26 0501: Common Electrical Requirements.

**1.2 SYSTEM DESCRIPTION**

- A. Performance Requirements:
  - 1. ON / OFF Control Functions: ON / OFF control of individual relays, or groups of relays, from single or multiple locations.
    - 1) Configurations are to be retained in memory with no battery backup required.
  - 2. Controls:
    - a. Operating Temperature: 0 to 40 deg C.
    - b. Transient Immunity: 6KV spikes.

**1.3 SUBMITTALS**

- A. Product Data: Catalog literature with performance specifications indicating compliance with requirements of this Section.
- B. Shop Drawings: Include interconnection diagram of entire system.

**1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. System shall be listed with Underwriters Laboratories (UL).
  - 2. Applicable components shall meet emission standards as suitable by Federal Communications Commission (FCC) as specified in Part 15, subpart J for Class A installations.

**PART 2 - PRODUCTS**

**2.1 COMPONENTS**

- A. Relay Panels:
  - 1. Recessed or surface mounted as shown on Drawings.

2. NEMA 1 enclosure with locking hinged door.
  3. Complete with components necessary to perform system operation functions.
  4. System shall be capable of controlling relays as shown on Drawings.
  5. 20 AMP Relays:
    - a. ON / OFF control of lighting and other electrical loads.
    - b. 20 AMP, HID full life rating and voltage rated up to 277 VAC.
    - c. Mechanically held in ON or OFF state.
  6. Transformers / Power Supply(s):
    - a. Provides system power.
    - b. Provides drive for component switching.
    - c. Have 24 VAC secondary and 120 or 277 primary.
    - d. Housed in same enclosure as relays and other system components.
  7. All relay panels in system shall be interconnected and switching and control functions shall be common to all panels.
- B. Switches:
1. Digital programmable momentary contact low voltage type compatible with relay panel. Where possible, style to be rectangular face decorator type to match decorator style duplex receptacles. Minimum color options: white, ivory, almond, grey and black. Color for each area to be selected by architect.
  2. Switches to be daisy-chained together on a single cable run back to the relay panel. Each switch shall be programmable to control any or all relays in all relay panels in system.
- C. Time Schedule Control:
- a. Interior Lighting
    - 1) Provide timed on/off functions on daily schedules as listed in contract documents. Also provide holiday and manual override functions.
    - 2)
  - b. Exterior Lighting
    - 1) Provide option for either timed astronomical on/off functions or photo cell/ time clock combinations.

## 2.2 MANUFACTURERS

- A. Contact Information:
1. Watt Stopper Inc, Santa Clara, CA, [www.wattstopper.com](http://www.wattstopper.com)
  2. Lutron Electronics Co., Inc., Coopersburg, PA, [www.lutron.com](http://www.lutron.com)
  3. Leviton
  4. Lithonia
  5. Hubbell

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Review proper installation of each type of device with equipment supplier.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

### **3.2 INSTALLATION**

- A. Install wiring, including control voltage cables, in conduit.
- B. Lighting Control:
  - 1. Provide time functions to control parking area, building flood lighting, and interior timed control functions as described in contract documents.
  - 2. Locate photocell outside building on roof and away from any light source and direct sunlight.
- C. Sequence Of Operation: Switches and Timed control functions shall provide ON and OFF control of relay(s) as described in Contract Documents.

### **3.3 DEMONSTRATION**

- A. Provide Factory commissioning and startup of services for entire system. Demonstrate correct functioning of equipment to designated Owner personnel.

**END OF SECTION  
260923**



## SECTION 260924 – LIGHTING AND CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following lighting control devices:
  - 1. Indoor occupancy sensors.
  - 2. Emergency shunt relay.
- B. See Division 26 Section "Network Lighting Controls" for low-voltage, manual and programmable lighting control systems.
- C. See Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.
- D. See Division 26 Section "Theatrical Lighting" for theatrical lighting controls.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

#### 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.

### PART 2 - PRODUCTS

#### 2.1 INDOOR OCCUPANCY SENSORS

- 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. Watt Stopper (The).
  - 2. Lutron
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted 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.
  5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
  7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
- 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. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
1. Monitoring: On-off status,
  2. Control: On-off operation.
- 2.2 EMERGENCY SHUNT RELAY
- 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. Lighting Control and Design, Inc.
  2. Bodine

- B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
  - 1. Coil Rating: as required .

### PART 3 - EXECUTION

#### 3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

#### 3.2 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.

#### 3.3 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.

#### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

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.

END OF SECTION 260924

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event"

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 6. Include wiring diagrams for power, signal, and control wiring.
  - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
- C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Field quality-control reports.
- E. Panelboard schedules for installation in panelboards.
- F. Operation and maintenance data.

1.4 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. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.5 WARRANTY

- 1. Warranty Period: one year from date of Substantial Completion.

1.6 EXTRA MATERIALS

- 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. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: one spares for each panelboard.
  - 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.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted 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, Wash-Down Areas: NEMA 250, Type 4X stainless steel
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4
  - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box
  - 3. Directory Card: Inside panelboard door, mounted in transparent card holder.
  - 4. All panels shown on sheet rock wall shall be recessed if possible.



- C. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Main and Neutral Lugs: Mechanical type.
  - 3. Ground Lugs and Bus Configured Terminators: Mechanical type.
  - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on 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 Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.

- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- E. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

#### 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. 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 with rms sensing; field-replaceable rating plug or field-replicable electronic trip.
  - 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 two-pole configurations with Class A ground-fault protection (6-mA trip).
  - 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  - 7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  - 8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- I. Comply with NECA 1.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

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451 East 200 South  
Lehi, Utah 84043

- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

## SECTION 262726 – WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Wall-box motion sensors.
  - 3. Snap switches and wall-box dimmers.
  - 4. Solid-state fan speed controls.
  - 5. Wall-switch and exterior occupancy sensors.
  - 6. Communications outlets.
- B. See Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

#### 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.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

## 2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-15R, and UL 498.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5252 (duplex).
    - b. Hubbell; HBL5252 (duplex).
    - c. Leviton; 5252 (duplex).
    - d. Pass & Seymour; 5252 (duplex).

## 2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. The feed through option can only be used for outlets within 4' of each other and in the same room.
- B. Duplex GFCI Convenience Receptacles, 125 V, 15 A:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; GF15.
    - b. Pass & Seymour
    - c. Leviton

## 2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Wall dimmer, 120, 20 A:
  1. To be low profile with preset on/off
  2. To dim the lights to 5% of light output without flickering
  3. To be rated and tested for the type of load.

4. Dimmers tied to LED fixtures/lamps shall be rated specifically for LED load and be listed as approved dimmer by the light fixture manufacture
  5. Products: Subject to compliance with requirements, provide one of the following:
    - a. Lutron
- D. Pilot Light Switches, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 2221PL for 120 V and 277 V.
    - b. Hubbell; HPL1221PL for 120 V and 277 V.
    - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
    - d. Pass & Seymour; PS20AC1-PLR for 120 V.
  2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- E. Key-Operated Switches, 120/277 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 2221L.
    - b. Hubbell; HBL1221L.
    - c. Leviton; 1221-2L.
    - d. Pass & Seymour; PS20AC1-L.
    - e.
  2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- F. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 1995.
    - b. Hubbell; HBL1557.
    - c. Leviton; 1257.
    - d. Pass & Seymour; 1251.
- G. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 1995L.
    - b. Hubbell; HBL1557L.
    - c. Leviton; 1257L.
    - d. Pass & Seymour; 1251L.

## 2.5 WALL PLATES

- A. Standard Cover Plates Screwless Style: The contractor is to familiarize himself with this cover plate. This style cover plate includes three piece part that may involve more labor than standard cover plate;
  - 1. Thermoplastic or Polycarbonate Matt Finish of .065 thickness
  - 2. 2 piece polycarbonate sub plate
  - 3. Color to match wiring device
  - 4. Ganged switchs shall have gange plate
  - 5. Approved manufactures, to be equal to Pass & Seymour SWP Series.
    - a. Hubbell
    - b. Leviton
    - c. Pass & Seymour SWP Series.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , die-cast aluminum with lockable cover.

## 2.6 FLOOR BOXES

- A. To be flushed with the finished floor. Provide quantity of duplex and data outlet as shown on the drawings. Coordinate exact location with the general contractor. Provide metal cover for the floor box. The floor box shall be suitable for the floor it is being installed in. Finish to be selected by the architect.
  - 1. Approved manufactures:
    - a. Legrand Cat#RFB4-\*\*-FPBT\*\*\* METAL COVER
    - b. Hubbell

## 2.7 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
  - 1. Wiring Devices Connected to Normal Power System: color to be selected by the architect
  - 2. Wiring Devices Connected to Emergency Power System: color to be selected by the architect

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.



2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than **6 inches (152 mm)** in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. 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.

### 3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION 262726

## SECTION 262813 - FUSES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Cartridge fuses rated 600-V ac and less for use in enclosed switches and enclosed controllers

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

#### 1.3 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. Comply with NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.

#### 1.4 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - 1. Cooper Bussmann, Inc.
  - 2. Edison Fuse, Inc.
  - 3. Ferraz Shawmut, Inc.
  - 4. Littelfuse, Inc.

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Lehi, Utah 84043

## 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

## PART 3 - EXECUTION

### 3.1 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK5, time delay.

### 3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

### 3.3 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

END OF SECTION 262813

## SECTION 262913 – ENCLOSED CONTROLLERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
  - 1. Full-voltage manual.
  - 2. Full-voltage magnetic.
  - 3. Multispeed.

#### 1.2 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

#### 1.4 SUBMITTALS

- A. Product Data: For each type of enclosed controller.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Wiring Diagrams: For power, signal, and control wiring.

- C. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
- D. Field quality-control reports.
- E. Operation and maintenance data.

#### 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. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

### PART 2 - PRODUCTS

#### 2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
    - f.
  - 2. Surface mounting.
  - 3. Pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

- c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button melting alloy type.
  3. Surface mounting.
  4. Pilot light.
- D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button melting alloy type.
  3. Surface mounting.
  4. Pilot light.
- E. Magnetic Controllers: Full voltage, across the line, electrically held.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. Configuration: Reversing.
  3. Contactor Coils: Pressure-encapsulated type.
    - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
  4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
  5. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor running overload protection.

- b. Sensors in each phase.
  - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
  - d. Trip test function
  - e. Visible trip indication
6. External overload reset push button.
- F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  - 2. Fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  - 3. Nonfusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  - 4. MCP Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

## 2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.



1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Other Wet or Damp Indoor Locations: Type 4.

B. .

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches (2006 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
  1. 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.
  2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch enclosed controller.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- G. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Comply with NECA 1.

### 3.2 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

### 3.3 CONTROL WIRING INSTALLATION

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Inspect controllers, wiring, components, connections, and equipment installation.
  - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
  - 3. Test continuity of each circuit.
  - 4. Test each motor for proper phase rotation.
  - 5. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Set field-adjustable switches and overload-relay pickup and trip ranges.
- B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

### 3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913



**DIVISION 27 – COMMUNICATIONS**

Not Used



**DIVISION 28 – ELECTRONIC SAFETY and SECURITY**

Not Used





**DIVISION 31 – EARTHWORK**

31 1000 - Site Clearing

31 2000 - Earth Moving



## **SECTION 31 1000**

### **SITE CLEARING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- D. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

##### **1.03 SUBMITTALS**

- A. See Section 01 3100 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
  - 1. Vegetation removal limits.
  - 2. Areas for temporary construction and field offices.

##### **1.04 QUALITY ASSURANCE**

- A. Clearing Firm: Company specializing in the type of work required.
  - 1. Minimum of 3 years of documented experience.

##### **1.05 PROJECT CONDITIONS**

- A. Comply with other requirements specified in Section 01 7000.

#### **PART 2 PRODUCTS**

##### **2.01 MATERIALS**

- A. Fill Material: As specified in Section 31 2200 - Grading

#### **PART 3 EXECUTION**

##### **3.01 SITE CLEARING**

- A. Comply with other requirements specified in Section 01 7000.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

##### **3.02 EXISTING UTILITIES AND BUILT ELEMENTS**

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.

- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.

### **3.03 VEGETATION**

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.
- B. Do not begin clearing until vegetation to be relocated has been removed.
- C. Do not remove or damage vegetation beyond the following limits:
  - 1. 40 feet outside the building perimeter.
  - 2. 10 feet each side of surface walkways, patios, surface parking, and utility lines less than 12 inches in diameter.
  - 3. 15 feet each side of roadway curbs and main utility trenches.
  - 4. 25 feet outside perimeter of pervious paving areas that must not be compacted by construction traffic.
  - 5. Exception: Specific trees and vegetation indicated on drawings to be removed.
  - 6. Exception: Selective thinning of undergrowth specified elsewhere.
- D. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
  - 1. At vegetation removal limits.
  - 2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
  - 3. Around other vegetation to remain within vegetation removal limits.
  - 4. See Section 01 5000 for fence construction requirements.
- E. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- F. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
  - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
  - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
  - 3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
  - 4. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
  - 5. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.
- G. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.
- H. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

### **3.04 DEBRIS**

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

**END OF SECTION**

## **SECTION 31 2000**

### **EARTH MOVING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, and pavements.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Excavating and backfilling for utility trenches.

##### **1.2 DEFINITIONS**

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- H. Subbase Course: Aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete walk.
- I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- J. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

### 1.3 QUALITY ASSURANCE

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

### 1.4 PROJECT CONDITIONS

- A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than **3 inches (75 mm)** in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a **1-1/2-inch (37.5-mm)** sieve and not more than 12 percent passing a **No. 200 (0.075-mm)** sieve.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

## 2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored to comply with local practice or requirements of authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

### **3.2 EXCAVATION, GENERAL**

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

### **3.3 EXCAVATION FOR STRUCTURES**

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus **1 inch (25 mm)**. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
  - 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

### **3.4 EXCAVATION FOR WALKS AND PAVEMENTS**

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### **3.5 EXCAVATION FOR UTILITY TRENCHES**

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to **12 inches (300 mm)** higher than top of pipe or conduit unless otherwise indicated.
  - 1. Clearance: **12 inches (300 mm)** each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.



Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Excavate trenches **6 inches (150 mm)** deeper than elevation required in rock or other unyielding bearing material, **4 inches (100 mm)** deeper elsewhere, to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

### **3.6 SUBGRADE INSPECTION**

- A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

### **3.7 UNAUTHORIZED EXCAVATION**

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of **2500 psi (17.2 MPa)**, may be used when approved by Architect.
  1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

### **3.8 STORAGE OF SOIL MATERIALS**

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### **3.9 UTILITY TRENCH BACKFILL**

- A. Place backfill on subgrades free of mud, frost, snow, or ice.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within **18 inches (450 mm)** of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in "Cast-in-Place Concrete"
- D. Trenches under Roadways: Provide **4-inch- (100-mm-)** thick, concrete-base slab support for piping or conduit less than **30 inches (750 mm)** below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of **4 inches (100 mm)** of concrete before backfilling or placing roadway subbase course. Concrete is specified in "Cast-in-Place Concrete"
- E. Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than **1 inch (25 mm)** in any dimension, to a height of **12 inches (300 mm)** over the pipe or conduit.
  - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Install warning tape directly above utilities, **12 inches (300 mm)** below finished grade, except **6 inches (150 mm)** below subgrade under pavements and slabs.

### **3.10 SOIL FILL**

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
  - 1. Under grass and planted areas, use satisfactory soil material.
  - 2. Under walks and pavements, use satisfactory soil material.
  - 3. Under steps and ramps, use engineered fill.
  - 4. Under building slabs, use engineered fill.
  - 5. Under footings and foundations, use engineered fill.

### **3.11 SOIL MOISTURE CONTROL**

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### **3.12 COMPACTION OF SOIL BACKFILLS AND FILLS**

- A. Place backfill and fill soil materials in layers not more than **8 inches (200 mm)** in loose depth for material compacted by heavy compaction equipment, and not more than **4 inches (100 mm)** in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
  1. Under structures, building slabs, steps, and pavements, scarify and recompact top **12 inches (300 mm)** of existing subgrade and each layer of backfill or fill soil material at 95 percent.
  2. Under walkways, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at 92 percent.
  3. Under turf or unpaved areas, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at 85 percent.
  4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

### **3.13 GRADING**

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  1. Turf or Unpaved Areas: Plus or minus **1 inch (25 mm)**.
  2. Walks: Plus or minus **1 inch (25 mm)**.
  3. Pavements: Plus or minus **1/2 inch (13 mm)**.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of **1/2 inch (13 mm)** when tested with a **10-foot (3-m)** straightedge.

### **3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS**

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
  - 1. Shape subbase course and base course to required crown elevations and cross-slope grades.
  - 2. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
  - 3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

### **3.15 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE**

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  - 1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
  - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

### **3.16 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

**3.17 PROTECTION**

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

**3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

**END OF SECTION 31 2000**



**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 1313 - Concrete Paving

32 3119 - Decorative Iron Fencing and Gates





## SECTION 32 1313

### CONCRETE PAVING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Driveways.
  - 2. Parking lots.
  - 3. Curbs and gutters.
  - 4. Walks.

##### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Other Action Submittals:
  - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

##### 1.3 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with **ACI 301 (ACI 301M)** unless otherwise indicated.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
  - 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than **48 inches** by **48 inches**.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 STEEL REINFORCEMENT**

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60 (Grade 420)**; deformed.
- C. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- D. Dowel Bars: ASTM A 615/A 615M, **Grade 60 (Grade 420)** plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels 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 specified.

### **2.2 CONCRETE MATERIALS**

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
  1. Portland Cement: ASTM C 150, gray portland cement Type I/II. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class C or Class F.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
- F. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
  - 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. **Davis Colors.**
    - b. **Dayton Superior Corporation.**
    - c. **Lambert Corporation.**
    - d. **LANXESS Corporation.**
    - e. **QC Construction Products.**
    - f. **Scofield, L. M. Company.**
    - g. **Solomon Colors, Inc.**
  - 2. Color: As selected by Architect from manufacturer's full range to match existing.

### **2.3 CURING MATERIALS**

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately **9 oz./sq. yd. (305 g/sq. m)** dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

### **2.4 RELATED MATERIALS**

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

### **2.5 PAVEMENT MARKINGS**

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

1. Color: As indicated.

## **2.6 CONCRETE MIXTURES**

- A. Prepare design mixtures, proportioned according to **ACI 301 (ACI 301M)**, with the following properties:
  1. Compressive Strength (28 Days): **4000 psi (27.6 MPa)**.
  2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
  3. Slump Limit: **4 inches (100 mm)**, plus or minus **1 inch (25 mm)**.
  4. Air Content: 6 percent plus or minus 1.5 percent.
- B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

## **2.7 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
- B. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION AND PREPARATION**

- A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.

### **3.2 EDGE FORMS AND SCREED CONSTRUCTION**

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### **3.3 STEEL REINFORCEMENT**

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

### **3.4 JOINTS**

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a **3/8-inch (10-mm)** radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

### **3.5 CONCRETE PLACEMENT**

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- B. Comply with **ACI 301 (ACI 301M)** requirements for measuring, mixing, transporting, placing, and consolidating concrete.
- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Screed paving surface with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

### **3.6 FLOAT FINISHING**

- A. General: Do not add water to concrete surfaces during finishing operations.

- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

### 3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these.

### 3.8 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
  - 1. Elevation: 3/4 inch (19 mm).
  - 2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
  - 3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/2 inch (13 mm).
  - 4. Joint Spacing: 3 inches (75 mm).
  - 5. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
  - 6. Joint Width: Plus 1/8 inch (3 mm), no minus.

### 3.9 PAVEMENT MARKING

- A. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- B. Sweep and clean surface to eliminate loose material and dust.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- C. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of **15 mils (0.4 mm)**.

### **3.10 REPAIRS AND PROTECTION**

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

**END OF SECTION 32 1313**





## **SECTION 32 3119**

### **DECORATIVE IRON FENCING AND GATES**

#### **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. Ductile iron (wrought) fencing, gates and hardware to match existing.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 03 Section "Cast-in-Place Concrete" for concrete for post footings.

##### **1.3 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Shop drawings showing location of fence, gates, each post, and details of post installation, gate swing, hardware, and accessories.

##### **1.4 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Firm experienced in successfully producing decorative fences similar to that indicated for this Project and with sufficient production capacity to produce required units without delaying the Work.
- B. Installer Qualifications: Arrange for installation of decorative fences specified in this Section by the same firm that fabricated it.
- C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code-Steel".
  - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

## **PART 2 - PRODUCTS**

### **2.1 METALS**

- A. General: Provide metals free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.
- B. Steel and Iron: Provide steel and iron in the form indicated complying with the following requirements:
  - 1. Square Tubing: Cold-formed steel structural tubing conforming to ASTM A 500, Grade B with minimum yield strength of 42,000 psi and not less than 1.8 oz. of zinc per sq. ft. Type A costing inside and outside according to ASTM F 1234, as determined by ASTM A 90.
  - 2. Steel Plate, Shapes, and Bars: ASTM A 36/A 36M.
  - 3. Gray Iron Castings: ASTM A 48, Class 30.
  - 4. Malleable Iron Casting: ASTM A 47 (ASTM A 47M), grade as recommended by fabricator for type of use indicated.

### **2.2 MISCELLANEOUS MATERIALS**

- A. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS specifications, and as required for color match, strength, and compatibility in the fabricated items.
- B. Fasteners: Use fasteners of same basic metal as the fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
  - 1. Provide concealed fasteners for interconnection of ornamental metalwork components and for their attachment to other work except where exposed fasteners are unavoidable or are the standard fastening method.
- C. Cast-in-Place and Post-Installed Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
  - 1. Expansion anchors.
- D. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements of FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

- F. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, complying with DOD-P-21035 or SSPC-paint 20.
- G. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

### **2.3 FITTINGS AND ACCESSORIES**

- A. Material: Comply with ASTM F 626. Mill-finished aluminum or galvanized iron or steel to suit manufacturer's standards.
  - 1. Steel and Iron: Unless specified otherwise, hot-dip galvanize pressed steel or cast-iron fence fittings and accessories with at least 1.2 oz. zinc per sq. ft. as determined by ASTM A 90.
  - 2. Post and Line Caps: Provide weathertight closure cap for each post.

### **2.4 CONCRETE**

- A. Concrete: Provide concrete consisting of portland cement per ASTM C 150, aggregates per ASTM C 33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3000 psi. Use at least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.

### **2.5 GATES**

- A. Fabricate perimeter frames of gates from same material and finish as fence framework. Assemble gate frames by welding. Provide horizontal and vertical members to ensure proper gate operation and attachment of hardware and accessories.
  - 1. Bracing: Install diagonal cross-bracing consisting of 5/16-inch-diameter adjustable-length truss rods on gates to ensure frame rigidity without sag or twist.
- B. Swing Gates:
  - 1. Gate Hardware: Provide galvanized hardware and accessories for each gate according to the following:
    - a. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6-foot nominal height. Hinges shall be self-closing type, designed to keep gate in closed position.
    - b. Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar.

### **2.6 FABRICATION**

- A. Form decorative fences to required shapes and sizes, with true curves, lines, and angles. Provide components to sizes and profiles indicated, but not less than required to comply with requirements indicated for structural performance.
- B. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work.

Drill and tap for required fasteners, unless otherwise indicated. Use concealed fasteners wherever possible.

- C. Comply with AWS for recommended practices in shop welding and brazing. Provide welds and brazes behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded and brazed joints of all flux, and dress all exposed and contact surfaces.
- D. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
- E. Provide castings that are sound and free of warp, cracks, blow holes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gatemarks, casting flash, and other casting marks.
- F. Finish exposed surfaces to smooth, sharp, well-defined lines and arises.
- G. Assemble items in the shop to the 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.
- H. Welded Connections: Fabricate handrails and railing systems of materials indicated below to interconnect members by welding. Use welding method that is appropriate for metal and finish indicated and that develops strength required to comply with structural performance criteria. Finish exposed welds and surfaces smooth, flush and blended to match adjoining surfaces.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.

## **2.7 FINISHES, GENERAL**

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

## **2.8 IRON AND STEEL FINISHES**

- A. Galvanizing: Hot-dip galvanize items indicated to be galvanized to comply with applicable standard listed below:
  - 1. ASTM A 153 for galvanizing iron and steel hardware.
  - 2. ASTM A 123 for galvanizing iron and steel products made from rolled, pressed, and forged steel shapes, casting, plates, bars, and strips.
- B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed ornamental metalwork:
  - 1. Exteriors (SSPC Zone IB): SSPC-SP 6 "Commercial Blast Cleaning".

- C. Finish: Refer to Section 09 9100, Painting, for required primer and finish coats.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Coordinate and furnish anchorages and setting drawings, diagrams, templates, instructions, and directions for installing items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the project site.

#### **3.2 INSTALLATION**

- A. Provide anchorage devices and fasteners where necessary for securing decorative fences to in-place construction.
- B. Perform cutting, drilling, and fitting required to install decorative fencing. Set products accurately in location, alignment, and elevation, plumb, level and true, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of fence sections, restore finishes to eliminate any evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- E. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at the same location.
- F. Field Welding: Comply with the applicable AWS specification for procedures of manual shielded metal-arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent surfaces.

#### **3.3 GATE INSTALLATION**

- A. Install gates plumb, level and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. Install gates according to manufacturer's instructions, plumb, level and secure.

Lehi Municipal Pool Building - Addition and Remodel  
451 East 200 South  
Lehi, Utah 84043

### **3.4 ADJUSTING**

- A. Gates and Gate Operators: After repeated operation of complete installation equivalent to 3 day's use by normal traffic, readjust gates for optimum operating conditions and safety. Lubricate and clean exposed surfaces.
- B. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.
- C. For galvanized surfaces, clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

### **3.5 PROTECTION**

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

**END OF SECTION 32 3119**

**DIVISION 33 – UTILITIES**

Not Used

