

PROJECT MANUAL

Nebraska Administrative Services
1526 Building Boiler
Lincoln, Nebraska

August 14, 2013

TCEP Project No.: 155-163-13



Mechanical Engineer
(Coordinating Professional)



Electrical Engineer

155-163-13

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**STATE OF NEBRASKA
ADMINISTRATIVE SERVICES
STATE BUILDING DIVISION**

**Standard Form of Agreement between Owner and Contractor
where the basis of payment is a STIPULATED SUM**

THE PROJECT IS:

Location:

Between **THE OWNER:**

State of Nebraska
AS/State Building Division
521 South 14th Street, Suite 500
Lincoln, NE. 68508-2707

The Owner's representative is:

Name:
Address:
Phone:

And **THE CONTRACTOR:**

Name:
Address:
City, State

**The Contractors
representative:**

Name:
Address:
City, State:

Phone:

Neither the Owner's nor the Contractor's representative shall be changed without ten days written notice to the other party.

The **Consultant** is:

Firm
Address:
City, State

The Consultant's representative is:

Name:
Phone:

The Consultant was selected according to state law.

The State, its officers, and employees shall be held harmless from claims arising from the actions or omissions of the Contractor, its sub-contractors, agents, or employees. The Contractor agrees to indemnify the State for any such claims.

ARTICLE 1 - SCOPE OF WORK

The Contractor shall furnish all materials and fully execute the Work described in the Contract Documents of Article 5. The Contractor shall, in a professional and diligent manner, do everything required in the Contract Documents.

ARTICLE 2 - TIME OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

- 2.1 The Work to be performed by the Contractor under this Agreement shall officially commence with the date of this Agreement provided in the "Execution of Contract" section at the end of this contract. The Contract Time shall be measured from this date of commencement.
- 2.2 **Substantial Completion** of the entire Work by the Contractor shall be made not later than **calendar days** from the date of commencement, subject to approved changes in the Contract Time as provided in the Contract Documents.

ARTICLE 3 - CONTRACT SUM

- 3.1 The Owner shall pay the Contractor for the performance of the Work, subject to approved additions and deductions as provided in the Contract Documents, the Contract Sum of:
Dollars (\$)
- 3.2 The Contract Sum is based upon the following alternates which are described in the Contract Documents and are hereby accepted by the Owner: **NONE**
- 3.3 Unit prices are as follows: **NONE**

ARTICLE 4 - PROGRESS AND FINAL PAYMENTS

- 4.1 All issues regarding payments shall be as described by pages through of the "General Conditions" in the Project Manual.
- 4.2 In Accordance with the Nebraska Prompt Payment Act, payments due and unpaid under the Contract 45 days after the due date shall bear interest from the 31st day following the date payment is due.

ARTICLE 5 - THE CONTRACT DOCUMENTS

- 5.1 Besides this Agreement, the Contract Documents consist of the General Conditions, Supplementary Conditions, and other specified Conditions, the Drawings, Specifications, and Addenda issued prior to execution of this Agreement, other documents specified in this Agreement, and Change Orders or other Modifications issued after execution of this Agreement. These documents form the Contract, which represents the entire agreement between the Owner and Contractor, and supersedes any prior written or oral negotiations, representations or agreements. In the event of a conflict between the terms of the documents, this Agreement shall govern, followed by the General Conditions, the Supplementary Conditions, the Specifications, the Drawings, Change Orders, and then any other Addenda. The Contract Documents, except for Change Orders or other Modifications issued after execution of this Agreement, are enumerated as follows:
- 5.2 The Agreement is this executed AS/State Building Division Standard Form of Agreement between Owner and Contractor.
- 5.3 The General Conditions are contained in the Project Manual, dated

5.4 The Supplementary and other Conditions of the Contract are those contained in the Project Manual, dated _____ and _____ are as follows:

Document	Title	Pages
----------	-------	-------

5.5 The Specifications are those contained in the Project Manual dated as in Paragraph 5.3, and are as follows:

Section	Title	Pages
---------	-------	-------

5.6 The Drawings are as follows:

Number	Title	Date
--------	-------	------

5.7 The Addenda are as follows:

Number	Date	Pages
--------	------	-------

5.8 Other documents forming part of the Contract Documents are as follows:
 BID PROPOSAL, PERFORMANCE AND PAYMENT BONDS, ADVERTISEMENT FOR BIDS, INSTRUCTIONS TO BIDDERS.

ARTICLE 6 - MISCELLANEOUS PROVISIONS

6.1 Compliance with Civil Rights Laws and Equal Opportunity Employment. The Contractor affirms that it complies with, and will continue to comply with, the Nebraska Fair Employment Practice Act and Title VI of the Civil Rights Act of 1964, as amended. The Contractor affirms that no person (including employees or applicants for employment) shall, on the grounds of age, religion, sex, disability, race or national origin, be excluded from participation in, be denied the benefits of, or otherwise subjected to discrimination under this contract or any other project, program or activity supported by this contract. The Contractor agrees that in performance of this contract neither he nor his subcontractors will discriminate against any of their employees or applicants for employment concerning the employees' or applicants' hire, tenure, terms, conditions or privileges of employment based on the employees' or applicants' race, color, religion, sex, marital status, age, disability, or national origin.

6.2 The Contractor agrees to comply with all applicable provisions of The Federal Rehabilitation Act of 1973, as amended, the Americans With Disabilities Act of 1990 as amended, Section 5043 of the Rehabilitation Act of 1973, as amended, the Age Discrimination Act of 1975, as amended, and the Nebraska Fair Employment Act, as amended, which are hereby incorporated by reference. The Contractor agrees to comply with any amendments to these laws effective during the term of the Agreement. The Contractor further agrees to include similar provisions in all subcontracts for services allowed in connection with this contract.

6.3 Drug Free Workplace Policy. The Contractor certifies that as a condition of the Agreement, neither the Contractor nor the employees of the Contractor shall engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity covered by the Agreement. The Department of Administrative Services reserves the right to request a copy of the Contractor's Drug Free Workplace policy. The Contractor further agrees to insert a provision similar to this statement in all sub-contracts for services required under this Agreement.

- 6.4** This Agreement shall be governed by the laws of the State of Nebraska. The Contractor agrees to comply with all applicable Federal, State, and local rules, regulations, and laws.
- 6.5** Contract Agreement Solicitation Statement. As per requirements of Sections 81-1716 through 81-1719, Revised Statutes of Nebraska, 1943, the Contractor warrants that he or she has not employed or retained any company or person, other than bonafide employees working for him or her, to solicit or secure this Agreement and that he or she has not paid, or agreed to pay, any person, company, corporation, individual, or firm, other than a bonafide employee working solely for him or her, and fee, commission, percentage, gift, or any other consideration contingent upon or resulting from the award for the making of this Agreement.
- 6.6** Work Eligibility Status of Employees. The Contractor is required and hereby agrees to use a federal immigration verification system to determine the work eligibility status of new employees physically performing services within the State of Nebraska. A federal immigration verification system means the electronic verification of the work authorization program authorized by the Illegal Immigration Reform and Immigrant Responsibility Act of 1996, 8 U.S.C. 1324a, known as the E-Verify Program, or an equivalent federal program designated by the United States Department of Homeland Security or other federal agency authorized to verify the work eligibility status of a newly hired employee.

If the Contractor is an individual or sole proprietorship, the following applies:

1. The Contractor must complete the United States Citizenship Attestation Form, available on the Department of Administrative Services website at www.das.state.ne.us.
2. If the Contractor indicates on such attestation form that he or she is a qualified alien, the Contractor agrees to provide the US Citizenship and Immigration Services documentation required to verify the Contractor's lawful presence in the United States using the Systematic Alien Verification for Entitlements (SAVE) Program.
3. The Contractor understands and agrees that lawful presence in the United States is required and the Contractor may be disqualified or the contract terminated if such lawful presence cannot be verified as required by Neb. Rev. Stat. §4-108.

ARTICLE 7 - TERMINATION OR SUSPENSION

- 7.1** The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause, or for insufficient appropriation or allocation of funds.
- 7.2** Upon receipt of written notice from the Owner of such termination for the Owner's convenience, or for insufficient appropriation or allocation of funds, the Contractor shall:
- .1 cease operations as directed by the Owner in the notice;
 - .2 take actions necessary, or as the Owner may direct, for the protection and preservation of the Work; and
 - .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.
- 7.3** In case of such termination for the Owner's convenience, or for insufficient appropriation or allocation of funds, the Contractor shall be entitled to receive payment for Work executed, and reasonable costs incurred as a direct result of such termination. HOWEVER, IN NO CASE shall the Contractor receive payment for any Work not executed, and the Contractor shall NOT receive payment for overhead and profit on the Work not executed.
- 7.4** Termination of the Contract for Breach of Contract shall be as described by pages through of the "General Conditions" in the Project Manual.

EXECUTION OF CONTRACT

This Agreement is entered into as of the date shown below and executed in three (3) originals for the Owner, the Contractor, and the Consultant.

OWNER

CONTRACTOR

Rodney Anderson
Administrator

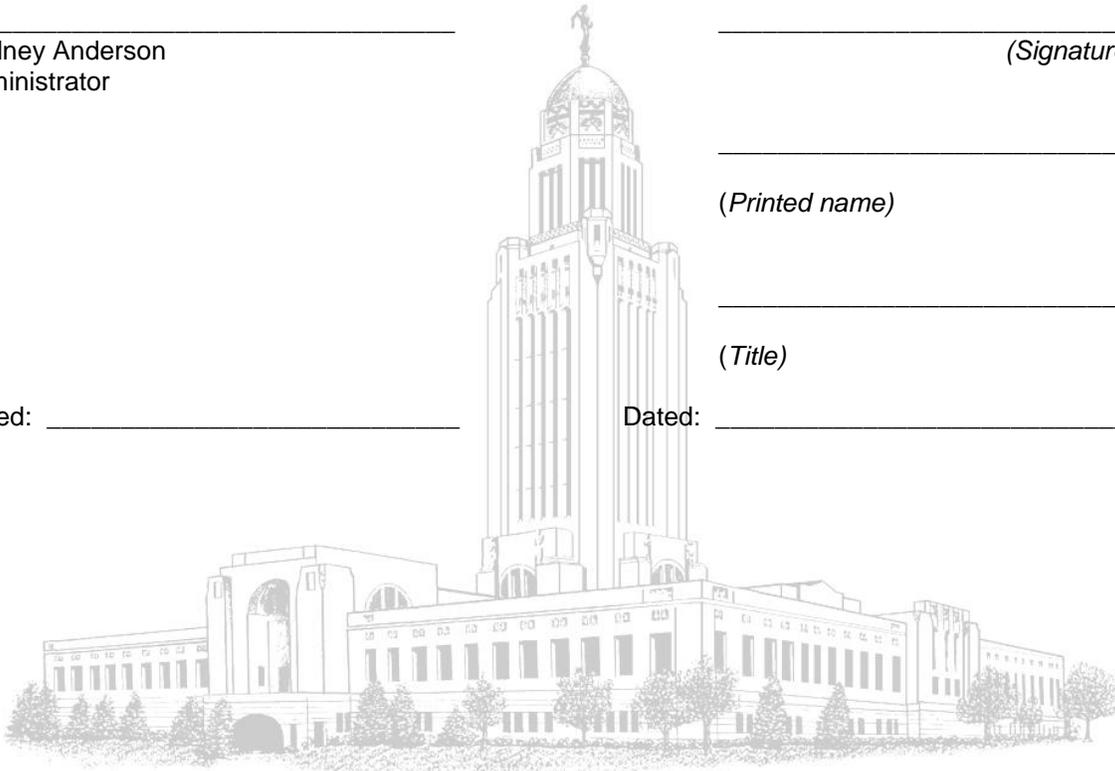
(Signature)

(Printed name)

(Title)

Dated: _____

Dated: _____



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Nebraska Resale or Exempt Sale Certificate

FORM
13

for Sales Tax Exemption
• Read instructions on reverse side/see note below

NAME AND MAILING ADDRESS OF PURCHASER			NAME AND MAILING ADDRESS OF SELLER		
Name			Name		
Street or Other Mailing Address			Street or Other Mailing Address		
City	State	Zip Code	City	State	Zip Code

Check Type of Certificate

Single Purchase Blanket If blanket is checked, this certificate is valid until revoked in writing by the purchaser.

I hereby certify that the purchase, lease, or rental by the above purchaser is exempt from the Nebraska sales tax for the following reason:

Check One Purchase for Resale (Complete Section A) Exempt Purchase (Complete Section B) Contractor (Complete Section C)

SECTION A—Nebraska Resale Certificate

Description of Item or Service Purchased

I hereby certify that the purchase, lease, or rental of
from the above seller is exempt from the Nebraska sales tax as a purchase for resale, rental, or lease in the normal course of our business, either in the
form or condition in which purchased, or as an ingredient or component part of other property to be resold.

I further certify that we are engaged in business as a: Wholesaler Retailer Manufacturer Lessor
of Description of Product Sold, Leased, or Rented

If None, State Reason

and hold Nebraska Sales Tax Permit Number 01-

or Foreign State Sales Tax Number

State

SECTION B—Nebraska Exempt Sale Certificate

The basis for this exemption is exemption category (Insert appropriate category as described on reverse of this form.)

If exemption category 2 or 5 is claimed, enter the following information:

Description of Item(s) Purchased

Intended Use of Item(s) Purchased

If exemption categories 3 or 4 are claimed, enter the Nebraska Exemption Certificate number. 05-

If exemption category 6 is claimed, seller must enter the following information and sign this form below:

Description of Item(s) Sold

Date of Seller's Original Purchase

Was Tax Paid when Purchased by Seller?

Was Item Depreciable?

YES NO

YES NO

SECTION C—For Contractors Only

1. Purchases of Building Materials or Fixtures:

As an Option 1 or Option 3 contractor, I hereby certify that purchases of building materials and fixtures from the above seller are exempt from
Nebraska sales tax. My Nebraska Sales or Consumer's Use Tax Permit Number is: 01-

2. Purchases Made Under Purchasing Agent Appointment on behalf of _____:
(exempt entity)

Pursuant to an **attached** Purchasing Agent Appointment and Delegation of Authority for Sales and Use Tax, Form 17, I hereby certify that purchases
of building materials, and fixtures are exempt from Nebraska sales tax.

Any purchaser, or their agent, or other person who completes this certificate for any purchase which is other than for resale, lease, or rental in the
regular course of the purchaser's business, or is not otherwise exempted from the sales and use tax under Neb. Rev. Stat. §§77-2701 through 77-27,135,
shall in addition to any tax, interest, or penalty otherwise imposed, be subject to a penalty of \$100 or ten times the tax, whichever amount is larger, for
each instance of presentation and misuse. With regard to a blanket certificate, this penalty shall apply to each purchase made during the period the blanket
certificate is in effect. Under penalties of law, I declare that I am authorized to sign this certificate, and to the best of my knowledge and belief, it is correct
and complete.

sign
here

Authorized Signature

Title

Date

NOTE: Sellers must keep this certificate as part of their records. DO NOT SEND TO THE NEBRASKA DEPARTMENT OF REVENUE.

Incomplete certificates cannot be accepted.

www.revenue.ne.gov, (800) 742-7474 (toll free in NE and IA), (402) 471-5729

INSTRUCTIONS

WHO MAY ISSUE A RESALE CERTIFICATE. Form 13, Section A, is to be issued by persons or organizations making purchases of property or taxable services in the **normal** course of their business for the purpose of resale either in the form or condition in which it was purchased, or as an ingredient or component part of other property.

WHO MAY ISSUE AN EXEMPT SALE CERTIFICATE. Form 13, Section B can only be issued by persons or organizations exempt from payment of the Nebraska sales tax by qualifying for one of the six enumerated **Categories of Exemption** (see below). Nonprofit organizations that have a 501(c) designation and are exempt from federal and state income tax are **not** automatically exempt from **sales** tax. Only the entities listed in the referenced regulations are exempt from paying Nebraska sales tax on their purchases when the exemption certificate is properly completed and provided to the seller. Organizations claiming a sales tax exemption may do so only on items purchased for their own use. For health care organizations, the exemption is limited to the specific level of health care they are licensed for. The exemption is not issued to the entire organization when multiple levels of health care or other activities are provided or owned by the organization. Items purchased by an exempt organization that will be resold must be supported by a properly completed Nebraska Resale Certificate, Form 13, Section A.

Indicate the category which properly reflects the basis for your exemption. Place the corresponding number in the space provided in Section B. If category 2 through 6 is the basis for exemption, you must complete the information requested in Section B.

[Nebraska Sales and Use Tax Reg-1-013, Sale for Resale – Resale Certificate](#), and [Reg-1-014, Exempt Sale Certificate](#), provide additional information on the proper issuance and use of this certificate. These and other regulations referred to in these instructions are available on our Web site: www.revenue.ne.gov/legal/regs/slstaxregs.

Use Form 13E for purchases of energy sources which qualify for exemption. Use Form 13ME for purchases of mobility enhancing equipment on a motor vehicle.

CONTRACTORS. Form 13, Section C, Part 1, must be completed by contractors operating under Option 1 or Option 3 to document their tax-free purchase of building materials or fixtures from their suppliers. Section C, Part 2, may be completed to exempt the purchase of building materials or fixtures pursuant to a [Purchasing Agent Appointment, Form 17](#). See the [contractor information guides](#) on our Web site www.revenue.ne.gov for additional information.

WHERE TO FILE. Form 13 is given to the seller at the time of the purchase of the property or service or when sales tax is due. The certificate must be retained with the seller's records for audit purposes. Do not send to the Department of Revenue.

SALES TAX NUMBER. A purchaser who completes Section A and is engaged in business as a wholesaler or manufacturer is not required to provide an identification number. Out-of-state purchasers can provide their home state sales tax number. Section B does not require an identification number when exemption category 1, 2, or 5 is indicated.

PROPERLY COMPLETED CERTIFICATE. A purchaser must complete a certificate before issuing it to the seller. To properly complete the certificate, the purchaser must include: (1) identification of the purchaser and seller, (2) a statement whether the certificate is for a single purchase or is a blanket certificate,

(3) a statement of basis for exemption including completion of all information for the basis chosen, (4) the signature of an authorized person, and (5) the date the certificate was issued.

PENALTIES. Any purchaser who gives a Form 13 to a seller for any purchase which is other than for resale, lease, or rental in the **normal** course of the purchaser's business, or is not otherwise exempted from sales and use tax under the Nebraska Revenue Act, shall be subject to a penalty of \$100 or ten times the tax, whichever amount is larger, for each instance of presentation and misuse.

Any purchaser, or their agent, who fraudulently signs a Form 13 may be found guilty of a Class IV misdemeanor.

CATEGORIES OF EXEMPTION

1. Purchases made directly by certain governmental agencies identified in [Nebraska Sales and Use Tax Reg-1-012, Exemptions; Reg-1-072, United States Government and Federal Corporations](#); and [Reg-1-093, Governmental Units](#), are exempt from sales tax. A list of specific governmental units are provided in the above regulations. Governmental units are not assigned exemption numbers.

Sales to the United States government, its agencies, and corporations wholly owned by the United States government are exempt from sales tax. However, sales to institutions chartered or created under federal authority, but which are not directly operated and controlled by the United States government for the benefit of the public, generally are taxable. Construction projects for federal agencies have specific requirements, see [Reg-1-017 Contractors](#).

Purchases that are **not** exempt from Nebraska sales and use tax include, but are not limited to, governmental units of other states, sanitary and improvement districts, urban renewal authorities, rural water districts, railroad transportation safety districts, and county historical or agricultural societies.

2. Purchases when the intended use renders it exempt as set out in paragraph 012.02D of Reg-1-012, Exemptions. Complete the description of the item purchased and the intended use as required on the front of Form 13. Sellers of **repair parts** for agricultural machinery and equipment cannot accept a Form 13 to exempt such sales from tax.

3. Purchases made by organizations that have been issued a Nebraska Exempt Organization - Certificate of Exemption are exempt from sales tax. [Reg-1-090, Nonprofit Organizations](#); [Reg-1-091, Religious Organizations](#); and [Reg-1-092, Educational Institutions](#), identify such organizations. These organizations will be issued a Nebraska state exemption identification number. This exemption number must be entered in Section B of the Form 13.

4. Purchases of common or contract carrier vehicles and repair and replacement parts for such vehicles.

5. Purchases of manufacturing machinery or equipment by a taxpayer engaged in business as a manufacturer for use predominantly in manufacturing. This includes the installation, repair, or maintenance of such qualified manufacturing machinery or equipment (see [Revenue Ruling 01-08-2](#)).

6. A sale that qualifies as an occasional sale, such as a sale of depreciable machinery and equipment productively used by the seller for more than one year and the seller previously paid tax on the item. The **seller** must sign and give the exemption certificate to the purchaser. The certificate must be retained by the purchaser for audit purposes (see [Reg-1-014, Exempt Sale Certificate](#)).

Purchasing Agent Appointment and Delegation of Authority for Sales and Use Tax

PURCHASING AGENT APPOINTMENT

Name and Address of Prime Contractor	Name and Address of Governmental Unit or Exempt Organization
Name	Name
Street or Other Mailing Address	Street or Other Mailing Address
City State Zip Code	City State Zip Code
Name and Location of Project	Appointment Information
Name	Effective Date (see Instructions)
Street or Other Mailing Address	Expiration Date
City State Zip Code	Nebraska Exemption Number (Exempt Organizations Only)
Identify Project	

The undersigned governmental unit or exempt organization appoints the above-named contractor and the contractor's delegated subcontractors as its agent to purchase and pay for building materials that will be annexed to real estate by them into the tax exempt construction project stated above.

**sign
here** ▶

Authorized Signature of Governmental Unit or Exempt Organization

Title

Date

DELEGATION OF PRIME CONTRACTOR'S AUTHORITY

Name and Address of Subcontractor	Delegation Information
Name	Effective Date
Street or Other Mailing Address	Expiration Date
City State Zip Code	Portion of Project

The undersigned prime contractor hereby delegates authority to act as the purchasing agent of the named governmental unit or exempt organization to the above-named subcontractor.

**sign
here** ▶

Signature of Prime Contractor or Authorized Representative

Title

Date

INSTRUCTIONS

WHO MUST FILE. Any governmental unit or organization that is **exempt** from sales and use tax may appoint as its agent a prime contractor to purchase building materials and/or fixtures that will be annexed to property that belongs to or will belong to the governmental unit or exempt organization pursuant to a construction contract with the governmental unit or exempt organization. The appointment of the prime contractor as its agent is completed by issuing a Purchasing Agent Appointment and Delegation of Authority for Sales and Use Tax, Form 17, to the prime contractor. The Form 17 is required to be given to the contractor **BEFORE** he or she annexes building materials. The governmental unit or exempt organization must identify the project (e.g., east wing, chapel construction, or new school auditorium). Most

nonprofit organizations are NOT exempt from sales tax in Nebraska. In addition, not all governmental units are exempt from Nebraska sales tax. Refer to [Contractor Information](#) on our Web site for additional information on exempt entities. A contractor can confirm the exempt status of a governmental unit or exempt organization by contacting the Nebraska Department of Revenue.

The exemption from the payment of the Nebraska and local option sales and use taxes only applies if the governmental unit or exempt organization directly, or through its contractor, pays for the building materials. **IMPORTANT NOTE:** When an organization that requires licensure in order to be exempt (i.e., nonprofit hospitals), but is not licensed at the time of the construction project, the exempt organization **CANNOT**

issue either a purchasing agent appointment or an exemption certificate. If the exempt organization becomes licensed upon completion of the project, it may apply for a refund of the tax paid or collected by the contractors.

WHEN TO FILE. A prime contractor engaging in a construction project with a governmental unit or exempt organization must receive a properly completed and signed Form 17 **BEFORE** any building materials are annexed. If Form 17 is not issued, the contractor must pay the sales and use taxes and the governmental unit or exempt organization may obtain a refund of the taxes paid by the contractor.

WHERE TO FILE. A copy of the completed form should be retained by the governmental unit or exempt organization issuing the Form 17. The original is to be retained by the prime contractor. Copies of this form must be made by the prime contractor for delegation purposes to any subcontractors working on the project identified on this form.

APPOINTMENT INFORMATION. Enter the dates the purchasing agent appointment will become effective and when it will expire. This appointment will not allow any purchases without payment of the tax by the prime contractor or subcontractor before the effective date or after the expiration date. The dates the delegation becomes effective and the expiration dates must be completed. The phrase “upon completion” or similar phrase is not acceptable as an expiration date. The governmental unit or exempt organization may need to issue another Form 17 if the project is not completed within the prior “effective” and “expiration” dates. Exempt organizations must enter their Nebraska Sales and Use Tax Exemption number.

DELEGATION OF PRIME CONTRACTOR’S AUTHORITY. The prime contractor may delegate his or her authority to act as the purchasing agent of the governmental unit or exempt organization to a subcontractor. The prime contractor must complete his or her copy of Form 17 for each subcontractor who is delegated authority to act as a purchasing agent. Reproductions of this delegation must be provided to the subcontractor, who must retain a copy for his or her records, and to the governmental unit or exempt organization.

Enter the dates the delegation of the subcontractor will become effective, when it will expire, and the portion of the project delegated. This delegation will not allow any purchases without payment of the tax by the subcontractor before the delegation date or after the expiration date. Any further delegation from a subcontractor to additional subcontractors must be delegated by providing a copy of the Form 17 that they received from the prime contractor and attaching it to a separate Form 17 with any further delegation to other subcontractors. The purchasing agent appointment is limited to the contractor’s purchase of building materials and/or fixtures for the specific project and is only valid during the appointment dates shown on the Form 17.

EXEMPT SALE CERTIFICATE. A prime contractor who has been appointed to act as a purchasing agent by a governmental unit or exempt organization, and who hires a subcontractor operating as an Option 1 contractor, must provide to that subcontractor a completed copy of Form 17 and a [Nebraska Resale or Exempt Sale Certificate, Form 13](#), with Section C,

Part 2, completed. The subcontractor will retain these forms in his or her records, and will not charge the contractor sales tax on any portion of the invoice involving the annexation of materials to the specific project identified on the Form 17. If these forms are not provided to the subcontractor operating under Option 1, the subcontractor must collect and remit sales tax on the charge for the separately stated building materials portion of the invoice. If the Option 1 subcontractor does not separately state the charge for the building materials from contractor labor, then the entire charge is taxable to the prime contractor.

Contractors operating under Option 2 (maintaining a tax-paid inventory) who have been issued a Form 17 from a governmental unit or an exempt organization, must furnish each vendor a copy of the Form 17 and a Form 13, completing Section C, Part 2, when purchasing building materials that will be annexed to real estate. Forms 13 and 17 must be retained with the vendor’s and contractor’s records for audit purposes. A contractor or subcontractor may reproduce copies of these documents which will be furnished to the vendors for each invoice or order made by them.

Invoices from vendors for the purchase of building materials by the contractor as purchasing agent, or the authorized subcontractor, must clearly identify that such purchase is for the specific Form 17 project.

CREDIT/REFUND OF SALES AND USE TAX. A contractor or subcontractor who has been appointed as a purchasing agent before any materials are annexed, may withdraw sales or use tax-paid materials from inventory that will be annexed to real estate or used to repair property annexed to real estate and receive a credit for the sales or use tax amount previously paid on those materials.

The contractor or subcontractor may take a credit either against his or her current tax liability, or file a [Claim for Overpayment of Sales and Use Tax, Form 7](#), and receive a refund of the sales or use tax paid on those materials.

TOOLS, EQUIPMENT, AND SUPPLIES. The purchase, rental, or lease of tools, supplies, or equipment (i.e., scaffolding, barricades, machinery, etc.) by a contractor for use in the completion of an exempt project CANNOT be purchased tax free, even if the contractor has been issued a Form 17. These items do not become annexed to the real estate.

OPTION 1 CONTRACTOR ONLY. If an Option 1 contractor is the **only** contractor involved in performing work for a governmental unit or exempt organization, a Form 17 is NOT required. The Option 1 contractor must only obtain a Form 13, Section B, from the exempt project owner.

PENALTY. Any person who signs this document with the intent to evade payment of tax is liable for the sales and use tax, interest, and penalty, and may be found guilty of a misdemeanor.

AUTHORIZED SIGNATURE. The purchasing agent appointment must be signed by an officer of the exempt organization or proper government official. The delegation of prime contractor’s authority must be signed by the owner, partner, corporate officer, or other individual authorized to sign by a power of attorney on file with the Nebraska Department of Revenue.

**STATE OF NEBRASKA
DEPARTMENT OF ADMINISTRATIVE SERVICES
STATE BUILDING DIVISION**

Construction Contract Change Order

Project:

Change Order Number:

Date:

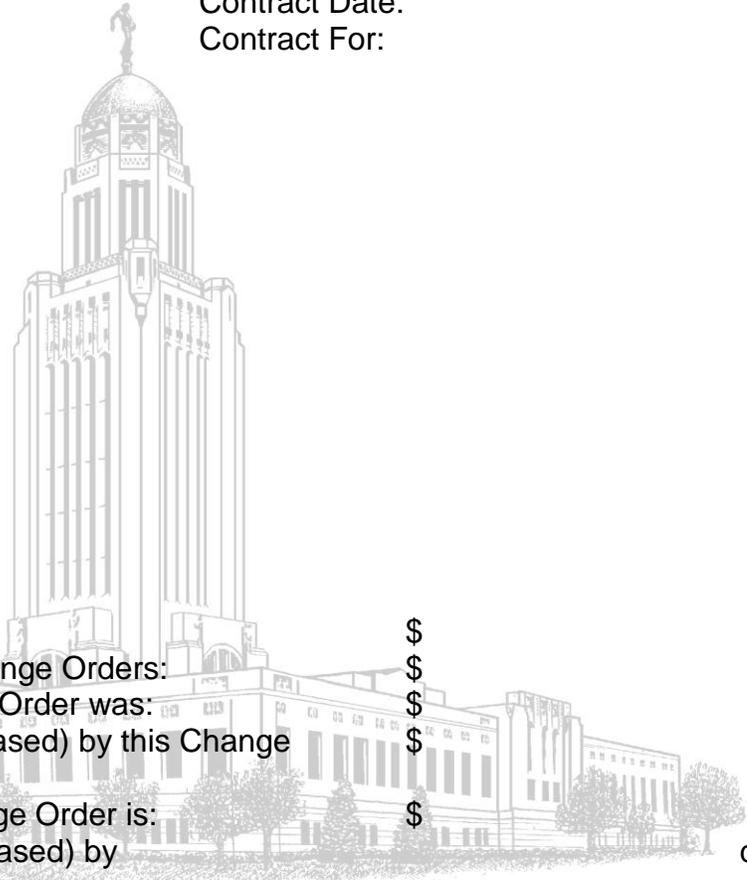
Contractor

Project Number:

Contract Date:

Contract For:

Description of change is as follows:



The original Contract Sum was:

\$

Net change from previously authorized Change Orders:

\$

The total contract sum prior to this Change Order was:

\$

The Contract Sum will be (increased/decreased) by this Change Order in the amount of

\$

The new Contract Sum including this Change Order is:

\$

The Contract Time will be (increased/decreased) by

days

Architect

Contractor

Owner

Address

Address

Address

City, State, Zip

City, State, Zip

City, State, Zip

By _____

By _____

By _____

Date _____

Date _____

Date _____

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155-163-13

SECTION 001100 - ADVERTISEMENT FOR BIDS

Sealed proposals for furnishing all plant, equipment, transportation, tools, materials, labor and skills necessary and incidental to perform all work described in the Proposed Contract Documents entitled: **1526 Building Boiler, Lincoln, Nebraska.**

Bids will be received at the State of Nebraska, DAS/State Building Division, located in the Executive Building, 521 South 14th Street, Suite 500 Conference Room, Lincoln, Nebraska until 2:00 PM on September 12, 2013, and will then be publicly opened and read aloud.

There shall be a Pre-Bid Walk-Through held at the Building 1526 located at 1526 K street, in Lincoln, NE on August 22, 2013 at 2:00 PM (Central Time). The walk-through is not mandatory.

All bids shall be made on the printed forms attached to and made a part of the Proposed Contract Documents. The said Documents have been prepared by The Clark Enersen Partners, Inc., 1010 Lincoln Mall, Suite 200 Lincoln, Nebraska 68508, (402) 477-9291. The drawings may be obtained from A&D Technical Supply, 1822 N Street, Lincoln, NE 68508, (402) 474-5454 with a \$50.00 refundable deposit for each set. Deposit will be refunded upon return of the unmarked and undamaged set within fourteen (14) days after bid opening. A non-refundable fee of \$10.00 will be charged for postage, if required. Documents will be delivered by UPS, please send a separate check for delivery.

Bidding Documents may also be examined at the following locations:

Reed Construction Data	customercare@reedbusiness.com
Norfolk Builders Bureau	405 Madison Ave. Norfolk, NE 68710
Columbus Builder's Service	(PO Box 515) 764 33 rd Ave. Columbus, NE 68602
Lincoln Builders Bureau	5910 S. 58 th Street, Suite C Lincoln, NE 68516
Omaha Builders Exchange	4255 S. 94 th Street Omaha, NE 68127
McGraw Hill Dodge	3059 Huntington Avenue Omaha, NE 68112

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Bids mailed to this office shall be addressed to:

DAS/State Building Division
The Executive Building
P. O. Box 98940
Lincoln, NE 68509-8940

Bids delivered in person shall be delivered to:

DAS/State Building Division
Executive Building - Suite 400
521 South 14th Street
Lincoln, NE

NOTICE: Bids submitted by facsimile transmission are NOT ACCEPTABLE.

Each bidder must submit with the bid a certified or cashiers' check or bid bond in an amount equal to five percent (5%) of the bid.

The character and amount of security to be submitted by the contractor for the performance of the contract is stated in the proposed contract documents.

Bidders may not withdraw their bids for a period of at least Sixty (60) days after the scheduled closing time for the receipt of the bids.

The State of Nebraska, DAS/State Building Division reserves the right to reject any or all bids and re-advertise for Bids; and further reserves the right to waive any informality or irregularity.

DAS/State Building Division
Rodney Anderson, Administrator

END OF SECTION 001100

INSTRUCTIONS TO BIDDERS

INDEX

1. Bid Security
2. Plans and Contract Documents
3. Working Conditions
4. Drug Free Work Place Policy
5. Open Competition
6. Interpretation of Contract Documents
7. Proposal Forms
8. Filing of Proposals
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10. Withdrawal of Bids
11. Acceptance of Bids
12. Alternate Proposals
13. Basis of Award of Contracts
14. When Award Effective
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20. Exemption from Payment of Nebraska Sales/Use Tax

Rev. Date: 05-11-04

INSTRUCTIONS TO BIDDERS

1. BID SECURITY

Each proposal must be accompanied by a bid bond or a certified or cashiers' check in the sum of five (5%) percent of the proposal, as a guarantee of good faith, drawn on a solvent bank and made payable to the order of the DAS/State Building Division, State of Nebraska, which will be retained by and may be forfeited to the DAS/State Building Division, State of Nebraska, as liquidated damage if such proposal is accepted, the Contract awarded, and the bidder or bidders fail to enter into a contract in form prescribed, with a satisfactory surety bond, within ten (10) days after such award is made.

The bid deposit of all except the three (3) lowest bidders may be returned within three (3) days after the opening of bids. The bid deposit of the three lowest bidders may be returned within 48 hours after the executed contract and required bonds have been finally approved by the Owner.

2. PLANS AND CONTRACT DOCUMENTS

Plans and Specifications (including Instructions to Bidders, General Conditions, and Special Provisions) and the Forms of Proposal, Contract and Bond, and all made a part of this Contract, are on file in the office of the DAS/State Building Division, State of Nebraska, and may be seen there; they may also be seen at Dodge Reports in Omaha, at the Builders Exchanges in Omaha and Lincoln, and at other locations listed in the Advertisement for Bids; plans and specifications can be obtained at the office named in the Advertisement for Bids.

3. WORKING CONDITIONS

Bidders are required to inform themselves fully on the conditions relating to construction and labor under which the work shall be or is now being performed, and the Contractor must employ, so far as possible, such methods and means in the carrying out of his work as will not cause any interruption or interference with any other Contractor.

4. PRE-BID MEETING ATTENDANCE REGISTRATION

For projects that specify mandatory pre-bid meetings, bids will only be accepted from those Companies/Firms which properly register their attendance at this meeting by completing all of the required information on the Mandatory Pre-Proposal Meeting Registration Sheet.

5. DRUG FREE WORK PLACE POLICY

The Contractor certifies that as a condition of the contract, neither the Contractor nor any employee of the Contractor shall engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity covered by this contract. The DAS/State Building Division reserves the right to request a copy of the Contractor's Drug Free Work Place policy. The Contractor further agrees to insert a provision similar to this statement in all subcontracts for services required under this agreement. A copy of this policy on company Letterhead shall be submitted to the Owner prior to signing contracts.

6. OPEN COMPETITION

Whenever in these specifications a material or article is specified by using the specific description or name of a proprietary product or the name of a manufacturer or vendor, rather than by using descriptive detail of substance and function, any article which the DAS/State Building Division decides will perform the duties imposed adequately and to the same effectiveness, will be acceptable as a substitute in lieu of the material or article so specified.

7. INTERPRETATION OF CONTRACT DOCUMENTS

If any person contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the plans, specifications, or other proposed contract documents, he may submit a written request for an interpretation thereof by the consulting Architect or Engineer or the DAS/State Building Division, whichever has prepared the documents. The person submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by Addendum duly issued and a copy of such Addendum will be mailed or delivered to each person receiving a set of such documents. The DAS/State Building Division will not be responsible for any other explanation or interpretations of the proposed documents. No such Addendum will be issued during the five (5) days immediately preceding the bid date.

8. PROPOSAL FORM

All proposals must be submitted on forms furnished by the State Building Division, State of Nebraska, and must be legibly written in ink or by typewriter. PROPOSAL FORMS will be provided in the Project Manual for use for submittal for this project. No alteration in proposals by erasure, interlineations, or insertions will be permitted.

9. FILING OF PROPOSALS

Each proposal shall be enclosed in a sealed envelope endorsed "Proposal for (Name Project, Letting Time and Name of Bidder)" and filed with the DAS/State Building Division, State of Nebraska, located at Lincoln, Nebraska, prior to the time set for the opening of bids. No bid will be considered which has not been filed with the DAS/State Building Division before the time set in the advertisement.

No bidder may submit more than one proposal. Two proposals under different names will not be received from one firm or corporation.

Filing proposals utilizing the FAX copy system will not be acceptable.

10. SIGNATURE OF BIDDERS

Each proposal must be signed in ink with the full name of each person, firm or corporation interested in it, together with their business address or place of residence.

Bids which are signed for a partnership should be signed in the firm name by at least one of the partners or in the firm name by an attorney-in-fact. If signed by an attorney-in-fact, there should be attached to the bid a power of attorney evidencing authority to sign the bid, executed by the partners.

Bids which are signed for a corporation should have the correct corporate name there of and the signature of the president or other authorized officer of the corporation manually written below the corporation name following the words: "By."

11. WITHDRAWAL OF BIDS

Any bidder may withdraw his bid at any time prior to the scheduled time for receipt of bids.

12. ACCEPTANCE OF BIDS

The DAS/State Building Division, State of Nebraska, reserves the right to waive any technicalities or informalities in bids and to accept or reject any or all bids when the Building Division considers it to be for the best interests of the State of Nebraska.

Where bidders attempt to condition their bids by stipulations not contained in the proposed contract documents, such bids may be disregarded as not responsive to the terms of the proposed Contract.

In submitting the proposal, the bidder agrees that the proposal may not be withdrawn during the period of sixty (60) days following the date of opening of the bids.

13. ALTERNATE PROPOSALS

All alternate proposals, when requested in the Proposal Form, shall be subject to the Owner's acceptance or rejection until 45 days after the Contractor has in writing informed the DAS/State Building Division he is withdrawing the alternate proposals.

14. BASIS OF AWARD OF CONTRACTS

The DAS/State Building Division, State of Nebraska, will not award the Contract to any bidder who does not furnish upon request satisfactory evidence that he has the necessary ability and experience in work of this character, and necessary financial resources, facilities, and plant to enable him to prosecute the same successfully and promptly and complete it within the time required in the contract.

Contract award, if made, will be to the responsible bidder submitting the lowest acceptable bid.

Upon completion of the selection of alternates, the DAS/State Building Division shall issue a letter of intent to award to the lowest acceptable bidder. The term "lowest acceptable bid" used in the above paragraph is defined as the lowest most responsible bidder offering the lowest total price for the combination of base bid and any alternate bids selected by the DAS/State Building Division. Participating bidders will have 10-days from issuance of the intent to award to file a protest/grievance.

15. WHEN AWARD EFFECTIVE

The Contract shall be deemed as having been awarded when formal written Notice of Award shall have been duly served upon the intended awardee by the DAS/State Building Division and both parties have signed the Contract.

16. FORMAL CONTRACT AND CONTRACT SECURITY

The successful bidder or bidders will be required to enter into a formal contract with the DAS/State Building Division, State of Nebraska. Form of Contract shall be same as the sample included in the Project Manual.

The successful bidder or bidders shall furnish a surety bond in an amount at least equal to 100 percent of the contract price as security for the faithful performance of this contract and for the payment of all persons performing labor and furnishing material in connection with this Contract. The bond to be executed by an acceptable surety company or companies authorized to execute surety bonds in the State of Nebraska. Form of performance and payment bonds shall be AIA Document No. A-312, Performance Bond and Payment Bond.

17. TIME OF COMPLETION

The Contractor shall commence work under the Contract on the earliest possible date after signing of Contract by both parties and shall fully complete all work thereunder within the time limit designated in the specifications and to be made a part of the Contract.

18. NUMBER OF COUNTERPARTS OF CONTRACT AND BOND REQUIRED

There shall be executed one (1) copy of the Contract Performance and Payment Bond and three (3) counterparts of the Contract.

19. NON-RESIDENT CONTRACTORS--REGISTRATION

Non-resident firms shall comply with the registration requirements and payment of fees to the Tax Commissioner of the State of Nebraska as defined in Sections 77-3101 through 77-3112, Revised Reissue Statutes of Nebraska.

20. FAIR LABOR STANDARDS

The proposal and the form of Contract contain a statement that the bidder is complying with, and will continue to comply with, fair labor standards in the pursuit of his business and in the execution of the work contemplated in this proposal.

Fair labor standards shall be construed to mean such a scale of wages and conditions of employment as are paid and maintained by at least fifty percent of the contractors in the area in the same business or field of endeavor as the contractor filing this proposal.

21. EXEMPTION FROM PAYMENT OF NEBRASKA SALES/USE TAX

The Contractor is exempt from payment of the Nebraska Sales/Use Tax under the regulations of the Nebraska Department of Revenue Act of 1967. The DAS/State Building Division will issue an Appointment of Purchasing Agent form and Exemption Certificates to the Contractor to be used for this project.

END OF INSTRUCTIONS TO BIDDERS

155-163-13

SECTION 004200 - PROPOSAL

Rodney Anderson, Administrator
DAS/State Building Division
Lincoln, Nebraska, 68508-2707

The undersigned, being familiar with local conditions affecting the cost of the work, and the Proposed Contract Documents, including the Advertisement for Bids, Instructions to Bidders, Proposal Form, Contract Form, Form of Contract Performance And Payment Bond, Form of Appointment of Purchasing Agent, Form of Exempt Sales/Use Tax Certificate, General Conditions, Special Conditions, Specifications and Plans all on file in the Office of the DAS/State Building Division, Lincoln, Nebraska, hereby proposes to furnish all plant, equipment, transportation, materials, tools, labor and skills necessary and required to perform all work as described in the Proposed Contract Documents entitled: **1526 Building Boiler, Lincoln, Nebraska** all in strict accordance with the Proposed Contract Documents including Addenda Numbers _____, _____, and _____, issued and attached thereto -

Bidders shall acknowledge the receipt of any and all addenda issued in the space provided above:

For the contract sum of:

Base Bid: _____, \$ _____

Alternates:

Alternate M-1: Revise routing of boiler flue up in north west corner of the existing light well and change entire length of the flue size from 6" diameter to 8 " diameter.

(Alternate M-1): _____, \$ _____)

The undersigned agrees to complete all work as specified in the Special Conditions, Section 000800, Paragraph 9 Construction Schedule.

The undersigned states that he is complying with, and will continue to comply with, fair labor standards in the pursuit of his business and in the execution of the contract on which he is bidding.

The undersigned acknowledges having reviewed provisions outlined for exemption of payment of sales taxes to the State of Nebraska and also understands the requirements for registration of any and all nonresident contractors and subcontractors with the Nebraska Department of Revenue.

155-163-13

Bid security is required and accompanies this proposal, the same being subject to forfeiture in the event of default by the undersigned.

In submitting this bid, it is understood that the right is reserved by the DAS/State Building Division to reject any or all bids and to waive informalities, and it is further agreed that this bid may not be withdrawn during the period of sixty (60) days following the scheduled closing time for receipt of the bids.

Date

Firm Name

By

Address

Title

Address

Firm's Federal Identification Number _____

Firm's Phone Number _____

END OF SECTION 004200

GENERAL CONDITIONS

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Rev. Date 9/29/09

File: SBD General Conditions 20080314.doc

GENERAL CONDITIONS

1. DEFINITIONS

The "DAS/State Building Division," sometimes referred to as the Owner or Department, and the "Contractor" are those named as such in the Contract.

The "DAS/State Building Division" is the Department of Administrative Services(DAS)/State Building Division of the State of Nebraska.

The "Architect/Engineer" is the Architect/Engineer of the DAS/State Building Division. He may act personally or by and through such assistants as may be duly authorized to act for him; but whenever in these conditions the word "Architect/Engineer" is used, it shall be understood as referring to the Architect/Engineer appointed by the DAS/State Building Division and not to any assistant.

The "Consultant" is the consulting architect or engineer that the Department may have employed to perform professional services required for the planning and construction of this project.

The term "the work" or "Work of the Contractor" includes labor or materials or both, equipment, transportation, and other facilities necessary to complete the Contract.

The term "Subcontractor" as employed herein, includes any person, firm or corporation having a direct contract with the Contractor to supply labor or materials or both for work of the Contractor, but does not include those who merely furnish material or materials not fabricated to a special design according to the plans and specifications of this work.

The term "Surety" includes any person, firm or corporation that has executed, as surety, the Contractor's performance bond securing the performance of the Contract.

The words "Plans" and "Drawings" are used synonymously in this Contract.

Wherever the word "Approved", "Approval", "As selected", appear in the specifications, it shall mean approval or selection by the Consultant or Engineer.

2. DEFINITION OF NOTICE

Where in any of the Contract Documents there is any provision with respect to the giving of notice, such notice shall be deemed to have been given; as to the DAS/State Building Division, when written notice shall be delivered to the Administrator of the DAS/State Building Division, or shall have been placed in the United States Mail, first class postage prepaid, addressed to the Administrator of the DAS/State Building Division, as to the Contractor, when written notice shall be delivered to the chief representative of the Contractor at the site of the project or by mailing such written notice in the United States Mail, first class postage prepaid, addressed to the Contractor at the place stated as the address of his permanent place of business in the Proposal Form; as to the Surety on the performance bond, when a written notice is placed in the United States Mail, first class postage prepaid, addressed to the Surety at a home office of such Surety or to its agent or agents who executed such performance bond on behalf of such surety.

3. AUTHORITY OF THE CONSULTANT OR ARCHITECT/ENGINEER

The DAS/State Building Division may for professional service required for certain projects employ consulting architects or engineers -- in these documents referred to as the Consultant. The DAS/State Building Division on certain other projects may direct that the professional services be performed by the staff of the DAS/State Building Division under the direction of the Architect/Engineer. It will clearly be stated in the Advertisement for Bids, Special Conditions, and Contract, whether professional services are being performed by a Consultant or the Architect/Engineer.

Plans and Specifications. The Consultant or Architect/Engineer, working to serve the interests of the Owner, has prepared the plans and specifications and shall make written interpretations of them. He or she shall approve all samples of material which are specified to be submitted for approval, approve the use of any equipment offered in lieu of that mentioned in the specifications and shall check and approve all shop drawings and details. He or she shall make periodic inspections of the project work and shall decide the quality of the work and material incorporated therein. He or she shall decide all questions which may arise as to the fulfillment of the Contract by the Contractor. Decisions by the Consultant or Architect/Engineer with regard to plans and specifications, work and materials, and contract questions, shall be made after consultation with the Owner.

4. CONTRACTOR'S SUPERINTENDENT

During the course of the work on the site, the Contractor shall employ a competent superintendent and any necessary assistants, all satisfactory to the Consultant or the Architect/Engineer. The Superintendent shall not be changed except with the consent of the Consultant or the Architect/Engineer, unless the Superintendent proves to be unsatisfactory to the Contractor and ceased to be in his employ. The Superintendent shall represent the Contractor in his absence and all directions given by him shall be as binding as if given by the Contractor. All decisions by the Superintendent shall be confirmed in writing to the Contractor. Other directions by the Superintendent shall be so confirmed on written request in each case.

5. PLANS AND SPECIFICATIONS -- CORRELATION

The work shall be executed in strict conformity with the plans and specifications.

Plans, drawings, and specifications are cooperative and supplementary. Portions of the work which can best be illustrated by the plans and drawings may not be included in the specifications and portions of the work best described by the specifications may not be depicted on the plans or drawings. All items necessary to construct or erect a complete improvement, project, building or structure shall be furnished whether called for in the specifications or shown on the plans and drawings. Special conditions shall take priority over General Conditions: Detailed Specifications shall take priority over General Specifications and large scale drawings shall take priority over small scale drawings. In case of disagreement between the plans, drawings and specifications, or within any document itself, the better quality or quantity of work shall be estimated and the matter drawn to the attention of the Consultant or Architect/Engineer for decision.

6. SHOP DRAWINGS

All work on which shop drawings are required must be in strict accordance with such drawings when approved and no work for which shop drawings are required is to be started until after the approval of said drawings. Each shop drawing shall be submitted to the Consultant or Architect/Engineer in the quantity specified by the Consultant or Architect/Engineer. Sufficient quantity shall be submitted to provide three sets of all approved submittals to the Owner.

All shop drawings must be checked and completed in every respect, numbered consecutively, have the name of the project printed thereon, and each lot must be submitted accompanied by a letter of transmission referring to the number of drawings and the name of project for identification and especially drawing the Consultant's or Architect/Engineer's attention to any modification of plans and specifications that may have been made.

The Contractor shall make any corrections required by the Consultant or Engineer and resubmit corrected sets to him for approval in the same quantity as the initial submittal.

After the shop drawings have been approved, any portion of shop drawings which modify the plans shall be rejected as soon as such modification is discovered unless said modification has been specifically pointed out to the Consultant or Architect/Engineer as stipulated above and specific approval secured. The approval of such shop drawings will be only general in character and shall in no way relieve the Contractor from any responsibility for the accuracy of the shop drawings or from proper fitting and construction of the work, or from the necessity of furnishing all materials and workmanship required by the drawings and specifications which may not be indicated on shop drawings when approved.

7. MATERIALS -- TESTS AND STANDARDS

Samples of materials selected by the Consultant or Architect/Engineer to be tested must be furnished by the Contractor. Tests will be made at no cost to the Contractor. Where not otherwise specified, all materials shall meet the American Standards for Testing of Materials (A.S.T.M.) Standard or tentative specifications for that material. The Contractor, when requested, shall furnish a sample of all material which shall be kept on the job as basis for comparison of material incorporated in the Work.

8. OBSOLETE EQUIPMENT

It is important that the DAS/State Building Division be protected as much as possible against the discontinuance of the make of equipment to be purchased, and that repair parts, and services of expert factory representatives, be made available if desired. Under these conditions the Contractor shall not furnish equipment not currently in production.

9. PATENTS

The Contractor and his Surety shall hold harmless the DAS/State Building Division, its officers, agents, and employees from liability of any nature or kind including costs and expenses, for or on account of any patented invention, articles or appliances manufactured or used in the performance of this Contract unless otherwise specifically stipulated in this Contract.

10. OTHER CONTRACTS

The DAS/State Building Division may award contracts for additional work and the Contractor shall fully cooperate with such other contractors and carefully fit his own work to that provided under the other contracts as may be directed by the Consultant or Architect/Engineer. If the Contractor commits or permits any act which interferes with the performance of work by any other contractor, this shall be grounds for termination of the contract.

11. ASSIGNMENT OF CONTRACT

The Contractor shall not assign this Contract or any part hereof without the written consent of the DAS/State Building Division. No assignment of this Contract shall be valid unless it contains a provision that the funds to be paid to the Assignee under the Assignment are subject to a prior lien for services rendered or materials supplied for the performance of work called for in said Contract in favor of all persons, firms, or corporations rendering such services or supplying such materials.

12. SUBCONTRACTING

The Contractor shall be fully responsible to the DAS/State Building Division for the acts and omissions of his subcontractors and of persons either directly or indirectly employed by them. The Contractor shall be responsible for assigning, coordinating, and achieving completion of all subcontracted work to satisfy all requirements of the Contract Documents in a timely and proper manner. All subcontracted work shall be subject to all requirements of the Contract Documents except those legal contractual duties for which only the Contractor has exclusive responsibility as specifically assigned by the Contract Documents. Nothing contained in the Contract shall create any Contractual relation between any subcontractor and the DAS/State Building Division. The attention of the Contractor and subcontractors are called to the Contract Documents which are part of this Contract. The Contractor must notify the DAS/State Building Division of each subcontract he intends to award, giving:

Name and address of subcontractor
Branch of work concerned
Total price of subcontract

No part of this Contract shall be sublet without prior approval of the DAS/State Building Division.

13. CONTRACTOR'S INSURANCE

The Contractor shall not commence work under this Contract until he or she has obtained all the insurance required hereunder and such insurance has been approved by the Owner nor shall the Contractor allow any subcontractor to commence work on his subcontract until all similar insurance required of the subcontractor has been obtained and approved by the Owner (or Contractor). Approval of the insurance by the Owner shall not relieve or decrease the liability of the Contractor hereunder.

If by the terms of any insurance a mandatory deductible is required, or if the Contractor elects to increase the mandatory deductible amount, the contractor shall be responsible for payment of the amount of the deductible in the event of a paid claim.

(a) WORKERS' COMPENSATION INSURANCE

The Contractor shall take out and maintain during the life of this Contract the statutory Workers' Compensation and Employer's Liability Insurance for all of his employees to be engaged in work on the project under this Contract and, in case any such work is sublet, the Contractor shall require the subcontractor similarly to provide Worker's Compensation and Employer's Liability Insurance for all of the latter's employees to be engaged in such work. This policy shall be written to meet the statutory requirements for the state in which the work is to be performed, including Occupational Disease. Where applicable, this policy shall provide USL&H coverage. This policy shall include a waiver of subrogation in favor of the Owner. The amounts of such insurance shall not be less than the limits stated hereinafter.

(b) COMMERCIAL GENERAL LIABILITY INSURANCE AND COMMERCIAL AUTOMOBILE LIABILITY INSURANCE

The Contractor shall take out and maintain during the life of this Contract such Commercial General Liability Insurance and Commercial Automobile Liability Insurance as shall protect him and any subcontractor performing work covered by this Contract from claims for damages for bodily injury, including death, as well as from claims for property damage, which may arise from operations under this Contract, whether such operation be by himself or by any subcontractor or by anyone directly or indirectly employed by either of them, and the amounts of such insurance shall not be less than limits stated hereinafter.

The Commercial General Liability Insurance shall be written on an occurrence basis, and provide Premises/Operations, Products/Completed Operations, Independent Contractors, Personal Injury and Contractual Liability coverages. The policy shall include the Owner, and others as required by the Contract Documents, as an Additional Insured. This policy shall be primary, and any insurance or self-insurance carried by the Owner shall be considered excess and non-contributory. The Commercial Automobile Liability Insurance shall be written to cover all Owned, Non-owned and Hired vehicles.

(c) INSURANCE-BUILDER'S RISK

Unless otherwise provided, the Contractor shall purchase and maintain Builder's Risk Insurance for the entire value of the project and work site, from a company or companies lawfully authorized and licensed to do business in the jurisdiction in which the Project is located. This insurance shall be written to cover all risks of direct physical loss, and shall include interests of the Owner, the Contractor, and Sub-contractors in the Work. A loss insured under this insurance shall be adjusted with the Owner and made payable to the Owner as fiduciary for the insureds, as their interests may appear.

(d) INSURANCE COVERAGE AMOUNTS REQUIRED

.1	Workers' Compensation and Employer's Liability	
	Coverage A	Statutory
	Coverage B	
	Bodily Injury by Accident	\$100,000 each accident
	Bodily Injury by Disease	\$500,000 policy limit
	Bodily Injury by Disease	\$100,000 each employee
.2	Commercial General Liability	
	General Aggregate	\$2,000,000
	Products/Completed Operations Aggregate	\$2,000,000
	Personal/Advertising Injury	\$1,000,000 any one person
	Bodily Injury/Property Damage	\$1,000,000 per occurrence
	Fire Damage	\$50,000 any one fire
	Medical Payments	\$5,000 any one person
.3	Commercial Automobile Liability	
	Bodily Injury/Property Damage	\$1,000,000 combined single limit
.4	Umbrella/Excess Liability	
	Over primary insurance	\$1,000,000 per occurrence
.5	Builder's Risk	100% of work completed values.

14. EVIDENCE OF COVERAGE

The Contractor shall furnish the Owner with a certificate of insurance coverage, which shall be submitted in duplicate to the Department of Administrative Services, Risk Management Division, 301 Centennial Mall South, Lincoln, NE 68509. These certificates shall include the name of the company, policy numbers, effective dates, dates of expiration and amounts and types of coverage afforded. If the Owner is damaged by the failure of the Contractor to maintain such insurance, then the Contractor shall be responsible for all reasonable costs properly attributable thereto.

The following clauses or endorsements must be added to the certificates for the required types of insurance. If the clause or endorsement is placed on the reverse side of such certificate, the signature of the official of the company who signs the certificate should follow it. All certificates must contain the following two clauses or endorsements:

"The insurance contract referred to herein provides complete coverage within the limits stated for the types of insurance mentioned covering all the insured's operations in connection with the insured's contract on the _____ (Project Name)."

"Said insurance contract also provides that it cannot be canceled by the insurer in less than thirty days after the insured has been given written notice of such cancellation."

15. PROTECTION OF PERSONS AND PROPERTY

The Contractor shall take all reasonable and proper precautions to protect persons and property from injury or damage resulting from his or her operation under this Contract. The requirements of the Nebraska Safety Codes adopted by the Nebraska State Department of Labor shall be applicable.

The Contractor shall protect all existing buildings, roadways, landscaping, and utilities against damage or interruption of services. It shall be the responsibility of the Contractor to correct health or safety hazards and repair property damage that results from their work. Such corrections shall be performed to restore conditions to at least the quality that existed at the time of commencement of this Work.

16. PROSECUTION OF THE WORK AND COMPLETION DATE

The work embraced in this Contract shall be started on the earliest possible date after the signing of contracts by both parties, and shall be carried on regularly and uninterruptedly thereafter, with such forces and by such means as will insure final completion of the entire Contract on or before the completion date set in the documents. The time of beginning, rate of progress and time of completion are essential conditions of the Contract.

The Contractor expressly agrees that in undertaking to complete the work within the Contract period fixed in the Contract Documents, he has taken into consideration and made allowances for all delays and hindrances incidental to such work, whether growing out of delays in securing materials or workmen, or otherwise.

Should the Contractor be delayed in the prosecution and completion of the work by a cause beyond his control, he shall have no claim or right of action for damages from the Owner for any such cause or delay. The Contractor may in such case be granted an extension of time specified for completion of the work as the Owner may award in writing on account of such delay; provided however, that claim for extension of time is made by the Contractor to the Owner, through the Consultant or Architect/Engineer, in writing, within two weeks from the time when such alleged cause for delay occurred. The Owner reserves the right to withhold granting of any time extensions until the stipulated Contract period is about to expire.

The Owner, at his discretion, may waive the above requirements and grant extensions of time for any reasons he deems valid. Time extensions will not be considered for weather delays unless the Contractor provides documentation of the days and hours his or her forces could not be on the job site due to the weather.

An extension of the Contract period may be granted by the Owner for any of the following reasons:

- (a) Additional work resulting from modification of the plan for the project.
- (b) Delays caused by the Owner.
- (c) Other reasons beyond the control of the Contractor which in the Owners' judgement would justify such extension.

No extension of the Contract period will be allowed for variation between contract quantities and actual quantities which cannot be predetermined and which amount to less than twenty-five percent (25%) of the contract quantities.

17. SURVEY STAKES AND LEVELS

The Contractor, unless otherwise specified, will stake out the project work and shall furnish and maintain the batter boards, level, etc.

The Contractor must carefully preserve bench marks and reference points established by the Consultant or Architect/Engineer; in case of their destruction, the Contractor will replace them and be responsible for any mistakes that may be caused by their loss or disturbance.

18. USE OF JOB SITE

The Contractor shall confine his or her equipment, apparatus, the storage of materials, and operations of his or her workers to limits indicated by law, ordinance, permits, or directions of the DAS/State Building Division and shall not unnecessarily encumber the premises with his materials.

The Contractor shall not load or permit any part of a structure to be loaded with a weight that will endanger its safety. The Contractor shall enforce the Consultant's or Architect/Engineer's instructions regarding signs, advertisement, fires, and smoke.

19. LABOR

All labor shall be performed in best and most workmanlike manner by mechanics skilled in their respective trades. The standards of the work required throughout shall be of such quality as will produce only first class results.

Mechanics whose work is unsatisfactory to the Consultant or Architect/Engineer, or are considered to be unskilled or otherwise objectionable, shall be instantly dismissed from the work upon notice to the Contractor from the Consultant or Architect/Engineer.

Contractors and subcontractors employed upon the work shall be required to conform to the labor laws of the State of Nebraska, and the various acts amendatory and supplementary thereto; and to all other laws, ordinances, and legal requirements applicable thereto.

20. INSPECTION

The DAS/State Building Division, through its authorized representatives and agents, shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and any data and records.

The Architect/Engineer shall, at all times, have access to the work and the premises used by the Contractor and to all places of manufacture where materials are being made for use under this Contract, and shall have full facilities for determining that such materials are being made strictly in accordance with the plans and specifications.

21. DEFECTIVE WORK OR MATERIAL

Work or material not in accordance with the Plans and Specifications, or in any way defective shall be removed at once on order of the Consultant or Architect/Engineer. The Contractor shall replace or rebuild at Contractor's own expense with satisfactory material and in a professional manner any work so removed and shall reimburse the DAS/State Building Division or any expense that it is put to by reason of extra work, and shall reimburse any other contractor who may incur expense caused by removal of the defective work.

22. TERMINATION FOR BREACH

In event that any of the provisions of this Contract are violated by the Contractor or any of his subcontractors, the DAS/State Building Division may serve written notice upon the Contractor and the Surety of its intention to terminate the Contract, and unless within ten (10) days after the serving of such notice upon the Contractor such violation shall cease and satisfactory arrangements for correction be made, the Contract shall, upon the expiration of said ten (10) days cease and terminate. In the event of any such termination, the DAS/State Building Division shall immediately serve notice thereof upon the Surety and the Contractor. The Owner may take over the work and prosecute the same to completion of Contract for the account and at the expense of the Contractor. The Contractor and his Surety shall be liable to the DAS/State Building Division for any excess cost occasioned the DAS/State Building Division thereby and in such event the DAS/State Building Division may take possession of and utilize in completing the work, such materials, appliances, and plant as may be on the site of the work and necessary therefore. Neither the Owner nor any member or employee thereof shall be in any way liable or accountable to the Contractor or his surety for the method by which the completion of the said work, or any portion thereof, may be accomplished or for the price paid therefore.

23. CONSTRUCTION REPORTS -- PAYMENT ESTIMATES

The Contractor shall submit to the Owner a schedule of values and quantities of materials and of other related items. The schedule(s) shall be in a form that correlates to the estimates upon which they are based, or as the Owner may require.

The Contractor shall submit to the Owner the following records on forms to be supplied by the Contractor (Notice - AIA Document forms shall be the latest edition):

- (a) AIA Document G702, Application and Certification for Payment
- (b) AIA Document G703, Continuation Sheet (Schedule of Values)

24. PAYMENT

So long as the work herein contracted for is carried out in accordance with the provisions of the Contract, the Contractor will, on or before the 25th day of each month, make an appropriate estimate of the value of the work performed during the month and the materials suitably stored on the work site, and shall prepare an Application And Certification For Payment and the Continuation Sheet and submit them to the Consultant. Within seven days after receipt of such Application And Certification For Payment it shall be approved either in whole or in part by the Consultant or Architect/Engineer, or disapproved. If disapproved, the Pay Application shall be corrected by the Contractor. Once a payment is approved, then the DAS/State Building Division will pay to the Contractor in State warrants, and in accordance with the payment provisions in the Agreement and these General Conditions, the amount approved, which shall be ninety percent (90%) of completed work and stored materials. The DAS/State Building Division may at any time reserve and retain payment as authorized in Provision #27 of these General Conditions. However, prior to final payment, the total paid to the Contractor shall not exceed ninety percent (90%) of the estimated value of the work performed and materials stored at the site.

The Contractor shall pay:

(1) for all transportation and utility services not later than the 20th day of the calendar month following that in which such services are rendered;

(2) for all articles, tools, and other expendable equipment for at least 90% of cost thereof, not later than the 20th day of the calendar month following that in which such materials, tools, and equipment are delivered to and properly stored at the site of the project, and the balance of the cost thereof not later than the 30th day following the completion of that part of the work in which such materials, tools, and equipment are incorporated or used; and

(3) to each of his subcontractors not later than the 5th day following each payment to the Contractor, the respective amounts allowed the Contractor on account of the work performed by his subcontractors, to the extent of each such subcontractor's interest therein.

25. EXTRA, ADDITIONAL OR OMITTED WORK -- PAYMENT FOR

The DAS/State Building Division shall have the right at any time and without notice to the Sureties, to alter and modify the Plans and Specifications, thus making specific changes in the construction, details, or execution of the work. All changes in plans and specifications will be made by the DAS/State Building Division in writing. The Contractor shall make such alterations as may thus be ordered by the DAS/State Building Division and in case these changes increase or decrease the amount of work to be done under this Contract, equitable amounts in price and time will be added to or deducted from the Contract price and Contract time. The amount of such increase or decrease shall be agreed upon between the Owner and the Contractor BEFORE the changes are made.

When directed in writing by the Consultant or Architect/Engineer and with approval of the DAS/State Building Division, the Contractor shall furnish all material and labor not otherwise provided for by the terms of this Contract, but which may be connected with or necessary to the proper completion of the Work. Such material and labor shall be furnished and completed as part of this Contract and subject to its provisions. The payment for any such work shall be determined by agreement between the Owner and the Contractor before the extra work is commenced, either on the basis of the unit price, or a lump sum price, or on a limited cost-plus basis not to exceed the specified limit.

The payment for extra, additional or omitted work to be performed by the contractor or subcontractors using their own forces shall be as follows: for all labor and foreman in direct charge of the specific operations, including liability and workers' compensation, the Contractor shall receive the wage rate agreed upon in writing before starting such work, for each hour that said labor, teams and foreman are actually engaged in such work, to which shall be added an amount for profit and overhead combined equal to 10% of the sum thereof. The wages of any foreman or time keeper who is employed partly on "cost-plus" work and partly on other work, shall be prorated between the two classes of work according to the number of employees employed on each class of work as shown by the payroll.

For all materials being permanently incorporated or installed into the Work, the Contractor shall receive the actual cost of such material delivered to the Work, including freight and handling charges as shown by original receipted bills, to which cost shall be added a sum equal to an amount of 10% thereof for profit and overhead combined as agreed to in advance by the Owner.

If it is necessary for the Contractor to rent equipment in the performance of such work, he will be allowed the actual rental price paid, if reasonable, for the actual time that such equipment is in use on the work and to which sum 10% shall be added for profit and overhead combined.

For contractors and subcontractors, prices submitted by their respective subcontractors for labor, materials, rentals, overhead and profit may be marked up a maximum of 5%.

No claims for extra work will be allowed unless accompanied by a written Change Order from the Consultant or Architect/Engineer and approved by the DAS/State Building Division authorizing such extra work and defining the agreed basis of payment. Change Orders shall be documented on AIA Form G701 prepared by the Consultant or Architect/Engineer.

The Contractor shall, immediately after completing extra work, file with the Architect/Engineer, in writing, all claims for extra work performed. If the Contractor fails to make such claims within 30 days, Contractor's right to extra pay for such work shall be deemed to have been waived and forfeited and he or she shall not be entitled to any payment on account of such extra work.

26. CONTRACTOR'S PAYMENTS FOR LABOR AND MATERIALS

The Contractor shall pay for all labor and materials used or furnished in the performance of this Contract. Before final payment, the Contractor must certify that all bills for labor and materials have been paid. In event he is requested and fails to furnish satisfactory evidence, the DAS/State Building Division may withhold any payments until it is satisfied that all such claims have been paid.

27. OWNER'S RIGHT TO WITHHOLD PAYMENT AND MAKE APPLICATION THEREOF

In addition to the payment to be retained by the DAS/State Building Division under the preceding provisions of these General Conditions, the DAS/State Building Division may withhold a sufficient amount of any payment otherwise due to the Contractor to cover:

- (a) payments that may be earned or due for just claims for labor or materials furnished in and about the performance of the work on the project under this Contract;
- (b) for defective work not remedied, and for damage to existing conditions or new work not remedied; and
- (c) for failure of the Contractor to make proper payments to his subcontractor.

The DAS/State Building Division shall disburse and shall have the right to act as agent for the Contractor in disbursing such funds as have been withheld pursuant to this paragraph to the party or parties who are entitled to payment therefrom. The DAS/State Building Division will render to the Contractor a proper accounting of all such funds disbursed on behalf of the Contractor.

28. CLEAN UP

On or before the completion of the work, the Contractor shall clean all parts of the Work under his Contract. He or she shall remove all rubbish and all his materials, tools, and equipment from the construction site, leaving the site in a condition as good or better than that existing at commencement of the Work.

The Contractor shall from time to time clean up and remove from the project rubbish and debris resulting from his work, and shall at completion of the Work remove all construction materials and equipment, leaving the project and site clean.

29. FINAL INSPECTION

When the work has been substantially completed, the Contractor shall notify the Consultant or Architect/Engineer, in writing, that the work is ready for final inspection and testing on a definite date and time as stated in such notice. The notice shall be given at least ten (10) days in advance of said date.

After the final inspection has been completed, the Consultant or Architect/Engineer shall present to the Contractor and the DAS/State Building Division a report ("punch list") listing all deficiencies found in the inspection of the Contractor's work which are to be corrected. The Contractor shall immediately make the required corrections to remove the deficiencies reported by the Consultant or Architect/Engineer. When the deficiencies have been removed, the Contractor shall request in writing a reinspection of the work by the Consultant or Architect/Engineer.

30. FINAL PAYMENT

As soon as practical after completion and acceptance of the Work, the Contractor shall prepare a final payment statement showing the final payment due. After approval by the Contractor, the Consultant or Architect/Engineer and the DAS/State Building Division, the final payment shall be processed in accordance with the payment provisions of the Agreement and the General Conditions.

31. GUARANTEE OF WORK

- (a) Except as otherwise specified all work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, equipment or workmanship for one year from the date of final completion of the Contract.
- (b) If, within any guarantee period, repairs or changes are required in connection with the guaranteed work, which, in the opinion of the Consultant or Architect/Engineer are rendered necessary as a result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the Contract, the Contractor shall, promptly upon receipt of notice from the Owner, and without expense to the Owner:
 - (1) Place in satisfactory condition all of such guaranteed work, correct all defects therein, and
 - (2) Make good all damages to the building or project work, or equipment or contents thereof, which, in the opinion of the Consultant or Architect/Engineer is the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the Contract; and
 - (3) Make good any work or materials, or the equipment and contents of said building or project work disturbed in fulfilling any such guarantee.
- (c) In any case where fulfilling the requirements of the Contract, and guarantees, the Contractor disturbs any work guaranteed under another contract, he shall restore such disturbed work to a condition satisfactory to the Consultant or Architect/Engineer and guarantee such restored work to the same extent as it was guaranteed under such other contract.
- (d) If the Contractor, 30 days after notice, fails to comply with the terms of the guarantee, the Owner may have defects corrected and the Contractor and Contractor's Surety shall be liable for all expenses incurred.
- (e) All special guarantees applicable to definite parts of the work that may be required by the Contract Documents shall be subject to the terms of Provision #31(a) through (e) during the first year of the life of such guarantee.

32. UNEMPLOYMENT COMPENSATION FUND

The Contractor shall make payments to the Unemployment Compensation Fund of the State of Nebraska all contributions and interest due under the provisions of Section 48-601 to 48-669, Revised Reissue Statute of Nebraska, on wages paid to individuals employed in the performance of this Contract as required by Section 48-657, Revised Reissued Statute of Nebraska.

Under the requirements of Section 48-657, Revised Reissue Statute of Nebraska, the Das/State Building Division cannot make payment to the Contractor on the final three percent (3%) of the Contract without first receiving from the Contractor a written clearance from the Commissioner of Labor certifying that all payments then due for contributions or interest which may have arisen under such Contract have been made by the Contractor, or his subcontractors, to the Unemployment Compensation Fund.

33. PRECONSTRUCTION CONFERENCE

A preconstruction conference shall be scheduled before starting construction, no later than 15 days after the date of the Agreement. It shall be held at the project site, or other convenient location. The meeting shall review responsibilities and personnel assignments of the Owner, Contractor, and the Consultant.

Authorized representatives of the Owner, Contractor, and the Consultant shall attend the preconstruction conference, as will the Contractor's superintendent, major subcontractors, manufacturers, suppliers, and other parties integral to the completion of the Work. All participants shall be familiar with the project and authorized to make decisions for the entities they represent.

The preconstruction conference will include discussion of items necessary for project progress and successful completion, such as: construction scheduling; critical work sequencing; designation of responsible personnel; procedures for processing field decisions and change orders; procedures for processing Applications for Payment; distribution of Contract Documents; submission of Shop Drawings and product data samples; preparation of record documents; use of the premises; parking availability; office, work, and storage areas; equipment deliveries and priorities; safety and first aid procedures; security; housekeeping; working hours; and other matters deemed important by the Owner.

34. WORK ELIGIBILITY STATUS OF EMPLOYEES

The Contractor is required and hereby agrees to use a federal immigration verification system to determine the work eligibility status of new employees physically performing services within the State of Nebraska. A federal immigration verification system means the electronic verification of the work authorization program authorized by the Illegal Immigration Reform and Immigrant Responsibility Act of 1996, 8 U.S.C. 1324a, known as the E-Verify Program, or an equivalent federal program designated by the United States Department of Homeland Security or other federal agency authorized to verify the work eligibility status of a newly hired employee.

If the Contractor is an individual or sole proprietorship, the following applies:

1. The Contractor must complete the United States Citizenship Attestation Form, available on the Department of Administrative Services website at www.das.state.ne.us.

2. If the Contractor indicates on such attestation form that he or she is a qualified alien, the Contractor agrees to provide the US Citizenship and Immigration Services documentation required to verify the Contractor's lawful presence in the United States using the Systematic Alien Verification for Entitlements (SAVE) Program.

3. The Contractor understands and agrees that lawful presence in the United States is required and the Contractor may be disqualified or the contract terminated if such lawful presence cannot be verified as required by Neb. Rev. Stat. §4-108.

END OF GENERAL CONDITIONS

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SECTION 008000 – SPECIAL CONDITIONS

1. The following sections of the GENERAL CONDITIONS shall be deleted in full unless otherwise noted:

2. **PROFESSIONAL SERVICES**

The professional Engineer Services for this project are furnished by The Clark Enersen Partners, Inc.

3. **SANITARY FACILITIES**

Arrangements shall be made by the Contractor with the Owner to provide a sanitary facility for use by the workmen.

4. **UTILITIES**

Water and electrical service is available for the Contractor's use at no extra cost to the Contractor. The Contractor shall furnish his own connecting lines, pipes, hoses, etc., from the source made available by the Owner.

5. **SPECIAL REQUIREMENTS FOR STATE BUILDING DIVISION CONSTRUCTION CONTRACTS**

The Contractor, upon signing the Contract, agrees to comply with the following Special Requirements:

FAIR LABOR STANDARDS

The undersigned states that he is complying with, and will continue to comply with, fair labor standards in pursuit of his business and in the execution of this Agreement.

NON-DISCRIMINATION IN EMPLOYMENT

The undersigned agrees that in performance of this Agreement neither he nor his subcontractors will discriminate against any of their employees or applicants for employment concerning the employees' or applicants' hire, tenure, terms, conditions, or privileges of employment based on the employees' or applicants' race, color, religion, sex, marital status, age, disability, or national origin.

DRUG FREE WORK PLACE POLICY

The Contractor certifies that as a condition of the Agreement neither the Contractor nor any employee of the Contractor shall engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity covered by this Agreement. The Department of Administrative Services reserves the right to request a copy of the Contractor's Drug Free Workplace policy. The Contractor further agrees to insert a provision similar to this statement in all subcontracts for services required under this Agreement.

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AMERICANS WITH DISABILITIES ACT

All provisions of this Agreement are subject to the Americans With Disabilities Act (29 C.F.R. 1601, 28 C.F.R. 35).

CONTRACT AGREEMENT SOLICITATION STATEMENT

As per requirements of Sections 81-1716 through 81-1719, Revised Statutes of Nebraska, 1943, the Contractor warrants that he has not employed or retained any company or person, other than bonafide employees working for him, to solicit or secure this agreement and that he has not paid, or agreed to pay, any person, company, corporation, individual, or firm, other than a bonafide employee working solely for him, any fee, commission, percentage, gift, or any other consideration contingent upon or resulting from the award for the making of this agreement.

6. PRE-CONSTRUCTION CONFERENCE

Prior to commencement of on-site work, the Contractor and any Subcontractors shall meet at the project site with the Engineer, SBD Project Manager and representatives of the Facility for the purpose of reviewing the materials, methods, and procedures to be followed in performing the work in compliance with the Contract Documents.

NOTICE: All listed materials approval submittals shall be approved by the Engineer before the Pre-Construction Conference is scheduled.

7. SUBSTITUTE MATERIAL SPECIFICATIONS

If the Contractor desires to substitute any material for that specified in these project documents, the Contractor shall submit specifications for each substitute material to The Clark Enersen Partners, Inc. for approval before bid opening. Such submittals shall be made in time to be received by The Clark Enersen Partners a minimum of seven (7) working days before the bids due date to allow for examination and notification of action to prospective bidders.

8. AIA DOCUMENTS

American Institute of Architects (A.I.A) Documents referred to in the project documents are available at: A.I.A. Nebraska, 102 Architecture Hall, University of Nebraska, P.O. Box 8045, Lincoln, NE 68501-0045; Telephone Number (402) 472-1456.

9. CONSTRUCTION SCHEDULE

The Contractor shall submit a detailed complete construction project schedule to the Engineer for review and approval within (4) weeks of receipt of the signed Contract. The schedule shall include proposed construction start, boiler installation, and completion dates, as well as all major construction project milestones. Schedule shall include all project work including Subcontractor work. The new boiler (B-10 and all associated work shall be substantially complete and available for continuous operation by February 13, 2014.

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10. PERMITS, INSPECTIONS, AND FEES

The Contractor shall be responsible for acquisition of and payment for all permits required by Authorities having jurisdiction over this project site. The Contractor shall also be responsible for scheduling and attendance of all Inspections required upon completion of the work and shall pay all fees associated with such inspections.

11. PROGRESS MEETINGS

After start of on-site construction work, progress meetings shall be scheduled at dates and times agreeable to the Contractor, Engineer, and representatives of the facility. Meetings may be held for purposes of discussion of issues including but not limited to construction progress, resolving construction problems, schedule, security and changes.

END OF SECTION 008000

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SECTION 008010 – SUPPLEMENTARY CONDITIONS

The following supplements shall be included in project requirements. If in the case of discrepancy, the Owner's General Conditions and Special Conditions shall govern.

1. THE PROJECT MANUAL

1.1 Reference Laws and Specifications:

- A. All references to the "Manufacturer's Specifications," "Manufacturer's Directions" or "Manufacturer's Recommendations" shall refer to the referenced manufacturer's published specifications or manuals. These publications hereby are made a part of and incorporated by this reference in the Contract Specifications as though repeated therein in full, and all manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned accordingly, unless specified to the contrary.
- B. For all equipment furnished by others, to be installed by the Contractor, the Contractor shall use manufacturer's detail drawings to establish roughing-in dimensions and location of services. In case of conflict, the equipment detail drawings and dimensions shall be used, except where aesthetic or structural considerations make an adjustment necessary.

2. CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

- 2.1 All repeated features throughout must be constructed alike, although drawn in detail only once and similarly all detail and ornament must be continued throughout all moldings, bands, etc., and all indications of material, etc., shall be understood to apply to all similar features throughout.
- 2.2 Wherever work is specified to be done "as directed", the Contractor must obtain specific written directions from the Owner's Representative before undertaking such work.
- 2.3 Contractor is solely responsible for coordination of bidding and scope of Work of subcontractors and shall assume full responsibility for complete coordination of the various subcontractors. Owner/and/or Architect will not act as arbiter as to which trade or subcontractor is to furnish and install various items indicated or required to perform construction.
- 2.4 In interest of conciseness, references to specification sections and details are preceded by the work "see". Any such references are to be interpreted to include applicable form of phrase, "and comply with,".
- 2.5 Wherever an article, device or piece of equipment is referred to in the singular, such reference shall apply to as many such articles as are shown on the Contract Documents or required to complete the installation.

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3. OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

3.1 Electronic CAD files may be provided to the Contractor or Subcontractor under the following conditions:

- A. Generally, only CAD floor plans and/or reflected ceiling plans shall be distributed. Distribution of any other types of CAD drawings should be approved by the Architect.
- B. All extraneous information such as dimensions, section call-outs, notes, etc. shall be removed from the CAD file. Under normal circumstances, walls, doors, room numbers and grid lines shall be the only information left in the drawing file.
- C. The Clark Enersen title block and all references to the Clark Enersen Partners shall be removed in their entirety, this includes any architect/engineer "seals".
- D. The distribution file(s) shall be copied onto a Compact Disk (CD-ROM) by the Architect.
- E. A flat fee of \$25.00 per floor plan sheet shall be received from:
 - 1. Sprinkler system contractors
 - 2. Sheet metal detailers/contractors
 - 3. Fire alarm system contractors
- F. All others requesting CAD files shall be charged \$100.00 per sheet.
- G. Disclaimers shall be attached to the CAD file distribution and shall read as follows:
 - 1. The end user of these CAD drawing files shall agree to defend, indemnify and hold harmless The Clark Enersen Partners from all claims, damages, losses, expenses and attorney fees that may arise from their use. These CAD drawing files may not be reproduced, altered or used without the explicit consent of The Clark Enersen Partners.
 - 2. All Contractor(s) who would like to obtain CAD drawings must contact The Clark Enersen Partners and request all sheets required. Contractor(s) must also complete and sign the Computer Generated Data Use Agreement included at the end of this section and forward to the Architect with each request. Upon receipt of a signed Computer Generated Data Use Agreement and required fees, The Clark Enersen Partners will issue all agreed upon files.

4. REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

4.1 By entering into the Construction Agreement with Owner, Contractor acknowledges that the Contractor has examined all documents pertaining to the Work, examined character of site and any existing structures, and is well acquainted with the nature of the Work, and all other matters, which can in any way affect the Work.

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- 4.2 The Contractor may use soil information described in Bidding Documents at the Contractor's own risk. Any additional soil information necessary to perform the Work is the responsibility of the Contractor and is to be obtained at the Contractor's expense.

5. SUBSTITUTION OF MATERIALS AFTER BID OPENING

- 5.1 After the Contract has been executed, the Owner and the Architect will consider a formal request for the substitution of products in place of those specified only under the conditions set forth in Section 01631 – Substitutions.

- 5.2 By making requests for substitutions based on the paragraph above, the Contractor:

- A. Represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified.
- B. Represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified.
- C. Certifies that the cost data presented is complete and includes all related costs under this Contract, except the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently becomes apparent; and
- D. Will coordinate the installation of the accepted substitute, making such changes as may be required for work to be completed in all respects.

6. SUBCONTRACTUAL RELATIONS

- 6.1 Contractor is fully responsible for acts and omissions of his subcontractors, and persons either directly or indirectly employed by them, or under their control, as he is for his own employees.
- 6.2 Nothing in Contract Documents creates any contractual relationship between any subcontractor and Owner or Architect.

7. WARRANTY PERIOD

- 7.1 The warranty period for all equipment, including mechanical equipment, elevators or other equipment that must be "started-up" prior to the date of Substantial Completion, shall have their warranty period commence with the date of Substantial Completion. Added costs to extend warranty period if needed from date of equipment start-up to date of Substantial Completion shall be borne by the Contractor and included in the base bid.

END OF SECTION 008010



**Computer Generated Data
Use Agreement**

Project: Building 1526 Boiler
Project Number: 155-163-13
Recipient Name:
Recipient Address:
Computer Data Covered:
Date:

Company Name, (hereinafter referred to as "Recipient") has requested the above-referenced computer generated data and media (hereinafter referred to as the "Files") for their use in preparing layout and fabrication drawings. The Clark Enersen Partners (hereinafter referred to as "Clark Enersen") hereby grants the Recipient a personal, nonassignable, nonexclusive and fully revocable license to use the Files. All right, title and interest in and to the Files is retained by Clark Enersen. The Recipient agrees that no copies of the Files shall be made unless prior approval is obtained from Clark Enersen.

The Files constitute the proprietary and confidential work product and trade secrets of Clark Enersen. Clark Enersen claims and reserves all rights and benefits afforded under federal copyright law, as well as any pertinent state and international law, in the Files generated for the above-referenced project (the "Project").

The Recipient recognizes the potential problems and opportunities for error in the use and processing of the Files. Clark Enersen makes no representation or warranty as to the accuracy, completeness, suitability or performance of any Files provided, nor does Clark Enersen warrant or represent that the Files shall be free of computer viruses or other such corruption.

The Recipient acknowledges that any plans and specifications contained in the Files are subject to change and therefore agrees to confirm that conditions existing at the Project site conform to the Files provided. Clark Enersen shall have no obligation to provide updated or revised Files as they become available. The Recipient further accepts responsibility for all deviations between the Files provided, the final design of the Project, and existing field conditions.

The Recipient agrees to defend, indemnify and hold harmless Clark Enersen from any and all liability associated with the Recipient's use of the Files.

Execution of this agreement below indicates the Recipient's acceptance of these terms and conditions.

Accepted:

Name: _____

Title: _____

Company: _____

Date: _____

Architecture + Landscape Architecture + Engineering + Interiors

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SECTION 011000 - SUMMARY OF WORK

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this section.
 - 1. See Section 008000 "Special Conditions", if included, for requirements relating to interpretation of the drawings and specifications.
 - 2. See Section 008010 "Supplementary Conditions", if included, for requirements relating to interpretation of the drawings and specifications.

1.2 PROJECT DESCRIPTION

- A. Building 1526 to have a new condensing heating hot water boiler installed. Location and extents of the building are included in the drawings for information purposes only.
- B. The components of the project shall include the following items and trades as well as those identified or are necessary by the project's construction documents; selective site demolition of utilities and site clearing; mechanical systems include boiler, in-line pump, boiler flue, combustion air ductwork, floor drain plumbing including piping and temperature controls; electrical systems including power; and other miscellaneous construction.
- C. Concurrent with the General Construction Contract the Building will be fully occupied. The General Contractor shall coordinate his/her construction schedule to account for building being fully occupied and performed in a manner to avoid disruption to the building occupants and function. The General Contractor shall have limited use of the passenger elevators during the construction.

1.3 WORK SEQUENCE

- A. The Work will be conducted to provide the least possible interference to the activities of the Owner.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION 011000

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SECTION 012300 - ALTERNATES

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.
 - 1. See Section 008000 "Special Conditions", if included, for requirements relating to interpretation of the drawings and specifications.
 - 2. See Section 008010 "Supplementary Conditions", if included for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for Alternates.

1.3 PROCEDURES

- A. Coordination: Coordinate related Work and modify or adjust adjacent Work as necessary to insure that Work affected by accepted Alternate is complete and fully integrated into the project.
- B. Notification: Immediately following the award of the Contract, the General Contractor shall prepare and distribute to all affected subcontractors, suppliers and other involved parties notification of the status of Alternate.
- C. Include as part of Alternate, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION

3.1 SCHEDULE OF ALTERNATES

Bid Alternate M-1: Revise routing of boiler flue from location shown as Base Bid to the alternate location being routed through basement equipment room and up in north west corner of the light well as shown on plans. Also change the flue diameter from 6" diameter to 8" diameter as necessary for the increased overall flue distance associated with this Alternate flue routing. Base Bid (6") and Bid Alternate #1 (8") to utilize the same AL-294C Category IV flue materials.

END OF SECTION 012300

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SECTION 012500 – SUBSTITUTION PROCEDURES

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
 - 1. See Section 008000 “Special Conditions”, if included, for requirements relating to interpretation of the drawings and specifications.
 - 2. See Section 008010 “Supplementary Conditions”, if included for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

1.3 DEFINITIONS

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:
 - 1. Substitutions requested during the bidding period, and accepted by Addendum prior to award of the Contract, are included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
 - 2. Revisions to the Contract Documents requested by the Owner or Architect.
 - 3. Specified options of products and construction methods included in the Contract Documents.
 - 4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

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1.4 SUBMITTALS

- A. Substitution Request Submittal: The Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received more than 60 days after commencement of the Work may be considered or rejected at the discretion of the Architect.
1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for change-order proposals.
 2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
 3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors, that will be necessary to accommodate the proposed substitution.
 - b. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.
 - c. Product Data, including Drawings and descriptions of products and fabrication and installation procedures.
 - d. Samples, where applicable or requested.
 - e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - f. Cost information, including a proposal of the net change, if any in the Contract Sum.
 - g. The Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
 - h. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 4. Architect's Action: If necessary, the Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. The Architect will notify the Contractor of acceptance or rejection of the substitution within 2 weeks of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance will be in the form of a change order.
 - a. Use the product specified if the Architect cannot make a decision on the use of a proposed substitute within the time allocated.

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2. PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: The Architect will receive and consider the Contractor's request for substitution when one or more of the following conditions are satisfied, as determined by the Architect. If the following conditions are not satisfied, the Architect will return the requests without action except to record noncompliance with these requirements.

1. Extensive revisions to the Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of the Contract Documents.
3. The request is timely, fully documented, and properly submitted.
4. The specified product or method of construction cannot be provided within the Contract Time. The Architect will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
5. The request is directly related to an "or-equal" clause or similar language in the Contract Documents.
6. The requested substitution offers the Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. The Owner's additional responsibilities may include compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner, and similar considerations.
7. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the substitution will overcome the incompatibility.
9. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed substitution can be coordinated.
10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
11. Where a proposed substitution involves more than one prime contractor, each contractor shall cooperate with the other contractors involved to coordinate the Work, provide uniformity and consistency, and assure compatibility of products.

B. The Contractor's submittal and the Architect's acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with the Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval.

3. EXECUTION (NOT APPLICABLE)

END OF SECTION 012500

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SECTION 012600 – CONTRACT MODIFICATION PROCEDURES

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
 - 1. See Section 008000 “Special Conditions”, if included, for requirements relating to interpretation of the drawings and specifications.
 - 2. See Section 008010 “Supplementary Conditions”, if included for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION

3.1 CHANGES IN THE WORK

- A. The Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on AIA Form G710, Architect's Supplemental Instructions.
- B. Owner-Initiated Proposal Requests: The Architect will issue a description of proposed changes in the Work. Request will include supplemental or revised Drawings and Specifications as required.
 - 1. Proposal requests issued by the Architect are for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.
 - 2. As soon as feasible, the Contractor shall submit an estimate of cost necessary to execute the change to the Architect for the Owner's review.
 - a. Provide itemized unit price breakdowns into separate material and labor costs, subcontractor costs and all additional markups.
 - b. Indicate the effect the proposed change will have on the Contract Time.

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- C. Contractor-Initiated Proposals: When latent or unforeseen conditions require modifications to the Work, the Contractor may propose changes by submitting a request for a change to the Architect.
 - 1. Provide a complete description of the proposed change and estimate of cost.
 - 2. Provide itemized unit price breakdowns into separate material and labor costs, subcontractor costs and all additional markups.
 - 3. Indicate the effect the proposed change will have on the Contract Time.
- D. Proposal Request Form: Use AIA Document G709 for Proposal Requests.
- E. Change Orders: The Architect will record changes to the Contract Amount on a Change Order Form prepared by the Architect.

END OF SECTION 012600

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SECTION 012900 – PAYMENT PROCEDURES

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this section.
 - 1. See Section 008000 “Special Conditions”, if included, for requirements relating to interpretation of the drawings and specifications.
 - 2. See Section 008010 “Supplementary Conditions”, if included for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments.
- B. Payment Application Times: Each progress payment date is as indicated in the Agreement.
- C. Payment Application Forms: Use AIA Document G 702 and Continuation Sheets G 703 as the form for Application for Payment.
- D. Application Preparation: Complete every entry on the form. Incomplete applications will be returned without action.
- E. Transmittal: Submit 3 executed copies of each Application for Payment to the Architect by means insuring receipt within 24 hours.
 - 1. Transmit each copy with a transmittal form listing attachments.
- F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of this application include the following:
 - 1. List of Subcontractors.
 - 2. Schedule of Values.
 - 3. Contractor's Construction Schedule (preliminary if not final).
 - 4. Copies of Building Permits
 - 5. Copies of Authorizations and Licenses From Governing Authorities.
 - 6. Certificates of Insurance and Insurance Policies.

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7. Performance and Payment Bonds.
8. Data Needed to Acquire Owner's Insurance (if required).

G. Application for Payment at Substantial Completion: Administrative actions and submittals that shall proceed or coincide with this application include:

1. Occupancy permits and similar approvals.
2. Application for reduction of retainage, and consent of surety.
3. Advice on shifting insurance coverage.
4. List of incomplete Work of Substantial Completion.

H. Final Payment Application: Administrative actions and submittals which must precede or coincide with this application include the following:

1. Completion of project close-out requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Removal of temporary facilities and services.
4. Removal of surplus materials, rubbish and similar elements.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION (NOT APPLICABLE)

END OF SECTION 012900

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SECTION 013100 – PROJECT MANAGEMENT AND COORDINATION

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
1. See Section 008000 "Special Conditions", if included, for requirements relating to interpretation of the drawings and specifications.
 2. See Section 008010 "Supplementary Conditions", if included for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:
1. General project coordination procedures.
 2. Administrative and supervisory personnel.
 3. Cleaning and protection.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 1 Section "Project Meetings" for progress meetings, coordination meetings, and preinstallation conferences.
 2. Division 1 Section "Submittals" for preparing and submitting the Contractor's Construction Schedule.

1.3 COORDINATION

- A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
 3. Make provisions to accommodate items scheduled for later installation.

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- B. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
 - 1. Prepare similar memoranda for the Owner and separate contractors where coordination of their work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of schedules.
 - 2. Installation and removal of temporary facilities.
 - 3. Delivery and processing of submittals.
 - 4. Progress meetings.
 - 5. Project closeout activities.

1.4 SUBMITTALS

- A. Staff Names: Within 15 days of commencement of construction operations, submit a list of the Contractor's principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers
 - 1. Post copies of the list in the temporary field office, and at each temporary telephone.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

3.2 CLEANING AND PROTECTION

- A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

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

- C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 - 1. Excessive static or dynamic loading.
 - 2. Excessively high or low temperatures.
 - 3. Excessively high or low humidity.
 - 4. Water or ice.
 - 5. Solvents.
 - 6. Chemicals.
 - 7. Light.
 - 8. Puncture.
 - 9. Abrasion.
 - 10. Heavy traffic.
 - 11. Soiling, staining, and corrosion.
 - 12. Rodent and insect infestation.
 - 13. Electrical current.
 - 14. Improper lubrication.
 - 15. Unusual wear or other misuse.
 - 16. Contact between incompatible materials.
 - 17. Misalignment.
 - 18. Excessive weathering.
 - 19. Unprotected storage.
 - 20. Improper shipping or handling.
 - 21. Theft.
 - 22. Vandalism.

END OF SECTION 013100

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SECTION 013119 - PROJECT MEETINGS

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this section.
1. See Section 008000 "Special Conditions", if included, for requirements relating to interpretation of the drawings and specifications.
 2. See Section 008010 "Supplementary Conditions", if included for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:
1. Pre-Construction Conference.
 2. Progress Meetings.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor shall schedule a pre-construction conference at the Project site prior to start of construction activities. The Contractor shall conduct the meeting and take minutes.
- B. Attendees: The Owner, Architect and their consultants, major subcontractors, suppliers and other concerned parties shall be represented at the conference.
- C. Agenda: Discuss such topics as:
1. Tentative construction schedule.
 2. Critical Work sequencing.
 3. Use of the premises.
 4. Designation of responsible personnel.
 5. Procedures for processing field decisions and Change Orders.
 6. Procedures for processing Applications for Payment.
 7. Distribution of Contract Documents.
 8. Submittal of Shop Drawings, Product Data, and Samples.
 9. Preparation of record documents.
 10. Parking availability.
 11. Safety procedures.

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12. Office, work and storage areas.
13. Equipment deliveries and priorities.
14. Security.
15. Housekeeping.
16. Working hours.

3.2 PROGRESS MEETINGS

- A. The Contractor shall schedule progress meetings at the Project site at monthly intervals. The Contractor shall conduct the meeting and take minutes.
- B. Attendees: The Owner, Architect and their consultants, major subcontractors, suppliers and other concerned parties shall be represented at the conference.
- C. Agenda: Discuss such topics as:
 1. Progress since last meeting.
 2. Schedule revisions.
 3. Changes in work.
- D. Schedule Updating: Revise the construction schedule after each progress meeting where revisions have been made.
- E. Reporting: The Contractor shall distribute copies of minutes of the meeting to each party present.

END OF SECTION 013119

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SECTION 013300 – SUBMITTAL PROCEDURES

1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work including;
 - 1. Schedule of Values.
 - 2. Shop Drawings.
 - 3. Product Data.
 - 4. Samples.
 - 5. Contractor's Construction Schedule.
 - 6. Engineering Reports.

1.3 SUBMITTAL PROCEDURES

- A. Processing: Allow sufficient review time so that work will not be delayed as a result of the time required to process submittals, including time for re-submittals.
 - 1. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work.
- B. Contractor's Stamp: Submittals of shop drawings and product data will not be accepted until stamped by the Contractor with a stamp indicating approval.
- C. Submittal Transmittal: Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.
- D. All submittals except physical samples will be processed through Submittal Exchange. The Owner will provide the account with Submittal Exchange.

1.4 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings.

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- B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings.

- 1. Submit shop drawings electronically.

- C. Do not use Shop Drawings without an appropriate final stamp from the Architect indicating action taken in connection with construction.

1.5 PRODUCT DATA

- A. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, and standard color charts.

1.6 SAMPLES

- A. Submit Samples for review of kind, color, pattern, and texture, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

1.7 SCHEDULE OF VALUES

- A. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.

1.8 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Construction Schedule: Prepare a fully developed Contractor's construction schedule. Submit to the Architect at the earliest feasible date.
- B. Distribution: Print and distribute copies to the Architect, Owner, sub-contractors, and other parties required to comply with scheduled dates. When revisions are made, distribute to the same parties.

1.9 ENGINEERING REPORTS

- A. Submit Engineering Reports as required in Section 033000 "Cast-in-Place Concrete."

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION (NOT APPLICABLE)

END OF SECTION 013300

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SECTION 017329 - CUTTING AND PATCHING

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
 - 1. See Section 008000 "Special Conditions", if included, for requirements relating to interpretation of the drawings and specifications.
 - 2. See Section 008010 "Supplementary Conditions", if included for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for cutting and patching.

1.3 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce the load-carrying capacity or load-deflection ratio.
- B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing the capacity to perform as intended.
- C. Visual Requirements: Do not cut and patch exposed work in a manner that results in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually satisfactory manner as determined by Architect.

2. PRODUCTS

2.1 MATERIALS

- A. Use materials that are identical to existing materials. If identical materials are not available, use materials that match existing adjacent surfaces to the fullest extent possible. Use materials whose installed performance will equal or surpass that of existing materials.

3. EXECUTION

3.1 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
 - 1. Protection: Protect existing construction during cutting and patching.

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3.2 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction.
- C. Patching: Patch with durable seams that are invisible.
 - 1. Restore exposed finishes in a manner that will eliminate evidence of patching and refinishing.
 - 2. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials as required to achieve uniform color and appearance.
 - a. Where patching occurs in a smooth paint surface, extend final paint coat over entire unbroken surface after the patched area has received primer and second coat.
 - 3. Patch, repair or rehabbing existing ceiling as necessary to provide an even plane surface of uniform appearance.

3.3 CLEANING

- A. Thoroughly clean areas and spaces where cutting and patching are performed.

END OF SECTION 017329

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SECTION 017700 – CLOSEOUT PROCEDURES

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this section.
1. See Section 008000 “Special Conditions”, if included, for requirements relating to interpretation of the drawings and specifications.
 2. See Section 008010 “Supplementary Conditions”, if included for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
1. Final Submittals.
 2. Final cleaning.
 3. Operating Instructions.
 4. Substantial Completion.
 5. Final Completion.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION

3.1 FINAL SUBMITTALS

- A. **Submit record documents to the Architect for the Owner’s records within 30 calendar days of Substantial Completion, without any mitigating circumstances. Failure to submit all required documents listed herein within this timeframe shall result in the 5 % project retainage being held until such time that documents are provided in their entirety.**
- B. **Record documents include the following:**
1. Record Drawings: One clean, undamaged set of Contract Drawings and Shop Drawings with all Addendums and contract modifications posted. See paragraph 3.5.D.4 for additional requirements.
 2. Record Specifications: One complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction.
 3. Record Product Data: One 3 copies of each Product Data submittal.

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4. **Record Samples:** Meet at the site with the Architect and the Owner's personnel to determine which of the submitted Samples are to be transmitted to the Owner for record purposes.
5. **Operation and Maintenance Manuals:** Submit 3 copies of maintenance manuals and operating instructions organized into suitable sets of manageable size, properly bound and indexed. Operation and maintenance manuals shall be provided in 3-ring binders of 2-1/2" maximum thickness with clear vinyl covers on front and spine. Provide title of project and volume number and material covered on front and spine of binder. Include sheet inside cover of each volume with name, address, and phone number of each contractor, subcontractor, or equipment supplier.
6. **Product/Supplier Information:** Submit an outline of all products used on the project. See subparagraph 3.5.D.1 for additional information.
7. **Warranty Information:** Submit a copy of all individual warranties for products used on the project. See subparagraph 3.5.D.2 for additional information.

3.2 FINAL CLEANING

- A. **Cleaning:** Employ experienced workers or professional cleaners for final cleaning. Clean surfaces or units to the condition expected in a normal building cleaning and maintenance program. Comply with manufacturer's instructions.
 1. Remove labels that are not permanent labels.
 2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances. Replace chipped or broken glass and other damaged transparent materials.
 3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
 4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
 5. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.
- B. **Removal of Protection:** Remove temporary protection and facilities installed for protection of the Work during construction.
- C. **Remove waste materials from the site and dispose of in a lawful manner.**
 1. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

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3.3 OPERATING INSTRUCTIONS

- A. Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. Coordinate with Owner to insure that all pertinent personnel receive instruction.
- B. See Section 220500, 230500 for additional requirements.**

3.4 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following:
 - 1. In the Application for Payment that first follows the date of Substantial Completion, show supporting documentation for completion and a statement showing an accounting of changes to the Contract Sum.
 - a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
 - 2. Advise Owner of pending insurance change-over requirements.
 - 3. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
 - 4. Discontinue or change over and remove temporary facilities from the site, along with construction tools and similar elements.
- B. Inspection Procedures: On receipt of a request for inspection, the Architect will proceed with inspection. The Architect will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
 - 1. The Architect will repeat inspection, if accompanied by the General Contractor's project manager, when requested and assured that the Work has been substantially completed.

3.5 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following.
 - 1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 - 2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

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3. Submit a copy of the Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance.
 4. Submit consent of surety to final payment.
 5. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Upon completion of re-inspection, the Architect will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or other obligations required for final acceptance.
- C. If necessary, re-inspection will be repeated.
- D. After completing all work associated with the project, including all punch list items, provide 3 sets of the following items to the Owner in one or more 3-ring binders to receive Final Payment.**
1. Provide 1 copy of all shop drawings with review comments in sequential order for Divisions 2 – 32.
 2. Provide a complete set of Record Drawings which note all field changes to the Work including change orders, field orders or any deviations from what is shown in the project documents. All Addendum items shall also be posted on the drawings and in the Project Manual.

END OF SECTION 017700

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SECTION 033000 - CAST-IN-PLACE CONCRETE

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
 - 1. See Section 008000 "Supplementary Conditions", if included, for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. Work shall include all labor, materials, and equipment necessary to completely furnish and install Cast-in-Place concrete as indicated on the plans and as herein specified.
- B. This Section includes the following:
 - 1. Cast-in-place concrete
 - 2. Form-work
 - 3. Reinforcing
 - 4. Mix design
 - 5. Placement procedures
 - 6. Finishes
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. See Section 01 "Project Management and Coordination" if included, for additional requirements.
 - 2. See Section 071700 "Blended Polymer Waterproofing System with Prefabricated Drainage Composite" for waterproofing requirements.
 - 3. See Section 32 "Portland Cement Concrete Paving."
 - 4. Concrete bases for mechanical equipment to be provided by General Contractor. Coordinate with mechanical contractors and mechanical specification.
 - 5. See all specified floor finish Sections for moisture emission rate requirements. Coordinate concrete placement and design to accommodate requirements.

1.3 SUBMITTALS

- A. Product data for proprietary materials and items.

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- B. Shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315 "Details and Detailing of Concrete Reinforcement" and ACI 315R "Manual of Engineering and Placing Drawings for Reinforced Concrete" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement and plan drawing showing placement layout. Include special reinforcement required at openings through concrete structures.
1. One submittal shall be provided for all concrete reinforcement components in an area (i.e., foundations, dowels, wall reinforcing, etc.) Separate packages will not be reviewed.
 2. Any deviations from Construction Documents shall be clearly noted for verification.
 3. Forming / top of wall layout drawings for poured walls.
 4. Construction Joints in Concrete Stairs on Grade: At concrete stairs exceeding 8'-0" in width, submit construction joint layout for review and approval by Architect/Engineer at least 15 days prior to start of work.
- C. Submit product literature of bonding agent to be used and provide sample of repair for review and approval by Architect/Engineer prior to commencement of repair operation.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
1. ACI 318, "Building Code Requirements for Reinforced Concrete".
 2. ACI 301, "Specifications for Structural Concrete for Buildings".
 3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".
- B. Concrete Testing Service: Engage a testing laboratory acceptable to Architect/Engineer to perform material evaluation tests and to design concrete mixes.
- C. Materials and installed work may require testing and re-testing at any time during progress of work. Tests shall be done at Owner's expense.
- D. A single supplier shall be used for exposed concrete.

2. PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Metal or approved exterior grade plywood. Provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.

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- B. Forms for Unexposed Finish Concrete: Plywood or metal. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC (volatile organic compound) content of 350 g/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- D. Carton Forms: Biodegradable paper surface, treated for moisture-resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no corrodible metal closer than 1½ inches to exposed surface.
 - 1. Provide ties that, when removed, will leave holes not larger than 1 inch diameter in concrete surface.

2.2 REINFORCING MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 50 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60, deformed. Grade 40 may be used for stirrups and ties.
- C. Epoxy-Coated Reinforcing Bars: ASTM A 615, grade 60, deformed bars, epoxy coated, with less than 2 percent damaged coating in each 12 inch bar length.
 - 1. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.
- D. Welded Wire Fabric: ASTM A 185, welded steel wire fabric in sheet stock only.
- E. Supports for Reinforcement: Bolsters, chairs, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI Specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or use stainless steel supports (CRSI, Class2).

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I, or Type III.

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- B. Normal Weight Aggregate: ASTM C 33, and as herein specified. Provide aggregates from a single source throughout project unless otherwise acceptable to the Engineer. Course aggregates shall meet the requirements for use in regions of moderate weathering. Nominal maximum sizes of aggregates shall not exceed the following limits.
1. Sections whose minimum thickness is 12" or more: 1-1/2".
 2. Sections whose minimum thickness is less than 12": 3/4".
- C. Water: ASTM C94.
- D. Admixtures, General: Admixtures for concrete shall contain not more than 0.1 percent chloride ions.
1. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
 2. Water-Reducing Admixture: ASTM C 494, Type A.
 3. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
 4. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
 5. Water-Reducing, Retarding Admixture: ASTM C 494, Type D
6. Fly Ash. ASTM C 618, Class C.
- a. Walls and foundation concrete may contain up to 30 percent fly ash.
 - b. Exposed concrete work including exterior slabs may contain up to 15 percent fly ash.
 - c. Flatwork concrete that is not exposed may contain up to 15 percent fly ash.
7. Other admixtures may be proposed subject to compliance with the requirements of this section and the approval of the Architect/Engineer.

2.4 CURING MATERIALS

- A. General: See Part 3 "Execution", requirements for selection of curing materials.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A or Class B.

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2.5 RELATED MATERIALS

- A. Granular Base: Clean mixture of crushed stone or crushed or uncrushed gravel to provide, when compacted, a smooth and even surface below slabs on grade in locations as noted on drawings. Mixture shall comply with the following: 100 percent passing a 1 1/2-inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve or as recommended by the Geotechnical Engineering Report.
- B. Vapor Retarder: Provide polyethylene sheet (Class A minimum) complying with ASTM E1745, E154, D1709 and E96 above prepared base material at interior slabs on grade.
 - 1. Permeance Rating: 0.02 Perms or lower.
 - 2. Provide manufacturers recommended adhesive or pressure-sensitive tape for all sheet seams.
- C. Patching Compound: Cement-based compound for applications from one inch thick to feathered edges.
- D. Bonding Compound: Polyvinyl acetate or acrylic base.
- E. Foam Expansion Joint Filler: Polyethylene closed-cell expansion-joint filler. Provide WR Meadows, Deck-O-Foam expansion joint filler or equal.
- F. Joint Sealer: ASTM C 920, See Specification Section 07900 for requirements.
- G. Chemical Hardener/Sealer: Hardener, dustproofer and sealer consisting of a water soluble inorganic silicate-based compound. Hardener/sealer shall incorporate a gray color packet per manufacturer's recommendations.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Structure Concrete Sealer, Midwest Floor Care, Inc., Adams, NE.
 - b. Sonneborn, Kure-N-Harden, Degussa Building Systems, Shakopee, MN.
 - c. Hydrozo, Enviroseal 20, Degussa Building Systems, Shakopee, MN.
 - d. Seal Hard, L & M Construction Specialties, Omaha, NE.
 - e. Other, equal, if and as specifically approved by Architect by Addendum during bidding period.
- H. Dovetail Anchor Slots: Hot-dip galvanized sheet steel, not less than 0.0336 inch thick (0.76 mm) with bent tab anchors. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.

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2.6 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by laboratory trial batch as specified in ACI 301. Use an independent testing facility acceptable to the Architect/Engineer for preparing and reporting proposed mix designs.
- B. Submit written reports to Architect of proposed mix. Do not begin concrete production until proposed mix designs have been approved by Architect/Engineer.
- C. Design mixes to provide normal weight concrete with the following properties, unless otherwise indicated on drawings and schedules:
 - 1. All pad and strip footings and concrete bases for mechanical equipment shall have a 28 day $F'c = 3000$ psi.
 - 2. All other concrete including slabs on grade, grade beams and pile caps shall have a 28 day $F'c = 4000$ psi.
- D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
 - 2. Other concrete: Not less than 1 inch nor more than 4 inches.
- E. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
 - 1. All pad and strip footings and concrete bases for mechanical equipment shall have a 28 day $F'c = 3000$ psi; water-cement ratio between 0.50 and 0.53.
 - 2. All other concrete including slabs on grade and grade beams shall have a 28 day $F'c = 4000$ psi; water-cement ratio between 0.40 and 0.45.
 - 3. **Note that concrete which is placed that exceeds the water cement ratios indicated will directly affect schedule for installation of floor finishes. Coordinate with overall schedule.**
- F. Mix design adjustments may be requested when characteristics of materials, job conditions, weather, or other circumstances warrant. Laboratory test data for revised mix design and strength test results must be submitted to and accepted by Architect/Engineer before using in work.

2.7 ADMIXTURES

- A. Show clearly on all submittals which admixtures if any are to be used in each concrete mix. Do not use any admixture whose use has not been approved by the Architect/Engineer.

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- B. Use air-entraining admixture in all exterior concrete in accordance with ACI 301 requirements.
 - 1. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content within the following limits:
 - a. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:
 - 1) 5 percent to 7 percent air.
 - b. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener:
 - 1) 2 percent to 4 percent air.
 - c. For all concrete scheduled to receive a surface hardener/dust proofer.
 - 1) Use of air entrainment admixtures is prohibited.
- C. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.

2.8 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as specified.
- B. Addition of water to the batch at the job site is permitted but subject to the limitations of ACI 301.
- C. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

3. EXECUTION

3.1 FORMS

- A. General: Design, erect, support, brace, and maintain formwork according to ACI 301 to support all loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position indicated on drawings within tolerance limits of ACI 117. Maintain formwork construction tolerances complying with ACI 347R.

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- B. Construct forms to sizes and shapes shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- C. When using form coating compound, coat contact surfaces of forms before reinforcement is placed. Apply form coating compound in compliance with manufacturer's recommendations. Rust stained steel formwork is not acceptable.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
- E. Provide temporary openings for clean-outs and inspections where interior area of concrete is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- G. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces.
- H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.
- J. Form Removal
 - 1. Formwork not supporting weight of concrete. Formwork for columns, walls, sides of beams and other parts not supporting the weight of concrete may be removed 24 hours after completion of placement of concrete, provided concrete is sufficiently hardened not to be damaged by removal operations and provided curing and protection of work are maintained.
 - 2. Top forms and sloping surfaces. Remove as soon as concrete has attained sufficient strength to prevent sagging. Make necessary repairs, finish as specified, and apply any required treatments as soon as possible and begin specified curing.

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3. Formwork supporting weight of concrete. Do not remove forms supporting weight of concrete in beams, slabs and other members until concrete has achieved not less than 85% of its specified 28-day strength. The strength of the concrete at any age shall be determined by the testing of two cylinders made and cured in accordance with ASTM C 39. The strength shall be assumed to be the average of the strength of the two cylinders tested. However, forms shall not be removed if the strength of either of the two cylinders tested is less than 75% of the specified 28-day strength. Alternately, forms supporting weight of concrete may be removed if reshoring is provided to support the full weight of the concrete. Remove forms and install reshores so that concrete is fully supported at all times. Leave reshores in place until concrete has achieved not less than 85% of its specified 28-day strength, determined as specified above.
4. Void forms. Do not remove.

K. Re-use of forms.

1. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
2. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.2 VAPOR RETARDER INSTALLATION

- A. General: Unless otherwise indicated, vapor retarder shall always be installed directly over prepared base material, directly beneath concrete slab. Place and seal vapor barrier in accordance with ASTM E 1643 and manufacturer's written instructions.
- B. Lap joints 6 inches and tape per specified requirements.

3.3 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as herein specified.
 1. Avoid cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages to vapor retarder/barrier before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Do not bend bars in field except as specifically indicated on the drawings or approved by Architect/Engineer. If bending is permitted, bend bars cold and in accordance with the requirements of ACI 315.

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- D. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by bolsters, chairs or other devices.
 - 1. Do not secure reinforcement to re-bar driven into ground or on rocks, dirt clods or other debris. Do not "float in" reinforcement.
- E. Place reinforcement to obtain minimum coverages as required by ACI 318 for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- F. Install welded wire fabric in as long lengths as practicable on bar supports to minimize sagging. Lap adjoining pieces at least one full mesh. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

- A. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.
- B. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- C. Horizontal and vertical keyways not less than 1.5 inches deep x 3.5 inches wide shall be provided at all construction joints in walls, grade beams and footings.
- D. Expansion Joints in Exterior Slabs-on-Grade: If spacing not indicated, construct exterior expansion joints in paving at 40 foot maximum intervals (at non-climate controlled concrete) and at points of contact between paving, sidewalks, etc and vertical surfaces, such as columns, foundations, reentrant and outside corners, and elsewhere as indicated.
 - 1. Required at exterior slabs only.
- E. Provide joint fillers and sealant at all expansion joints.
- F. At interior slabs, provide ½" expansion joint material unless otherwise noted at perimeter of slab. See drawings for additional details and requirements.
- G. At interior slabs, provide felt bond-breaker unless otherwise noted at all columns. See drawings for additional details and requirements.

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- H. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade. Use saw cuts 1/8 inch wide by 1/4 slab depth or inserts 1/4 inch wide by 1/4 of slab depth.
 - 1. If joint spacing not indicated, lay out joints to form square panels. When this is not practical, rectangular panels can be used if the long dimension is no more than 1.25 times the short side. In 4" slabs, the long side should not exceed 10 feet.
 - a. Required at interior and exterior slabs.
 - b. Spacing: Not to exceed 30 x slab thickness or 10 feet, whichever is less.
- I. Control Joints in Basement Walls: Provide joints at 24'-0" on center using 3/4" chamfer strips. Horizontal bars shall be continuous through joints.
- J. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Support and protect exposed waterstops during progress of work. Field fabricated joints in waterstops according to manufacturer's printed instructions.

3.5 INSTALLATION OF EMBEDDED ITEMS

- A. Set and build into work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached to embeddings.
- B. Install dovetail anchor slots in concrete structures as indicated on drawings.

3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Remove debris, dirt clods, etc. from trenches and excavations prior to concrete placement. Notify and coordinate with other trades to permit installation of their work.
- B. General: Comply with the most current version of ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.
- C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

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- D. **Placing Concrete Slabs:** Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - a. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 301.
 2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
- E. **Cold Weather Placing.** Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions or low temperatures in compliance with the most current version of ACI 306 "Cold Weather Concreting" and as specified.
1. When air temperature has fallen to or is expected to fall below 40 degrees Fahrenheit within four hours after the finishing of placement operations, uniformly heat water and aggregates before mixing to obtain a concrete mixture of not less than 50 degrees Fahrenheit, and not more than 80 degrees Fahrenheit at point of placement. Do not bring heated water into direct contact with cementitious materials.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt and other materials containing anti-freeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- F. **Hot Weather Placing.** When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with the most current version of ACI 305 "Hot Weather Concreting" and as specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees Fahrenheit. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.

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3.7 MONOLITHIC SLAB FINISHES

- A. Float Finish: Apply float finish to all monolithic slab surfaces prior to trowel or non-slip broom finish.
1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances required by ASTM E 1155. Cut down high spots and fill low spots. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
 2. Concrete adjacent to all floor drains shall be finished level to drain inlet. Warping of slab is prohibited unless approved in writing by the Architect.
- B. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances required by ASTM E 1155. Grind smooth surface defects that would telegraph through applied floor covering system.
 2. Finish slab on grade surfaces to the following tolerance according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F (F) 35; and of levelness F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness F(L) 17.
- C. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete flatwork.
1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.8 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the most current version of ACI 306.1 for cold-weather protection and with recommendations in the most current version of ACI 305R for hot-weather protection during curing.

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- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308-92, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer **unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.**

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4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work
 1. Exposed areas to be reviewed by Architect/Engineer for acceptance.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings and associated items. Cast-in safety inserts and accessories as shown on Drawings. Screed, tamp and trowel-finish concrete surfaces.

3.10 INSTALLATION OF NON-SHRINK GROUT

- A. Preparation for placing.
 1. Roughen surface below bearing area with pneumatic tools.
 2. Thoroughly clean roughened surface of concrete foundations and soak surface with water for 24 hours prior to grouting. Remove standing water from surfaces before placing grout.
- B. Placing.
 1. Place and cure non-shrink grout in strict accordance with manufacturer's printed instructions.
 2. Grout must be free of bleeding at recommended water content.
 3. Temperature of concrete foundations and baseplates at time of placing grout shall be within limits recommended by grout manufacturer.
- C. Grout under base plates to provide full bearing area after steel or equipment has been properly positioned and secured.

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3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.
 - 1. Patch and repair of unacceptable concrete surfaces is the responsibility of the Contractor.
 - 2. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
 - 3. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
 - a. This shall include all areas of concrete that have curled due to uneven curing.
 - 4. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect.
 - 5. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 - 6. Submit product literature of bonding agent to be used and provide sample of repair for review by Architect/Engineer prior to commencement of repair operation.

END OF SECTION 033000

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SECTION 055000 - METAL FABRICATIONS

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.
 - 1. See Section 00800 "Supplementary Conditions", if included, for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. Work shall include all labor, materials and equipment necessary to completely furnish and install the Metal Fabrications as indicated on the plans and as herein specified.
- B. This section includes the following:
 - 1. Exterior flue supports
 - 2. Supports at mechanical equipment and penetrations.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

1.4 SUBMITTALS

- A. Product data for products used in miscellaneous metal fabrications.
- B. Shop drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Provide product data for powder coating type and color.
- D. Provide product data of anchoring items and epoxy.
- E. Provide a shop drawing of metal fabrication as well as a prototype for approval prior to installation.

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1.5 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with American Welding Society (AWS) "Standard Qualification Procedure". Use welders that have satisfactorily passed AWS qualification tests within 12 months prior to the start of construction. If recertification of welders is required, retesting will be the Contractor's responsibility. Welding certificates to be available upon Architect's/Engineer's request.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication. Allow for trimming and fitting.

1.7 SEQUENCING AND SCHEDULING

- A. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.

2. PRODUCTS

2.1 GENERAL

- A. For metal fabrications exposed to view, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Cold-Rolled Structural Steel Sheet: ASTM A 1008, Grade A.
- E. Cold-Rolled Steel Sheet: Commercial Quality.
- F. Galvanized Steel Sheet: Structural Quality, ASTM A 653, Grade A, G90.
- G. Steel Pipe: ASTM A 53, Schedule 40, black finish at interior, galvanized finish at exterior.

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- H. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either [ASTM A 47](#) malleable iron or [ASTM A 27](#) cast steel. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.
- I. Welding Rods and Bare Electrodes: In accordance with AWS specifications for metal alloy welded.

2.3 GROUT AND ANCHORING CEMENT

- A. Nonshrink Nonmetallic Grout: Premixed, nonstaining, noncorrosive, nongaseous grout complying with COE ASTM 1107.
- B. Interior Anchoring Cement: Prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water.
- C. Erosion-Resistant Anchoring Cement: Prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water.

2.4 GROUT AND ANCHORING CEMENT

- A. Nonshrink Nonmetallic Grout: Premixed, nonstaining, noncorrosive, nongaseous grout complying with COE ASTM C 1107.
- B. Interior Anchoring Cement: Prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water.
- C. Erosion-Resistant Anchoring Cement: Prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water.

2.5 FASTENERS

- A. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.
- B. Lag Bolts: Square head type, FS FF-B-561.
- C. Machine Screws: Cadmium plated steel, FS FF-S-92.
- D. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

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- E. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A153.
- F. Wood Screws: Flat head carbon steel, FS FF-S-111.
- G. Plain Washers: Round, carbon steel, FS FF-W-92.
- H. Drilled-In Expansion Anchors: Expansion anchors shall be stud type with a single piece three section wedge. The anchors shall meet the description in FS FF-S-325, Group II, Type 4, Class 1 for concrete expansion anchors. Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).
- I. Toggle Bolts: Tumble-wing type, FS FF-B-588.
- J. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

2.6 PRIMER

- A. Surface Preparation: Clean surfaces to be primed. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications.
- B. Primer: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than **2.5 – 3.5 mils**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, VOC-compliant, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664.
 - 2. Manufacturers standard primer compliant with all specified requirements. **(for use in interior environments only)**
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.

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2.7 CONCRETE FILL

- A. Concrete Materials and Properties: Comply with requirements of Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless higher strengths are indicated.

2.8 FABRICATION, GENERAL

- A. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Form exposed work true to line, level and with straight sharp edges. Shear and punch metals cleanly and accurately. Ease exposed edges to a radius of 1/32 inch. Remove burrs and sharp or rough areas on exposed surfaces.
- C. Allow for thermal movement resulting from change in ambient temperature in the design, fabrication, and installation of metal assemblies.
- D. Weld corners and seams continuously to comply with AWS recommendations. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed connections, finish so that no roughness shows and contour matches adjacent.
- E. Form exposed connections with hairline joints, using concealed fasteners wherever possible. Where necessary, use exposed fasteners of Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- F. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water.

2.9 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required.
- B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood; steel washers elsewhere.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Provide steel framing and supports for applications which are not a part of structural steel framework, as required to complete work.

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- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
 - a. Except as otherwise indicated, space anchors **24 inches** on center and provide minimum anchor units in the form of steel straps **1-1/4 inches** wide by **1/4 inch** thick by **8 inches** long.
- C. Fabricate support for suspended toilet partitions as follows:
 - 1. Braces and Angles: Steel angles of size required for rigid support of partitions and for secure anchorage.

2.11 FINISHES, GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designing finishes.
- B. Finish metal fabrications after assembly.
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with hot-dip galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated, Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with the following requirements:
 - 1. ASTM A 153 for galvanizing iron and steel hardware.
 - 2. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch (0.76 mm) thick or thicker.
- 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 metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6 "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 3 "Power Tool Cleaning."

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- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA 1 "Paint Application Specification No. 1" for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

3. EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing to in-place construction.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds and methods used in correcting work.
- D. Provide galvanized hardware and support brackets or prime and paint all exterior metal.
- E. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface. Welds shall meet the National Ornamental and Miscellaneous Metals Association (NOMMA) standards as noted on the Drawings. NOMMA 1, NOMMA 2, NOMMA 3 and or NOMMA 4 standard is required as noted on the Drawings.

3.2 SETTING LOOSE PLATES

- A. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
- C. Pack grout solidly between bearings surfaces and plates to ensure that no voids remain.

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3.3 ADJUSTING AND CLEANING

- A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting.
- B. For galvanized surfaces clean welds, bolted connections and apply galvanizing repair paint to comply with ASTM A780

END OF SECTION 055000

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SECTION 092900 - GYPSUM DRYWALL

1. GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
 - 1. See Section 008010 "Supplementary Conditions", if included, for requirements relating to interpretation of the drawings and specifications.

1.2 SUMMARY

- A. This Section includes the following types of gypsum board construction:
 - 1. Non load bearing steel framing members to receive gypsum board.
 - 2. Gypsum board screw-attached to steel framing and furring members.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. See Section 079200 "Joint Sealants" for acoustical sealant.
 - 2. See Section 083113 "Access Doors" for recessed or concealed access doors.

1.3 SUBMITTALS

- A. Product data from manufacturers for each type of product specified.

1.4 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: ASTM E 119.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages bearing identification of manufacturer. Store inside under cover and keep protected against damage.

1.6 PROJECT CONDITIONS

- A. Establish and maintain environmental conditions to comply with ASTM C 840.

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2. PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
1. Domtar Gypsum Co.
 2. Gold Bond Building Products Div., National Gypsum Co.
 3. United States Gypsum Co.
 4. Certainteed Gypsum.

2.2 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

- A. General: ASTM C 754.
- B. Hanger Anchorage Devices: Size devices for 3x calculated load except size direct pull-out concrete inserts for 5x calculated loads.
- C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.
- D. Channels: Cold-rolled steel, 0.0598 inch minimum thickness and 7/16 inch wide flanges, protected with rust-inhibitive paint, and as follows:
1. Carrying Channels: 1½ inch deep, 475 lbs per 1000 ft.
 2. Furring Channels: ¾ inch deep, 300 lbs per 1000 ft.
- E. Fire Resistance: Where indicated, provide 1 hour rated assembly.

2.3 STEEL FRAMING FOR NON LOAD BEARING WALLS AND PARTITIONS

- A. Steel Framing: ASTM C 645; 25 gauge minimum thickness and as follows:
1. Steel stud supplier shall size studs as appropriate for the condition where they will be installed. Gauge thickness should be modified appropriately for condition.
 2. Steel Studs and Runners: 3-5/8" wide unless otherwise indicated.
 3. Steel Rigid Furring Channels: Hat-shaped, 7/8 inch deep.
 4. Z-Furring Members: Fabricated from hot-dipped galvanized steel sheet, face flange of 1¼", wall attachment flange of 7/8", depth as indicated.
- B. Fasteners: Provide fasteners of type and size required to fasten members securely to substrates involved; comply with manufacturer's recommendations.

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2.4 GYPSUM BOARD

A. Gypsum Wallboard: ASTM C 36, and as follows:

1. Type: Type X typical, water-resistant as tile back-up, where indicated on the drawings and as follows:
 - a. **Water resistant drywall shall be used for walls of all rooms from floor level to 48" above finished floor at all locations where finished floor elevation is below surrounding grade on any side of the building. This shall include basements, walk-out basements or other areas where exterior grade elevation is above finished floor level.**
 - 1) The fire resistance rating of the wall assembly shall be maintained with that indicated on the drawings.
2. Edges: Tapered.
3. Thickness: 5/8 inch walls, unless otherwise indicated.

B. Abuse-Resistant Gypsum Wallboard: ASTM C 36, manufactured to produce greater resistance to surface indentation and through-penetration than standard gypsum panels. (**install over minimum 20 gauge studs whether indicated on drawings or not.**)

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. National Gypsum Company; Gold Bond Hi-Abuse Wallboard.
 - b. United States Gypsum Co.; Fiberock Brand Abuse-Resistant Gypsum Panels.
 - c. Or approved equal.
2. Core: **5/8 inch (15.9 mm)**, Type X.
3. Long Edges: Tapered.
4. Location: As indicated.

2.5 TILE BACKING PANELS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

1. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) "Dens-Shield Tile Backer" manufactured by G-P Gypsum Corp.
 - 2) United States Gypsum Co.; Fiberock Brand Aqua-Tough Interior Panels.
 - 3) Or approved equal.

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- b. Core: **5/8 inch (15.9 mm)**, Type X.
- 2. Cementitious Backer Units: ANSI A118.9. Proprietary backing units with glass fiber mesh reinforcing and water resistant coating on both faces. Provide at shower areas and elsewhere as indicated:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Custom Building Products; Wonderboard.
 - 2) FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - 3) United States Gypsum Co.; DUROCK Cement Board.
 - b. Thickness: **1/2 inch (12.7 mm)**.

2.6 TRIM ACCESSORIES

- A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
 - 1. Material: Formed metal or plastic, with metal complying with the following requirement:
 - a. Steel sheet zinc coated by hot-dip process or rolled zinc.
 - 2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
 - a. Cornerbead on outside corners, unless otherwise indicated.
 - b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
 - c. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.
 - d. U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.
 - e. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.

2.7 GYPSUM BOARD JOINT TREATMENT MATERIALS

- A. General: ASTM C 475, ASTM C 840.
- B. Joint Tape: Paper reinforcing tape, unless otherwise indicated.
- C. Drying-Type Joint Compounds: Factory-prepackaged, ready-mixed, vinyl-based:
 - 1. Taping compound formulated for embedding tape and for first coat over fasteners and flanges of corner beads and edge trim.
 - 2. Topping compound formulated for fill (second) and finish (third) coats.

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2.8 MISCELLANEOUS MATERIALS

- A. Gypsum Board Screws: ASTM C 1002.
- B. Acoustical Sealant: See Section 079200 Joint Sealants for requirements and extent required.**
 - 1. To be installed by drywall subcontractor in concealed locations and by sealant subcontractor in exposed locations.**
- C. Sound Attenuation Blankets: Unfaced mineral fiber insulation complying with ASTM C 665 for Type I.

3. EXECUTION

3.1 INSTALLATION OF STEEL FRAMING, GENERAL

- A. Steel Framing Installation Standard: ASTM C 754 and ASTM C 840.
- B. Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, grab bars and similar construction.
- C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement. Do not bridge building expansion and control joints with framing or furring members.

3.2 INSTALLATION OF STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

- A. Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to approved anchorage devices or fasteners. Do not attach hangers to underside of concrete slabs with powder-actuated fasteners. Do not connect or suspend steel framing from ducts, pipes or conduit.
- B. Install suspended steel framing members in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.
 - 1. Wire Hangers: 0.1620 inch diameter (8 gage), 4 ft. on center.
 - 2. Carrying Channels (Main Runners): 1½ inch, 4 ft. on center.
 - 3. Rigid Furring Channels (Furring Members): 16 inches on center.
- C. Installation Tolerances: Level to within 1/8 inch in 12 ft.

3.3 INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS

- A. Install runners (tracks) where stud system abuts other construction. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.

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- B. Installation Tolerances: Not more than 1/8 inch from faces of adjacent framing.
- C. Extend partition framing to structural supports or substrates above suspended ceilings, unless otherwise indicated. Continue framing over doors and openings and frame around ducts penetrating partitions above ceiling.
- D. Install studs and furring at 16 inches on center unless otherwise indicated.
- E. Frame openings to comply with GA-219.

3.4 APPLICATION OF GYPSUM BOARD

- A. General: ASTM C 840. Install boards in manner which minimizes the number of end-butt joints and with face side out. Butt boards for a light contact at edges; do not force into place. Space fasteners in gypsum boards in accordance with referenced application and finishing standard and manufacturer's recommendations.
- B. Locate joints over supports. Do not place tapered edges against cut edges. Stagger vertical joints.
- C. Form control joints and expansion joints at locations indicated, or as follows:
 - 1. Install control joints according to ASTM C 840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.
 - 2. **If control joints are not shown on the drawings they shall be located at a maximum of 30 feet o.c. Coordinate exact location with Architect prior to installation.**
- D. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide ¼ inch to ½ inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.
- E. Where sound-rated drywall construction is indicated, seal construction at perimeters, openings and penetrations with a continuous bead of acoustical sealant. Comply with ASTM C 919 and manufacturer's recommendations and close off sound-flanking paths around or through construction.

3.5 FINISHING OF GYPSUM BOARD

- A. General: ASTM C 840. Apply joint treatment at gypsum board joints; flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for finishing.
- B. Prefill open joints and beveled edges using setting-type joint compound.
- C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

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- D. Finish interior gypsum wallboard by applying the following joint compounds in 3 coats, and sand between coats and after last coat:
 - 1. Embedding and First Coat: Ready-mix drying-type taping compound.
 - 2. Fill (Second) Coat: Ready-mix drying-type topping compound.
 - 3. Finish (Third) Coat: Ready-mix drying-type topping compound.
- E. Partial Finishing: Omit second and third coat on concealed drywall construction.
- F. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- G. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.
- H. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.6 INSTALLING TRIM ACCESSORIES

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.
- B. Install cornerbead at external corners.
- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
 - 1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
 - 2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
 - 3. Install U-bead where indicated.

3.7 PROTECTION

- A. Provide final protection and maintain conditions which ensures gypsum drywall being without damage or deterioration at time of Substantial Completion.

END OF SECTION 092900

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SECTION 220500 - BASIC PLUMBING REQUIREMENTS

1. GENERAL

1.1 SECTION INCLUDES

- A. This section describes Basic Plumbing Requirements required to provide for a complete installation of all plumbing systems for this project. This section shall apply to all other Division 22 specification sections as well as all work shown on the drawings.
- B. It is the intent of the Plumbing Division of the Specifications that all plumbing work specified herein be coordinated as required with the work of all other Divisions of the Specifications and Drawings so that all installations operate as designed.
- C. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation to the satisfaction of the Owner's representative.
- D. The Contractor shall note that, in some cases, piping as shown on the Drawings provide general location and routing information only. The Contractor shall be responsible for providing interference-free systems with proper clearance to facilities and equipment.
- E. Where the word "provide" is used, it shall mean "furnish and install" unless otherwise noted or specified.
- F. Note that the words "mechanical" and "plumbing" are used interchangeably throughout the Division 22 and 23 specification sections.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section and all other sections of Division 22.

1.3 DESCRIPTION OF WORK

- A. The work included under this section consists of providing all labor, materials, supervision, and construction procedures necessary for the installation of the complete plumbing systems required by these specifications and/or shown on the drawings of the contract.
- B. The Contract Drawings are shown in part diagrammatic intended to convey the scope of work, indicating the intended general arrangement of equipment, piping, ductwork, etc.

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1.4 QUESTIONS OF INTERPRETATION

- A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect/Engineer for clarification. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.
- B. The Architect/Engineer shall be the sole judge regarding interpretations of conflicts within contract documents.

1.5 CONTRACT DOCUMENT DISCREPANCIES

- A. If any ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of bid.
- B. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of three-dimensional objects. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies should be identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
- C. The Contractor shall follow the drawings in laying out work and verify clearances for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of materials or equipment, obtain instructions from the Architect/Engineer before proceeding with the work.
- D. If there is a conflict between manufacturer's recommendations and the Contract Documents, the manufacturer's recommendations shall govern with no additional cost to the Owner.

1.6 PERMITS

- A. The Contractors shall familiarize themselves with all requirements regarding all permits, fees, etc., and shall comply with them. All permits, licenses, inspections and arrangements required for the work shall be obtained by the Contractor at his expense.

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- B. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor.

1.7 QUALITY ASSURANCE

- A. Installers shall have at least 2 years of successful installation experience on projects with plumbing installation work similar to that required by the project. All equipment and materials shall be installed in a neat and workmanlike manner and shall be aligned, leveled, and adjusted for satisfactory operation, unless noted otherwise in other plumbing sections.
- B. Manufacturers of equipment and materials must be regularly engaged in the manufacture of the specified equipment and material with similar construction and capacities and whose products have been in satisfactory use in similar service for not less than five (5) years, unless noted otherwise in other sections.
- C. Qualify welding processes and operators for structural steel according to AWS D1.1. "Structural Welding Code - Steel.
- D. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- E. Contractor signed welder certificate(s) shall be submitted. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current. A record shall be maintained on the job site showing the date and results of qualification tests for each welder employed on the job. One certified copy of the qualification test for each welder so employed shall be furnished to the Owner's representative.
- F. For all the refrigerant work/service required by this project, all refrigerant technicians shall be EPA/ASHRAE 34 certified for corresponding classification type I, II, III and/or IV.

1.8 CODES AND REFERENCES

- A. The design, manufacture, testing, and method of installation of all equipment and materials furnished under the requirements of this specification shall, at minimum, conform to the following as applicable:
 - 1. Safety and Health Regulations for Construction.
 - 2. Occupational Safety and Health Standards, National Consensus Standards and Established Federal Standards.
 - 3. National Electrical Code (NEC), see Division 26 sections for applicable edition.
 - 4. National Fire Protection Association (NFPA) Codes and Standards.
 - 5. Life Safety Code (NFPA 101)
 - 6. Factory Mutual Engineering Corporation: FM Global.
 - 7. American Gas Association (AGA)
 - 8. Underwriters' Laboratories, Inc. (UL)
 - 9. National Electrical Safety Code (NEC)

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10. Applicable National, State, and Local Codes
11. ANSI/ASME B31.1.
12. ANSI/ASME B31.9.
13. International Building Code (IBC).
14. International Mechanical Code (IMC).
15. Lincoln Plumbing Code (LPC).
16. International Energy Conservation Code (IECC).
17. International Fuel Gas Code (IFGC).
18. Other governing, state, and local codes that apply.

- B. Where there is a conflict between the code and the contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified shall not be substituted. In the event of a question, obtain instructions from the Architect/Engineer before proceeding with the work.

1.9 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Sections "General Conditions" and "Special Conditions".
- B. The Architect/Engineer's review of submittals, including any corrections or comments made on the shop drawings during the review process, do not relieve Contractor from compliance with requirements of the Contract Documents. The review is only a review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication process and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. The Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect/Engineer's review of those drawings.
- C. No portion of the work requiring submission of a shop drawing, product data or sample shall be commenced until the submittal has been reviewed by the Architect/Engineer. All such portions of the work shall be in accordance with reviewed submittals and the associated manufacturer recommendations.
- D. Shop drawings shall include the minimum following information as applies. Additional specific information required is outlined in other Plumbing Sections.
1. All equipment items shall be marked with the same item number as used on drawings or schedules.
 2. Certified performance and data with system operating conditions indicated. All coil, heat exchanger, and pump performance data shall be computer generated.
 3. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicating size, weights (shipping, installed, and operating), furnished specialties and accessories; and installation and start-up instructions.

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4. **Shop Drawings:** Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loading, required clearances, and methods of assembly of components.
5. **Wiring Diagrams:** Submit manufacturer's electrical requirements for power supply wiring to electrical equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of electrical equipment and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
6. **Maintenance Data:** Submit maintenance data and parts list for each plumbing equipment, control and accessory; including "troubleshooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

E. Provide separate shop drawing submittals for the following items.:

1. Section 220500:

Submittal Requirement:	Date Submitted:
Plumbing permits	
EPA/ASHRAE 34 refrigeration certification	
Welding certificates	
Warranties	
As-built documents	
Pipe pressure test logs	
Operation and maintenance manuals	
Coordination drawings	
Close-out / walk-through documentation	
Training seminar documentation	

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2. Section 220529:

Submittal Requirement:	Date Submitted:
Pipe supports, anchors, sleeves, and hangers	
Equipment curbs, supports, and hangers	
Mechanical seals	
Roof curbs and supports	
Fire sealants	

3. Section 220553:

Submittal Requirement:	Date Submitted:
Mechanical and plumbing identification materials	
Valve schedule	

4. Section 220719:

Submittal Requirement:	Date Submitted:
Pipe insulation materials and insulation schedule	

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5. Section 221000:

Submittal Requirement:	Date Submitted:
Plumbing piping material and fitting schedule	
Plumbing valves	
Plumbing pipe accessories	
Plumbing hydrostatic test report(s)	
Domestic water sample test report(s)	

6. Section 224000:

Submittal Requirement:	Date Submitted:
Plumbing fixtures and accessories	

1.10 SUBSTITUTIONS

- A. All proposals shall be based on providing and installing the materials or items of equipment as shown on the Contract Documents. The Contractor's options in selecting materials and equipment are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects.
- B. Where the terms "or equivalent" is used, the Contractor may substitute alternate equipment, materials, etc. subject to review by the Architect/Engineer and the Owner's representative during the submittal phase of the project.
- C. Where the term "or approved equivalent" is used, the Contractor may not substitute alternate equipment, materials, etc. unless obtaining written approval from the Architect/Engineer at least ten (10) days before the bid date. Notifications of any such approvals by the Architect/Engineer shall only be made in writing by Addendum.
- D. Where the term "no equivalent" is used, the Contractor must provide the specified or scheduled equipment, materials, etc.
- E. Proposed substitutions will be judged on the basis of quality, capacity, performance, features, physical size, and appearance. The reputation of the manufacturer, delivery time requirements, and the availability of repair or replacement parts may also be considered.
- F. The Architect/Engineer shall be the sole and final judge as to the suitability of substitution items.



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- G. If a substitution is approved, the Contractor shall bear the total cost of all changes due to substitution. These costs may include additional compensation to the Architect/Engineer for redesign and evaluation services, increased cost of work by the Owner or other Contractors, and similar considerations.
 - 1. If an approved substitution differs from the specified item in terms of power requirements, dimensions, capacities, and ratings, the associated plumbing and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are to be increased accordingly, but all recommended manufacturer clearances, etc., are to be maintained within the allotted mechanical spaces. No additional costs will be approved for these modifications. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.11 WARRANTY

- A. Refer to the General Conditions section of this Specification for general warranty requirements and information. Additional warranty requirements are specified in subsequent Plumbing Sections.

1.12 CLOSE OUT AND OPERATION INSTRUCTIONS

- A. Operate each system and item of equipment in a test run of appropriate duration, but no less than 7 days, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance.
- B. Systems shall not be used for temporary operation during construction without written approval from the Architect/Engineer. If approved and used during construction, all systems must be properly maintained and operated according to manufacturer recommendations. Immediately prior to turnover to the Owner, the contractor shall perform all necessary preventative maintenance according to all manufacturer recommendations, including, but not limited to, filter replacement, strainer cleaning, belt adjustment, etc.
- C. Any system placed in temporary operation for testing during construction shall be properly maintained and operated by the Contractor.
- D. All systems shall be protected against freezing, flooding, corrosion or other forms of damage prior to acceptance by the Owner.
- E. Material or equipment damaged, shown to be defective or not in accordance with the Specifications shall be repaired or replaced to the satisfaction of the Owner's representative.
- F. All tests shall be made after notification to and in the presence of the Owner's representative.
- G. Before starting up any system, each piece of equipment comprising any part of the system shall be checked for proper lubrication and any other condition which may cause damage to the equipment or endanger personnel.

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- H. After systems have been demonstrated to be satisfactory for 7 consecutive days and ready for permanent operation, all permanent pipe line strainers shall be cleaned, valve and packings properly adjusted, lubrication checked and replenished if required. Temporary piping, etc. shall be removed and openings restored in a permanent manner acceptable to the Owner's representative.
- I. At the time of substantial project completion, turn over the prime responsibility for operation of the plumbing equipment and systems to the Owner's operating personnel. Until the time of final acceptance, provide full time operating personnel, who are completely familiar with the work, to consult with and continue training the Owner's personnel.
 - 1. If any systems are operated prior to substantial completion, the contractor shall perform all necessary preventative maintenance according to all manufacturer recommendations.

2. PRODUCTS

2.1 MATERIALS

- A. Unless otherwise specified, all materials and equipment shall be new, unused, and undamaged. Materials and equipment shall be the current designs and models of manufacturers regularly engaged in their production.

2.2 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

- A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details and requirements and make all necessary accommodations.

2.3 QUANTITY OF SPECIFIED ITEMS REQUIRED

- A. Wherever in the Contract Documents an item, device, or piece of equipment is referred to in the singular number, such reference shall apply to as many such articles as are shown on the drawings or required to complete the installation.

3. EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety.

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3.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Store and handle material and equipment in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. Use proper lifting equipment where size/weight requires handling by such means.
- D. Comply with manufacturer's rigging and moving instructions for unloading material and equipment, and moving them to final location.
- E. Equipment requiring disassembly for access purposes shall be disassembled and reassembled as required for movement into the final location following manufacturer's written instructions.
- F. Deliver material and equipment as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.
- G. Plumbing Contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.
- H. All piping is to be protected while stored for installation. Pipe ends are to be provided with pipe plugs, plastic wrap taped ends or pipe ends crimped closed. No exceptions. Piping found open will be tagged and prior to being installed by the contractor shall be cleaned, inspected by the owner representative and cleaning approved by the owner. Any pipe that has been installed without being approved by the owner shall be removed for visual inspection by the owner representative.
- I. Any material that is damaged during delivery, storage, handling, or installation shall be brought to the attention of the Architect/Engineer for review of its acceptability in the project.
 - 1. The Architect/Engineer shall be the sole and final judge as to the suitability of damaged items.

3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in other divisions for rough-in requirements.

3.4 COORDINATION

- A. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

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- B. Coordinate the work with the work of the different trades so that:
1. Interferences between mechanical, plumbing, fire protection, electrical, architectural, and structural work, including existing services, will be avoided.
 2. Within the limits indicated on the drawings, the maximum practicable space for operation, maintenance repair, removal and testing of plumbing and other equipment will be provided.
 3. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Equipment requiring access, including terminal units, fire/smoke dampers, and piping valves.
 - d. Ductwork.
 - e. Electrical busduct.
 - f. Electrical cable trays, including access space.
 - g. Piping (hydronic and plumbing).
 - h. Sprinkler/standpipe piping.
 - i. Electrical conduits and wireway.
 4. Pipes, ducts, and similar items, shall be kept as close as possible to ceiling, walls, and columns, to take up a minimum amount of space. Pipes, ducts, and similar items shall be located so that they will not interfere with the intended use of other equipment.
- C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.
- D. Furnish and install, without additional expense to the Owner, all offsets, fittings and similar items necessary in order to accomplish the requirements of coordination.

3.5 PLUMBING INSTALLATIONS

- A. All dimensions and clearances affecting the installation of work shall be verified in the field in relation to established datum, to building openings and to the work of other trades.
- B. The location of all equipment and systems shall be coordinated to preclude interferences with other construction.
- C. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the Architect/Engineer and the Owner's representative shall be notified and any changes approved before proceeding with the work.
- D. Arrange for chases, slots, and openings in other building components during progress of construction to allow for plumbing installations.
- E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum possible headroom.

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- F. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- G. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect/Engineer.
- H. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- I. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

3.6 ACCESSIBILITY

- A. All work shall be installed so as to be accessible for operation, maintenance and repair with particular attention given to locating valves, controls and equipment requiring periodic lubrication, cleaning, adjusting or servicing of any kind.

3.7 LUBRICATION AND TOOLS

- A. Provide a fresh charge of lubricant in accordance with manufacturer's recommendations to all equipment requiring lubrication prior to start-up and maintain lubrication as required until acceptance by Owner.
- B. Provide for each piece of equipment any special tools and a list of such tools required for the operation or adjustment of the equipment and turn over to the Owner's representative prior to final acceptance of the equipment.

3.8 START-UP

3.9 GENERAL CONTRACTOR - PLUMBING EXTENT OF WORK

- A. Access Panels
 - 1. Furnish and install panels for access to valves and similar items where no other means of access, such as readily removable, sectional ceiling is shown or specified.

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2. The Contractor shall make every effort to locate all material and equipment requiring service and maintenance above accessible ceilings or utilize the indicated access panels. Material and equipment requiring service and maintenance that is shown above inaccessible ceilings shall be relocated to accessible or exposed areas whenever possible. When these items are located in exposed areas, the Contractor is to verify with the Architect/Engineer that the installation will not affect the aesthetics of the building. However, when it is not possible to locate these items in accessible or exposed areas due to the configuration of the actual installation of the plumbing and other trade systems or aesthetic reasons, additional access panels shall be provided.

B. Cutting and Patching

1. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:
2. Contractor shall coordinate all cutting and patching of holes, in existing building and new construction which are required for the passage of plumbing work.
3. Contractor shall verify, prior to submitting his bid, the number, size and location of all cutting and patching requirements.
4. Under no circumstances shall any structural members, load-bearing walls or footings be cut without first obtaining written permission from the Architect/Engineer.
5. Cut, channel, chase and core drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of the trades involved.
6. Patching of concrete openings shall be filled with grout and finished smooth with the adjacent surface.
7. All below-grade openings for pipe shall be sealed with interlocking synthetic rubber line assembly, Link-Seal by Thunderline Corporation or equal.
8. All penetrations through the walls, floor, or structure of chases in which relative pressurization relationships are important shall be sealed airtight. Maintain a 2 hr. fire rating at all chase penetrations and 1 hour fire rating between floors.
9. Repair cut surfaces to match adjacent surfaces.
10. Perform cutting, fitting, and patching of plumbing equipment and materials required to:
 - a. Uncover work to provide for installation of ill-timed work.
 - b. Remove and replace defective work.
 - c. Remove and replace work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed Work as specified for testing.
 - e. Install equipment and materials in existing structures.
 - f. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

C. Roof curbs, roof support for plumbing equipment and roof penetrations.

1. Verify, prior to submitting bid, the number, size, and location of all roof curb and roof supports and the location of all roof penetrations. Provide all roof deck-mounted equipment, pipe supports, and pipe penetrations. Cut roof deck for pipe and duct penetrations, unless noted otherwise. Provide all roof covering/membrane mounted equipment and pipe supports and roof drains, unless noted otherwise.

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2. Contractor shall be liable for all associated costs to install the roof curbs, roof supports and roof penetrations not shown on the roof plan or added after the roof system has been installed. Coordinate with the General Contractor prior to construction the number size and location of all roof penetrations.
3. All roof curbs, supports, and rails shall be sized to keep equipment a minimum of 18" above the roof insulation membrane in order to limit snow accumulation at or near equipment.

D. Painting

1. Field paint plumbing equipment and materials in specified areas as noted on the plumbing plans, plumbing schedules and in the specifications. Where items are to be painted, provide materials in these areas that are suitable for accepting paint. Clean and prepare the materials as necessary prior to painting, including removal of sharp edges. At minimum, items in these areas shall be painted:
 - a. Exposed items in areas other than mechanical rooms. Paint color shall match the adjacent surfaces (i.e. walls, ceilings, etc.) and shall follow the patterns of any adjacent accent colors.
 - 1) Items insulated with aluminum or stainless steel jackets are not required to be painted.
 - b. Concealed field-fabricated bare iron or steel items required for installation of work under this Division. Remove rough or sharp edges prior to painting.
 - c. Exposed field-fabricated bare iron or steel items required for installation of work under this Division. Remove rough or sharp edges prior to painting.
 - d. Exterior items which are not factory-painted. Paint color shall be selected by Architect.

END OF SECTION 220500

PIPE PRESSURE TEST LOG

PROJECT:

BUILDING:

GENERAL CONTRACTOR:

CLARK ENERSEN PROJECT NUMBER: 155-056-10

MECHANICAL CONTRACTOR:

TEST INFORMATION						TEST PRESSURE					
TEST DATE	PIPI NG SYS TEM	AREA TESTED	TEST MEDIA (WATER OR AIR)	TEST DURATION (MINUTES)	PRESSURE GAGE NUMBER	INITIAL (PSIG)	FINAL (PSIG)	TESTED BY	WITNESSED BY	PASS / FAIL (P/F)	COMMENTS

ADDITIONAL

COMMENTS:

PRESSURE GAGE INFORMATION

GAGE NUMBER	MANUFACTURER	PRESSURE RANGE	RESOLUTION	STYLE	DIAL SIZE	GAGE NUMBER	MANUFACTURER	PRESSURE RANGE	RESOLUTION	STYLE	DIAL SIZE

NOTE: USE MULTIPLE FORMS IF NECESSARY

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SECTION 221000 – PLUMBING PIPING

1. GENERAL

1.1 SECTION INCLUDES

- A. Pipe and pipe fittings.
- B. Valves.
- C. Sanitary waste and vent piping system.
- D. Natural gas piping system.

1.2 RELATED SECTIONS

- A. Section 220500 - Basic Plumbing Requirements.
- B. Section 220529 – Hangers and Supports for Plumbing Piping and Equipment.
- C. Section 220553 – Identification for Piping.
- D. Section 220719 – Plumbing Piping Insulation.
- E. Section 221119 – Plumbing Specialties.
- F. Section 224000 – Plumbing Fixtures.
- G. Section 223000 – Plumbing Equipment.

1.3 REFERENCES

- A. See Section 220500.

1.4 SUBMITTALS

- A. See Section 220500.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of valves.

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1.6 OPERATION AND MAINTENANCE DATA

- A. Reference Section 220500.

1.7 QUALITY ASSURANCE

- A. See Section 220500.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.8 DELIVERY, STORAGE AND HANDLING

- A. See Section 220500.

1.9 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with International Plumbing Code.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.11 EXTRA MATERIALS

- A. Provide two repacking kits for each size valve.

2. PRODUCTS

2.1 SANITARY WASTE AND VENT PIPING, BURIED

- A. Cast Iron Pipe: ASTM A74, hub-and-spigot, service weight.
 - 1. Fittings: Cast iron, ASTM A74, service weight.
 - 2. Joints: ASTM C564 neoprene gasket system.

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2.2 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
 - 2. Joints: NFPA 54, threaded or welded to ANSI B31.1, ANSI B31.2, ANSI B31.9, ASME Sec 1.
- B. Copper Tubing: ASTM B88 Type K drawn temper.
 - 1. Fittings: ANSI B No. 22 wrought copper fittings streamlined pattern.

2.3 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under:
 - 1. Ferrous pipe: 150 psig malleable iron threaded unions.
 - 2. Copper tube and pipe: 150 psig bronze unions with soldered joints.
- B. Pipe Size Over 2 Inches:
 - 1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.
 - 2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.
- C. Grooved and Shouldered Pipe End Couplings:
 - 1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - 2. Sealing gasket: "C" shape composition sealing gasket.
- D. Dielectric Connections: Where connecting ferrous and non-ferrous piping materials, use "ClearFlow" nipples to separate piping materials.

2.4 SWING CHECK VALVES

- A. Up to and including 2 Inches: Bronze swing disc, 125 psig working pressure.
- B. Over 2 Inches: Cast iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.

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2.5 BALL VALVES

- A. Up to and including 3 inches: Bronze two piece body, chrome plated steel full-port ball, teflon seats and stuffing box ring, lever handle.

2.6 GATE VALVES

- A. Over 3 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, single wedge, flanged ends. Class 125, MSS SP-70.
- B. Chainwheel: On valves 4" and larger and installed higher than 8-feet above finished floor, provide sprocket rim, brackets, and chain compatible with valve.

2.7 STRAINERS

- A. Size 2 inch and Under: Screwed bronze body for 250 psig working pressure, Y pattern with 20-mesh stainless steel perforated screen.
- B. Size 2-1/2 inch and larger: Flanged cast iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.8 GAS VALVES

- A. Gas Cocks 2 Inch and Smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends.
- B. Gas Cocks 2-1/2 Inch and Larger: MSS SP-78; 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.
- C. Solenoid Valves: Aluminum body, 120 volts AC, 60 Hz, Class B continuous duty molded coils; NEMA 4 coil enclosure; electrically opened/electrically closed; dual coils; normally closed; UL and FM approved and labeled.
- D. Gas Line Pressure Regulators: Single stage, steel or aluminum jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; with threaded end for 2 inch and smaller, flanged ends for 2-1/2" and larger; for inlet and outlet gas pressures, specific gravity, and volume flow incicated.

2.9 CALIBRATED BALANCE VALVES

- A. Pre-Set Balance Feature. Valves to be designed to allow Installing Contractor to pre-set balance points for proportional system balance prior to system start-up in accordance with scheduled flow rates.

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- B. Valve Design and Construction. All valves shall have a calibrated orifice or venturi section, two 1/4" threaded pressure tap ports with integral seals, and memory stop to retain the set position. Valves should be rated for 125 psig working pressure and 250 Deg. F maximum operating temperature.
- C. Valves shall be selected based on flow rate, not on pipe size dimensions.
- D. Preformed Insulation. All vales to be provided with molded insulation to permit access for balance and read-out.

2.10 DRAIN VALVES

- A. Equipped with hose adaptor fitting.

3. EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

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- G. Vent pipes shall extend minimum 12" above finish roof line.
- H. Install force-main piping according to AWWA C600. Install thrust-block supports at vertical and horizontal offsets.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access where valves and fittings are not exposed.
- K. Establish elevations of buried piping outside the building to ensure not less than 5 ft of cover.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- M. Provide support for utility meters in accordance with requirements of utility companies.
- N. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Division 09 sections.
- O. Excavate in accordance other sections for work of this Section.
- P. Backfill in accordance with other sections for work of this Section.
- Q. Install bell and spigot pipe with bell end upstream.
- R. Install valves with stems upright or horizontal, not inverted.
- S. Install chainwheel operators on valves 4" and larger that are installed 8-feet above finished floor or greater. Extend chain down to maximum 5-feet above finished floor.
- T. Install strainers in horizontal pipe or in vertical pipe such that flow is downward. Do not install strainers in vertical pipe with flow upward.
- U. Install ball valve at all water main branch take-offs to restroom groups or individual remote plumbing fixtures with ceiling access panel in GWB ceilings if necessary for access to shut-off valves.
- V. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
 - 2. Install restrained joint system in accordance with manufacturer recommendations.

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3.4 APPLICATION

- A. Use grooved mechanical couplings/joints and fasteners only in accessible locations.
- B. Use mechanical couplings/joints on laboratory waste and vent system in accessible locations under laboratory benches only.
- C. Install unions downstream of valves and at equipment or apparatus connections.
- D. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- E. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- F. Install ball valves for throttling, bypass, or manual flow control services.
- G. Provide spring loaded check valves on discharge of water pumps.
- H. Provide plug valves in natural gas systems for shut-off service.
- I. Provide flow control valves in water recirculating systems where indicated.

3.5 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.
- B. Slope water piping and arrange to drain at low points.

3.6 PLUMBING PIPING PRESSURE TESTING

- A. Submit copy of Pipe Pressure Test Log provided in section 220500 for each section of piping tested. Refer to International Plumbing Code for general pipe pressure testing requirements (i.e., test pressure gauges, inspections, etc.).
- B. Leave uncovered and unconcealed all new, altered, extended, or replaced piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.

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- C. Test for leaks and defects all new plumbing piping systems and parts of existing systems, which have been altered, extended or repaired. Test in accordance with the local authority having jurisdiction. In the absence of a locally published and enforced test procedure, testing shall be accomplished as follows:
 - 1. Waste, Vent and Storm Piping Systems.
 - a. Test in accordance with Lincoln Plumbing Code with minimum of 10' of head.
 - b. Test all drain lines after traps are installed and filled using either smoke test or odor test.
- D. Repair all leaks and defects using new materials and retest all plumbing systems until satisfactory results are obtained.
- E. Natural Gas Piping System.
 - a. Test in accordance with NFPA 54 and local utility requirements.

3.7 SERVICE CONNECTIONS

- A. Provide new sanitary and water services as shown on the plans. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

END OF SECTION 221000

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SECTION 224000 - PLUMBING FIXTURES

1. GENERAL

1.1 SECTION INCLUDES

- A. Installation requirements of plumbing fixtures scheduled in Floor Sink Schedule.

1.2 REFERENCE SECTION 220500 FOR THE FOLLOWING GUIDELINES

- A. References
- B. Submittals
- C. Quality Assurance
- D. Delivery, Storage and Handling

1.3 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings and instructed by the manufacturer.
- B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

2. PRODUCTS

2.1 PLUMBING FIXTURES

- A. Refer to Plumbing Fixture Schedule for all required product information.

3. EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.

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3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install each fixture with trap with 2 slip joints, easily removable for servicing and cleaning.
- C. Provide chrome plated rigid or flexible supplies to fixtures with stops, reducers, and escutcheons.
- D. Install components level and plumb.
- E. Install and secure fixtures in place with scheduled wall supports or wall carriers and bolts.
- F. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.

3.4 CLEANING

- A. Directly prior to project turnover, clean plumbing fixtures and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed fittings.
- C. Do not allow use of plumbing fixtures for use during construction unless approved in writing by Owner.

END OF SECTION 224000

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SECTION 230500 – BASIC HVAC REQUIREMENTS

1. GENERAL

1.1 SECTION INCLUDES

- A. This section describes Basic Mechanical Requirements required to provide for a complete installation of all mechanical systems for this project. This section shall apply to all other Division 23 specification sections as well as all work shown on the drawings.
- B. It is the intent of the Mechanical Division of the Specifications that all mechanical work specified herein be coordinated as required with the work of all other Divisions of the Specifications and Drawings so that all installations operate as designed.
- C. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation to the satisfaction of the Owner's representative.
- D. The Contractor shall note that, in some cases, ductwork and piping as shown on the Drawings provide general location and routing information only. The Contractor shall be responsible for providing interference-free systems with proper clearance to facilities and equipment.
- E. Where the word "provide" is used, it shall mean "furnish and install" unless otherwise noted or specified.
- F. Note that the words "mechanical" and "plumbing" are used interchangeably throughout the Division 22 and 23 specification sections.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section and all other sections of Division 23.

1.3 DESCRIPTION OF WORK

- A. The work included under this section consists of providing all labor, materials, supervision, and construction procedures necessary for the installation of the complete mechanical systems required by these specifications and/or shown on the drawings of the contract.
- B. The Contract Drawings are shown in part diagrammatic intended to convey the scope of work, indicating the intended general arrangement of equipment, piping, ductwork, etc.

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1.4 QUESTIONS OF INTERPRETATION

- A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect/Engineer for clarification. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.
- B. The Architect/Engineer shall be the sole judge regarding interpretations of conflicts within contract documents.

1.5 CONTRACT DOCUMENT DISCREPANCIES

- A. If any ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of bid.
- B. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of three-dimensional objects. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies should be identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
- C. The Contractor shall follow the drawings in laying out work and verify clearances for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of materials or equipment, obtain instructions from the Architect/Engineer before proceeding with the work.
- D. If there is a conflict between manufacturer's recommendations and the Contract Documents, the manufacturer's recommendations shall govern with no additional cost to the Owner.

1.6 PERMITS

- A. The Contractors shall familiarize themselves with all requirements regarding all permits, fees, etc., and shall comply with them. All permits, licenses, inspections and arrangements required for the work shall be obtained by the Contractor at his expense.

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- B. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor.

1.7 QUALITY ASSURANCE

- A. Installers shall have at least 2 years of successful installation experience on projects with mechanical installation work similar to that required by the project. All equipment and materials shall be installed in a neat and workmanlike manner and shall be aligned, leveled, and adjusted for satisfactory operation, unless noted otherwise in other mechanical sections.
- B. Manufacturers of equipment and materials must be regularly engaged in the manufacture of the specified equipment and material with similar construction and capacities and whose products have been in satisfactory use in similar service for not less than five (5) years, unless noted otherwise in other sections.
- C. Qualify welding processes and operators for structural steel according to AWS D1.1. "Structural Welding Code - Steel.
- D. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- E. Comply with provisions of ASME B31 Series "Code for Pressure Piping", including all addenda.
- F. Contractor signed welder certificate(s) shall be submitted. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current. A record shall be maintained on the job site showing the date and results of qualification tests for each welder employed on the job. One certified copy of the qualification test for each welder so employed shall be furnished to the Owner's representative.
- G. For all the refrigerant work/service required by this project, all refrigerant technicians shall be EPA/ASHRAE 34 certified for corresponding classification type I, II, III and/or IV.

1.8 CODES AND REFERENCES

- A. The design, manufacture, testing, and method of installation of all equipment and materials furnished under the requirements of this specification shall, at minimum, conform to the following as applicable:
 - 1. Safety and Health Regulations for Construction.
 - 2. Occupational Safety and Health Standards, National Consensus Standards and Established Federal Standards.
 - 3. National Electrical Code (NEC), see Division 26 sections for applicable edition.
 - 4. National Fire Protection Association (NFPA) Codes and Standards.
 - 5. Life Safety Code (NFPA 101)
 - 6. Factory Mutual Engineering Corporation: FM Global.

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7. American Gas Association (AGA)
8. Underwriters' Laboratories, Inc. (UL)
9. National Electrical Safety Code (NEESC)
10. Applicable National, State, and Local Codes
11. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
12. ANSI/ASME B31.1.
13. ANSI/ASME B31.9.
14. ANSI/AIHA Z9.5.
15. International Building Code (IBC).
16. International Mechanical Code (IMC).
17. International Plumbing Code (IPC).
18. International Energy Conservation Code (IECC).
19. International Fuel Gas Code (IFGC).
20. Other governing, state, and local codes that apply.

- B. Where there is a conflict between the code and the contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified shall not be substituted. In the event of a question, obtain instructions from the Architect/Engineer before proceeding with the work.

1.9 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Sections "General Conditions" and "Special Conditions".
- B. The Architect/Engineer's review of submittals, including any corrections or comments made on the shop drawings during the review process, do not relieve Contractor from compliance with requirements of the Contract Documents. The review is only a review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication process and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. The Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect/Engineer's review of those drawings.
- C. No portion of the work requiring submission of a shop drawing, product data or sample shall be commenced until the submittal has been reviewed by the Architect/Engineer. All such portions of the work shall be in accordance with reviewed submittals and the associated manufacturer recommendations.
- D. Shop drawings shall include the minimum following information as applies. Additional specific information required is outlined in other Mechanical Sections.
1. All equipment items shall be marked with the same item number as used on drawings or schedules.

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2. Certified performance and data with system operating conditions indicated. All coil, fan, energy recovery, terminal unit, sound attenuation, and pump performance data shall be computer generated.
3. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicating size, weights (shipping, installed, and operating), furnished specialties and accessories; and installation and start-up instructions.
4. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loading, required clearances, and methods of assembly of components.
5. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to electrical equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of electrical equipment and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
6. Maintenance Data: Submit maintenance data and parts list for each mechanical equipment, control and accessory; including "troubleshooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

E. Provide separate shop drawing submittals for the following items:

1. Section 230500:

Submittal Requirement:	Date Submitted:
Mechanical and plumbing permits	
Welding certificates	
Warranties	
As-built documents	
Pipe pressure test logs	
Operation and maintenance manuals	
Close-out / walk-through documentation	
Training seminar documentation	

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2. Section 230519:

Submittal Requirement:	Date Submitted:
Calibrated balance valves	
Pressure gauges	
Thermometers	
Pressure/temperature test plugs	
Duct static pressure gauges	

3. Section 230529:

Submittal Requirement:	Date Submitted:
Pipe supports, anchors, sleeves, and hangers	
Equipment curbs, supports, and hangers	
Mechanical seals	
Roof curbs and supports	
Fire sealants	

4. Section 230553:

Submittal Requirement:	Date Submitted:
Mechanical and plumbing identification materials	
Valve schedule	

5. Section 230593

Submittal Requirement:	Date Submitted:
Pre-balancing conference meeting documentation	
Pre-balancing field deficiency report(s)	

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6. Section 230713:

Submittal Requirement:	Date Submitted:
Ductwork insulation materials and insulation schedule	

7. Section 230716:

Submittal Requirement:	Date Submitted:
Equipment insulation materials and insulation schedule	

8. Section 230719:

Submittal Requirement:	Date Submitted:
Pipe insulation materials and insulation schedule	

9. Sections 230900

Submittal Requirement:	Date Submitted:
Control drawings	
Control materials and equipment	
Sequences of operation	
Points list	

10. Sections 230901

Submittal Requirement:	Date Submitted:
Control valves	
Valve and damper operators	
Sensors / transmitters	
Control wiring	

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11. Section 232113:

Submittal Requirement:	Date Submitted:
HVAC piping material and fitting schedule	
HVAC valves	
HVAC pipe accessories	
HVAC hydrostatic test report(s)	

12. Section 232116:

Submittal Requirement:	Date Submitted:
HVAC specialty equipment and materials	
Strainers	
Air vents	
Relief valves	

13. Section 232123:

Submittal Requirement:	Date Submitted:
HVAC pumps	

14. Section 232500:

Submittal Requirement:	Date Submitted:
Chemical treatment materials	
Chemical material safety data sheet (MSDS) information	
Monthly field inspection reports	

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1.10 SUBSTITUTIONS

- A. All proposals shall be based on providing and installing the materials or items of equipment as shown on the Contract Documents. The Contractor's options in selecting materials and equipment are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects.
- B. Where the terms "or equivalent" is used, the Contractor may substitute alternate equipment, materials, etc. subject to review by the Architect/Engineer and the Owner's representative during the submittal phase of the project.
- C. Where the term "or approved equivalent" is used, the Contractor may not substitute alternate equipment, materials, etc. unless obtaining written approval from the Architect/Engineer at least ten (10) days before the bid date. Notifications of any such approvals by the Architect/Engineer shall only be made in writing by Addendum.
- D. Where the term "no equivalent" is used, the Contractor must provide the specified or scheduled equipment, materials, etc.
- E. Proposed substitutions will be judged on the basis of quality, capacity, performance, features, physical size, and appearance. The reputation of the manufacturer, delivery time requirements, and the availability of repair or replacement parts may also be considered.
- F. The Architect/Engineer shall be the sole and final judge as to the suitability of substitution items.
- G. If a substitution is approved, the Contractor shall bear the total cost of all changes due to substitution. These costs may include additional compensation to the Architect/Engineer for redesign and evaluation services, increased cost of work by the Owner or other Contractors, and similar considerations.
 - 1. If an approved substitution differs from the specified item in terms of power requirements, dimensions, capacities, and ratings, the associated mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are to be increased accordingly, but all recommended manufacturer clearances, etc., are to be maintained within the allotted mechanical spaces. No additional costs will be approved for these modifications. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.11 WARRANTY

- A. Refer to the General Conditions section of this Specification for general warranty requirements and information. Additional warranty requirements are specified in subsequent Mechanical Sections.

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1.12 CLOSE OUT AND OPERATION INSTRUCTIONS

- A. Operate each system and item of equipment in a test run of appropriate duration, but no less than 7 days, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance.
- B. Systems shall not be used for temporary operation during construction without written approval from the Architect/Engineer. If approved and used during construction, all systems must be properly maintained and operated according to manufacturer recommendations. Immediately prior to turnover to the Owner, the contractor shall perform all necessary preventative maintenance according to all manufacturer recommendations, including, but not limited to, filter replacement, strainer cleaning, belt adjustment, etc.
- C. Any system placed in temporary operation for testing during construction shall be properly maintained and operated by the Contractor.
- D. All systems shall be protected against freezing, flooding, corrosion or other forms of damage prior to acceptance by the Owner.
- E. Material or equipment damaged, shown to be defective or not in accordance with the Specifications shall be repaired or replaced to the satisfaction of the Owner's representative.
- F. All tests shall be made after notification to and in the presence of the Owner's representative.
- G. Before starting up any system, each piece of equipment comprising any part of the system shall be checked for proper lubrication and any other condition which may cause damage to the equipment or endanger personnel.
- H. After systems have been demonstrated to be satisfactory for 7 consecutive days and ready for permanent operation, all permanent pipe line strainers shall be cleaned, valve and packings properly adjusted, lubrication checked and replenished if required. Temporary piping, etc. shall be removed and openings restored in a permanent manner acceptable to the Owner's representative.
- I. Conduct a walk-through instruction seminar for the Owner's personnel pertaining to the continued operation and maintenance of mechanical equipment and systems. Explain the identification system, maintenance requirements, operational diagrams, temperature control provisions, sequencing requirements, security, safety, efficiency and similar features of the systems. Walk-through must be documented as to those attending and subjects covered. Walk-through document(s) shall be signed and dated by the contractor's representative and the owner's representative.
 1. Provide instruction, operation and maintenance seminar, minimum 2 hours training for the following items:
 - a. Boiler and Boiler Pump

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- b. Boiler Controls
 - c. BMS Temperature Control Systems
2. Training sessions shall be recorded by video camera by the contractor and the recording shall be turned over to the owner in DVD format.
- J. At the time of substantial project completion, turn over the prime responsibility for operation of the mechanical equipment and systems to the Owner's operating personnel. Until the time of final acceptance, provide full time operating personnel, who are completely familiar with the work, to consult with and continue training the Owner's personnel.
- 1. If any systems are operated prior to substantial completion, the contractor shall perform all necessary preventative maintenance according to all manufacturer recommendations.

1.13 AS-BUILT DOCUMENTS

- A. Prepare as-built documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in above, indicate the following installed conditions:
- 1. The Mechanical Contractor shall provide the Owner with as-built drawings for ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units and indicate all devices requiring periodic maintenance or repair, such as control power transformers, EMCS panels/routers, field controllers, duct static pressure sensors, piping pressure sensors, etc.
 - 2. All mechanical systems as described in the Specifications and/or shown on the drawings.
 - 3. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section "Mechanical Identification." Indicate actual inverts and horizontal locations of underground piping.
 - 4. Equipment/material locations (exposed and concealed), dimensioned from prominent building lines and from finished floor elevation.

1.14 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, include the following information for equipment items:
- 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

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2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.
 5. All shop drawings including associated shop drawing review forms consolidated in a tabbed 3 ring binder
- B. In addition to the printed copies of the maintenance manuals, provide an electronic copy of the maintenance manual in .pdf format to the Owner.

2. PRODUCTS

2.1 MATERIALS

- A. Unless otherwise specified, all materials and equipment shall be new, unused, and undamaged. Materials and equipment shall be the current designs and models of manufacturers regularly engaged in their production.

2.2 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

- A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details and requirements and make all necessary accommodations.

2.3 QUANTITY OF SPECIFIED ITEMS REQUIRED

- A. Wherever in the Contract Documents an item, device, or piece of equipment is referred to in the singular number, such reference shall apply to as many such articles as are shown on the drawings or required to complete the installation.

3. EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety.

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3.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Store and handle material and equipment in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. Use proper lifting equipment where size/weight requires handling by such means.
- D. Comply with manufacturer's rigging and moving instructions for unloading material and equipment, and moving them to final location.
- E. Equipment requiring disassembly for access purposes shall be disassembled and reassembled as required for movement into the final location following manufacturer's written instructions.
- F. Deliver material and equipment as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.
- G. Mechanical Contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.
- H. All piping is to be protected while stored for installation. Pipe ends are to be provided with pipe plugs, plastic wrap taped ends or pipe ends crimped closed. No exceptions. Piping found open will be tagged and prior to being installed by the contractor shall be cleaned, inspected by the owner representative and cleaning approved by the owner. Any pipe that has been installed without being approved by the owner shall be removed for visual inspection by the owner representative.
- I. Any material that is damaged during delivery, storage, handling, or installation shall be brought to the attention of the Architect/Engineer for review of its acceptability in the project.
 - 1. The Architect/Engineer shall be the sole and final judge as to the suitability of damaged items.

3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in other divisions for rough-in requirements.

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3.4 COORDINATION

- A. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- B. Coordinate the work with the work of the different trades so that:
 - 1. Interferences between mechanical, plumbing, fire protection, electrical, architectural, and structural work, including existing services, will be avoided.
 - 2. Within the limits indicated on the drawings, the maximum practicable space for operation, maintenance repair, removal and testing of mechanical and other equipment will be provided.
 - 3. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Equipment requiring access, including terminal units, fire/smoke dampers, and piping valves.
 - d. Ductwork.
 - e. Electrical busduct.
 - f. Electrical cable trays, including access space.
 - g. Piping (hydronic and plumbing).
 - h. Sprinkler/standpipe piping.
 - i. Electrical conduits and wireway.
 - 4. Pipes, ducts, and similar items, shall be kept as close as possible to ceiling, walls, and columns, to take up a minimum amount of space. Pipes, ducts, and similar items shall be located so that they will not interfere with the intended use of other equipment.
- C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.
- D. Furnish and install, without additional expense to the Owner, all offsets, fittings and similar items necessary in order to accomplish the requirements of coordination.

3.5 MECHANICAL INSTALLATIONS

- A. All dimensions and clearances affecting the installation of work shall be verified in the field in relation to established datum, to building openings and to the work of other trades.
- B. The location of all equipment and systems shall be coordinated to preclude interferences with other construction.

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- C. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the Architect/Engineer and the Owner's representative shall be notified and any changes approved before proceeding with the work.
- D. Arrange for chases, slots, and openings in other building components during progress of construction to allow for mechanical installations.
- E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum possible headroom.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- G. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect/Engineer.
- H. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- I. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

3.6 ACCESSIBILITY

- A. All work shall be installed so as to be accessible for operation, maintenance and repair with particular attention given to locating valves, controls and equipment requiring periodic lubrication, cleaning, adjusting or servicing of any kind.

3.7 LUBRICATION AND TOOLS

- A. Provide a fresh charge of lubricant in accordance with manufacturer's recommendations to all equipment requiring lubrication prior to start-up and maintain lubrication as required until acceptance by Owner.
- B. Provide for each piece of equipment any special tools and a list of such tools required for the operation or adjustment of the equipment and turn over to the Owner's representative prior to final acceptance of the equipment.

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3.8 START-UP

A. PIPING SYSTEMS PRESSURE TESTING

1. The following personnel in the order listed shall be considered acceptable witnesses of all piping pressure testing:
 - a. Local Authority Having Jurisdiction
 - b. Owner's Representative
 - c. Mechanical Engineer / Architect
 - d. Contractor's Foreman
2. Removal of pressure charge and associated drain down shall also be witnessed.
3. Contractor shall provide a minimum of 24-hour notice to at least one of the above listed parties before commencing any piping systems pressure test.
4. Pressure gauge requirements: Provide recently calibrated gauge with 4" face and a range such that test pressure is between 50% and 100% of gauge range. For example, a gauge with a 15 psig range is acceptable for a 10 psig pressure test, whereas a gauge with a 30 psig range is unacceptable in this application. Gauge resolution shall be suitable for type of testing, system size and test media. Gauge shall have been recently calibrated.
5. All piping pressurizing equipment shall be disconnected before test is commenced and shall remain disconnected for the entire duration of the test.
6. Entire system shall be properly vented before test is commenced and pressure is applied.
7. For specific piping pressure testing requirements and procedures, see applicable piping systems specification sections. At minimum, however, pipe systems should be tested at the following pressures and all installed components must be rated at this pressure at the actual operating temperature:

a. Chilled water	150 psig
b. Heating water	150 psig
c. Steam and condensate (incl. venting and blowdown)	150 psig
8. Submit a completed "Pipe Pressure Test Log" provided at the end of this Section for each pressure test before final project closeout. Test log shall also be included in operation and maintenance manuals. Use multiple forms if necessary.

3.9 GENERAL CONTRACTOR - MECHANICAL EXTENT OF WORK

A. Access Panels

1. Furnish and install panels for access to valves and dampers and similar items where no other means of access, such as readily removable, sectional ceiling is shown or specified.

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2. The Contractor shall make every effort to locate all material and equipment requiring service and maintenance above accessible ceilings or utilize the indicated access panels. Material and equipment requiring service and maintenance that is shown above inaccessible ceilings shall be relocated to accessible or exposed areas whenever possible. When these items are located in exposed areas, the Contractor is to verify with the Architect/Engineer that the installation will not affect the aesthetics of the building. However, when it is not possible to locate these items in accessible or exposed areas due to the configuration of the actual installation of the mechanical and other trade systems or aesthetic reasons, additional access panels shall be provided.

B. Cutting and Patching

1. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:
2. Contractor shall coordinate all cutting and patching of holes, in existing building and new construction which are required for the passage of mechanical work.
3. Contractor shall verify, prior to submitting his bid, the number, size and location of all cutting and patching requirements.
4. Under no circumstances shall any structural members, load-bearing walls or footings be cut without first obtaining written permission from the Architect/Engineer.
5. Cut, channel, chase and core drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
6. Patching of concrete openings shall be filled with grout and finished smooth with the adjacent surface.
7. All below-grade openings for pipe shall be sealed with interlocking synthetic rubber line assembly, Link-Seal by Thunderline Corporation or equal.
8. All penetrations through the walls, floor, or structure or other areas in which relative pressurization relationships are important shall be sealed airtight. Refer to the drawings for additional information regarding rooms in which maintaining pressurization is important.
9. Repair cut surfaces to match adjacent surfaces.
10. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - a. Uncover work to provide for installation of ill-timed work.
 - b. Remove and replace defective work.
 - c. Remove and replace work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed Work as specified for testing.
 - e. Install equipment and materials in existing structures.
 - f. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

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C. Concrete Bases

1. Minimum 4" high concrete housekeeping pads shall be provided under all floor-mounted mechanical equipment, regardless of whether explicitly shown on the Drawings. Concrete inertia pads with spring isolators shall be provided for all base-mounted pumps and air compressors installed on any floors which are not slab-on-grade. Inertia pads and isolators shall be sized by the equipment manufacturer if specific information is not provided in the Contract Documents.
2. Contractor shall verify, prior to submitting his bid, the number, size and location of all mechanical equipment bases.
3. Construct concrete equipment bases a minimum 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000 psi, 28-day compressive strength concrete, reinforcement and forms as specified in Division 3 Section "Cast-In-Place Concrete." Coordinate final equipment base size with General Contractor.
4. All equipment shall be mechanically fastened to concrete bases.

D. Roof curbs, roof support for mechanical equipment and roof penetrations.

1. Verify, prior to submitting bid, the number, size, and location of all roof curb and roof supports and the location of all roof penetrations. Provide all roof deck-mounted equipment, pipe supports, and pipe penetrations. Cut roof deck for pipe and duct penetrations, unless noted otherwise. Provide all roof covering/membrane mounted equipment and pipe supports and roof drains, unless noted otherwise.
2. Contractor shall be liable for all associated costs to install the roof curbs, roof supports and roof penetrations not shown on the roof plan or added after the roof system has been installed. Coordinate with the General Contractor prior to construction the number size and location of all roof penetrations.
3. All roof curbs, supports, and rails shall be sized to keep equipment a minimum of 18" above the roof insulation membrane in order to limit snow accumulation at or near equipment.

E. Painting

1. Field paint mechanical equipment and materials in specified areas as noted on the mechanical plans, mechanical schedules and in the specifications. Where items are to be painted, provide materials in these areas that are suitable for accepting paint. Clean and prepare the materials as necessary prior to painting, including removal of sharp edges. At minimum, items in these areas shall be painted:
 - a. Exposed items in areas other than mechanical rooms. Paint color shall match the adjacent surfaces (i.e. walls, ceilings, etc.) and shall follow the patterns of any adjacent accent colors.
 - 1) Items insulated with aluminum or stainless steel jackets are not required to be painted.

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- b. Concealed field-fabricated bare iron or steel items required for installation of work under this Division. Remove rough or sharp edges prior to painting.
- c. Exposed field-fabricated bare iron or steel items required for installation of work under this Division. Remove rough or sharp edges prior to painting.
- d. Exterior items which are not factory-painted. Paint color shall be selected by Architect.

2. Paint all items in accordance with Division 09 sections.

3.10 ELECTRICAL-MECHANICAL EXTENT OF WORK

- A. The responsibility of work specified under Division 23 and 26 is clarified under, Section 230513, "Electrical Requirements for Mechanical Equipment. Coordinate all electrical requirements prior to ordering powered mechanical equipment.

3.11 OWNER-FURNISHED ITEMS

- A. The responsibility for furnishing, installing, providing power, and providing control for several items are listed below. The Contractor shall verify and coordinate all requirements to ensure proper installation and operation of all items.

END OF SECTION 230500

PIPE PRESSURE TEST LOG

PROJECT:

BUILDING:

GENERAL CONTRACTOR:

CLARK ENERSEN PROJECT NUMBER: 155-056-10

MECHANICAL CONTRACTOR:

TEST INFORMATION						TEST PRESSURE					
TEST DATE	PIPI NG SYS TEM	AREA TESTED	TEST MEDIA (WATER OR AIR)	TEST DURATION (MINUTES)	PRESSURE GAGE NUMBER	INITIAL (PSIG)	FINAL (PSIG)	TESTED BY	WITNESSED BY	PASS / FAIL (P/F)	COMMENTS

ADDITIONAL

COMMENTS:

PRESSURE GAGE INFORMATION

GAGE NUMBER	MANUFACTURER	PRESSURE RANGE	RESOLUTION	STYLE	DIAL SIZE	GAGE NUMBER	MANUFACTURER	PRESSURE RANGE	RESOLUTION	STYLE	DIAL SIZE

NOTE: USE MULTIPLE FORMS IF NECESSARY

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SECTION 230519 – HVAC METERS AND GAUGES

1. GENERAL

1.1 SECTION INCLUDES

- A. Condensate meters.
- B. Pressure gauges and pressure gauge taps.
- C. Thermometers and thermometer wells.
- D. Piping pressure and temperature test plugs.
- E. Static pressure and filter gauges.

1.2 REFERENCES

- A. See Section 230500.

1.3 SUBMITTALS

- A. See Section 230500.

1.4 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of instrumentation.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

2. PRODUCTS

2.1 PRESSURE GAUGES

- A. Standard: ASME B40.100.
- B. Type: General use, Grade A accuracy, phosphor bronze bourdon-tube type, bottom connection, liquid-filled.
- C. Case: Drawn steel or brass, glass lens, 4-1/2-inches diameter.

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- D. Connector: Brass, 1/4-inch NPS.
- E. Scale: White coated aluminum, with permanently etched markings.
- F. Accuracy: Plus or minus 1 percent of range span.
- G. Range: Conform to the following:
 - 1. Vacuum: 30 inches Hg to 15 psi.
 - 2. All fluids: 2 times operating pressure.

2.2 PRESSURE GAUGE ACCESSORIES

- A. Syphon: 1/4-inch NPS straight coil constructed of brass tubing with threads on each end.
- B. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure. Provide extension for use on insulated systems.

2.3 THERMOMETERS, GENERAL

- A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.
- B. Scale range: Temperature ranges for services listed as follows:
 - 1. Heating Water: 30 to 300 deg with 2-degree scale divisions.
 - 2. Heat Recovery Water: 0 to 100 deg F with 2-degree scale divisions.
 - 3. Chilled Water: 0 to 100 deg F with 2-degree scale divisions.
 - 4. Condenser Water: 0 to 150 deg with 2-degree scale divisions.
 - 5. Steam and Condensate: 50 to 400 deg F with 2-degree scale divisions.
 - 6. Ductwork: -40 to 160 deg F with 2-degree scale divisions.

2.4 GLASS THERMOMETERS

- A. Standard: ASME B400.200.
- B. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.
- C. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Tube: Blue or red reading, magnifying lens, with non-mercury fluid.

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- E. Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.
- F. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.
 - 1. Provide ventilated shroud if used in air system.

2.5 THERMOMETER WELLS

- A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

2.6 PIPING PRESSURE AND TEMPERATURE TEST PLUGS

- A. Test Plugs shall be nickel-plated brass body, with 1/2-inch NPS fitting and 2 self-sealing valve-type core inserts, suitable for inserting a 1/8-inch O.D. probe assembly from a dial-type thermometer or pressure gage. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation. Pressure rating shall be 500 psig.
- B. Core Material: Conform to the following for fluid and temperature range:
 - 1. Air, Water, Oil, and Gas, 20 to 200 deg F: Self-sealing EPDM.

2.7 SIGHT FLOW INDICATORS

- A. Construction: Bronze or stainless-steel body, with sight glass and paddle wheel indicator, and threaded or flanged ends.
- B. Minimum Pressure Rating: 150 psig.
- C. Minimum Temperature Rating: 200 deg F.
- D. End Connections for NPS 2 and Smaller: Threaded.
- E. End Connections for NPS 2-1/2 and Larger: Flanged.

3. EXECUTION

3.1 GENERAL

- A. Install in accordance with manufacturer's instructions.

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3.2 THERMOMETERS

- A. Install thermometers in vertical and tilted positions to allow reading by observer standing on floor.
- B. Install as shown on plans and elsewhere as indicated.
- C. Thermometer Wells:
 - 1. Install in piping tee where thermometers are indicated, in vertical position. Provide extension on insulated systems.
 - 2. Fill well with oil or graphite and secure cap.
 - 3. Install in socket extending to center of pipe.

3.3 PRESSURE GAUGES

- A. Install pressure gauges in piping tee with pressure gauge valve, located on pipe at most readable position.
- B. Install as shown on plans, and elsewhere as indicated.
- C. Pressure Gauge Accessories:
 - 1. Install ball valve between system and pressure gauge.
 - 2. Install in piping tee with snubber.
 - 3. Install syphon in lieu of snubber for steam pressure gauges.

3.4 TEST PLUGS

- A. Test Plugs: Install where indicated, located on pipe at most readable position. Secure cap.

3.5 ADJUSTING AND CLEANING

- A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.
- B. Cleaning: Clean windows of meters and gauges and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint.

END OF SECTION 230519

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SECTION 230529 – HVAC HANGERS AND SUPPORTS

1. GENERAL

1.1 SECTION INCLUDES

- A. Pipe hangers, supports, and accessories.
- B. Equipment supports.
- C. Equipment roof curbs.
- D. Equipment roof supports.
- E. Sleeves and seals.
- F. Flashing and sealing equipment and pipe stacks.
- G. Sealants, firestop insulation, putty and compounds.
- H. Mechanical seals.

1.2 REFERENCES

- A. ANSI/ASME B31.1 – Power Piping.
- B. ANSI/AMSE B31.9 – Building Services Piping.
- C. MSS SP-58 – Pipe Hangers and Supports – Materials, Design, and Manufacture.
- D. MSS SP-69 – Pipe Hangers and Supports – Selection and Application.
- E. MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices.

1.3 REFERENCE SECTION 230500 FOR THE FOLLOWING GUIDELINES

- A. Submittals
- B. Delivery, storage and handling

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1.4 PRODUCTS

1.5 PIPE HANGERS AND SUPPORTS

A. Hydronic Piping:

1. Conform to International Mechanical Code, ASME B31.9, MSS SP58, MSS SP69 and MSS SP89, as applicable.

B. Steam and Steam Condensate Piping:

1. Conform to International Mechanical Code, ASME B31.1, MSS SP58, MSS SP69, MSS SP89, as applicable.

C. 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.

D. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

1.6 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.

1.7 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with intumed lips.

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4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

1.8 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

1.9 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1.10 PIPE STANDS

- A. General Requirements for Pipe Stands: 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.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

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D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
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:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
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-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

1.11 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

1.12 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength

1.13 EQUIPMENT ROOF CURBS

- A. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, variable step to match roof insulation, 1-1/2 inch thick insulation, factory installed wood nailer. Minimum 18 inch height above top of insulation (not the roof structure).

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1.14 EQUIPMENT ROOF SUPPORTS

- A. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, variable step to match roof insulation, 1-1/2 inch thick insulation, factory installed wood nailer. Minimum 18 inch height above top of insulation (not the roof structure).

1.15 SLEEVES

- A. Sleeves for Pipes Through Rated Floors and Walls: Schedule 40 steel pipe.
- B. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage galvanized steel.
- C. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel.

1.16 SEALANTS, FIRESTOP INSULATION, PUTTY, AND COMPOUNDS

- A. Firestopping Insulation: Glass fiber type, non-combustible, UL listed.
- B. Firestop Putty: Non-hardening, non shrinking, UL listed.
- C. Firestop Compounds: Cementitious material , non-shrinking, UL listed.
- D. Sealants:
 - 1. Non fire/smoke rated partitions: Acrylic or silicone based caulking.
 - 2. Fire/smoke rated partitions: Silicone based caulking, UL listed.

1.17 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Metal Counterflashing: 22 gage galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb/sq ft sheet lead
 - 2. Soundproofing: 1 lb/sq ft sheet lead.

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- D. Flexible Flashing: 47 mil thick sheet buty; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

1.18 MECHANICAL SEALS

- A. Mechanical Seals: Modular mechanical type, consisting of interlocking EPDM synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with type 316 stainless steel bolts and reinforced plastic polymer pressure plates which cause rubber sealing elements to expand when tightened, providing a watertight and gas-tight seal and electrical insulation. Provide Advance Products & Systems Model Innerlynx or equivalent.
 - 1. Provide high-temperature silicone links rated for 400 Deg. F for steam and condensate applications.
 - 2. A sleeve shall be provided for each mechanical seal.
 - a. Thermoplastic sleeves: Sleeve shall have smooth walls and shall be made of molded non-metallic high density polyethylene (HDPE) with an integral solid water stop, Advance Products & Systems Model PWS or equivalent.
 - b. Steel sleeves: Sleeve shall have smooth walls, shall be made of Schedule 40 steel with an integral welded solid water stop, and shall have corrosion-resistant coating, Advance Products & Systems Model GWS or equivalent.

2. EXECUTION

2.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

2.2 HANGER AND SUPPORT INSTALLATION

A. General

- 1. Reference applicable codes for maximum support spacing; see Section 230500. Additional supports shall be provided at other locations as specified in this Section.
- 2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- 3. Place hangers within 12 inches of each horizontal elbow.
- 4. Use hangers with 1-1/2 inch minimum vertical adjustment.
- 5. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- 6. Support grooved pipe adjacent to each joint and at other locations per manufacturer recommendations.
- 7. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

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8. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 9. Support riser piping independently of connected horizontal piping.
 10. Provide copper plated hangers and supports for non-insulated copper pipe.
 11. Design hangers for pipe movement without disengagement of supported pipe.
 12. Adjust hangers to distribute loads equally on attachments and to achieve specified pipe slopes.
 13. Support piping adjacent to large pipe accessories such as valves, air separators, traps, etc. Provide additional supports as recommended by accessory manufacturer.
 14. Independently support valves 16" and larger.
 15. Install all hangers, supports, and accessories that shall be attached to structural steel prior to the application of structural steel fireproofing. Repair fireproofing if damaged during remainder of project.
 16. Saddles, Shields and Inserts
 - a. Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - b. Install protective shields MSS Type 40 on cold piping that has vapor barrier. Shields shall span an arc of 180 degrees (360 degrees on trapeze hangers with U-bolt clamps).
 - c. Pipes 8 inches and larger shall use thermal-hanger shield inserts.
 - d. Insert materials shall be at least as long as the protective shield.
 - e. Provide manufacturer-recommended saddles, inserts, and/or shields where cellular foam insulation is used. The removal of sections of cellular foam insulation for the purpose of pipe support is not acceptable.
- B. 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.
- C. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- 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.

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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.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. 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.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. 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.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. 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.

O. Insulated Piping:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

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- 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.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 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.
 - f. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

2.3 HANGER AND SUPPORT SCHEDULE

- A. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
 1. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Use thermal-hanger shield inserts for insulated piping and tubing.

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G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Pipe Hangers

- a. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
- b. 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.
- c. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
- d. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- e. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- f. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
- g. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
- h. 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.
- i. 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.
- j. Vee Bottom Clevis Hanger: For suspension of flexible plastic piping, Cooper B-Line B3106 or equivalent. Include plastic pipe support channel, Cooper B-Line B3106V.

2. Pipe Clamps

- a. 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.
- b. 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.
- c. Wall or Ceiling Mounted Pipe Strap/Clamp (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

3. Pipe Supports

- a. 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.
- b. 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.
- c. 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.

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- d. Pipe Rollers (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.
 - e. 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.
 - f. 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.
- H. 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.
- I. 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.
- J. 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. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 5. C-Clamps (MSS Type 23): For structural shapes. Shall only be connected to bottom joist chord if weight is 200 lbs or less.
 6. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads. Shall only be connected to bottom joist chord if weight is 200 lbs or less.
 7. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions. Shall only be connected to bottom joist chord if weight is 200 lbs or less.
 8. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel. Shall only be connected to bottom joist chord if weight is 200 lbs or less.

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9. 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.
 10. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- K. 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): For protection of pipe insulation; depth of saddle to be larger than insulation thickness. 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.
- L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- M. Comply with MSS SP-69 for trapeze pipe-hanger selections.
- N. Comply with MFMA-103 for metal framing system selections.

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- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

2.4 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

2.5 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.
 - 5. Prime and paint all metal equipment supports, brackets, hardware. Color to be metallic silver matching flue exterior or galvanized.

2.6 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.

2.7 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

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- B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.
- D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

2.8 EQUIPMENT ROOF CURBS

- A. Provide a equipment roof curb for each roof-mounted equipment item that does not have integral equipment curb that would extend the bottom of the equipment a minimum of 24" above the roof insulation. Coordinate location of roof supports with equipment manufacturer.
- B. Provide all necessary sealants and flashing required for a waterproof installation. Coordinate with roof manufacturer and other trades.

2.9 EQUIPMENT ROOF SUPPORTS

- A. Provide a minimum of two equipment roof supports for each roof-mounted equipment item that does not have integral equipment rails that would extend the bottom of the equipment a minimum of 24" above the roof insulation. Coordinate location of roof supports with equipment manufacturer.
- B. Provide all necessary sealants and flashing required for a waterproof installation. Coordinate with roof manufacturer and other trades.

2.10 SLEEVES

- A. Provide pipe and duct sleeves at all fire/smoke rated partitions, exterior wall penetrations and wall penetrations into exposed areas. Pipe and duct sleeves are not required for penetrations through non-rated concealed partitions.
- B. At the Contractor's option, pipe sleeves may be omitted if the wall or floor is core drilled.
- C. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Sleeves through floors shall be grinded flush with finish floor level.
- F. Where piping or ductwork penetrate non-rated floor, ceiling, or wall, close off space between pipe or duct and adjacent work with urethane rod stock and caulk air tight.

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- G. Where piping or ductwork penetrate rated floor, ceiling, or wall, close off space between pipe or duct with appropriate fire rated sealant, insulation, putty or compound.
- H. Provide on ductwork close fitting metal collar or escutcheon covers on the side of penetration that are exposed to view.
- I. Install chrome plated steel escutcheons on piping at finished surfaces.
- J. Waste, vent and storm pipe penetrations through the concrete floor slab shall be encased in the poured concrete slab.

2.11 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls and floors.
- B. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

2.12 MECHANICAL SEALS

- A. Provide mechanical seals and sleeves through exterior wall and floor penetrations, and in 3-hour or higher fire rated partitions.

END OF SECTION 230529

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SECTION 230553 – HVAC IDENTIFICATION

1. GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe Markers.
- D. Duct Markers.

1.2 REFERENCE SECTION 230500 FOR THE FOLLOWING GUIDELINES

- A. References
- B. Related Sections
- C. Submittals
- D. Quality Assurance

1.3 PROJECT RECORD DOCUMENTS

- A. Record actual locations of tagged valves.

2. PRODUCTS

2.1 NAMEPLATES

- A. Equipment Mark Nameplates: Laminated three-layer plastic with engraved black letters (matching equipment mark indicated on drawings) on light contrasting background color, with minimum 3/4 inch high letters.

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- B. Equipment Nameplates: Factory-applied permanent nameplate indicating the manufacturer's name, model, serial number, temperature and pressure design, and any other data necessary to conform with specified requirements. On equipment installed outdoors, nameplate shall be stamped steel or engrave plastic.

2.2 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter or square.
- B. Chart: Typewritten list that is plastic laminated and mounted in mechanical room. Valve list is to coordinate with mechanical piping schematics if provided on plans.
- C. Pipe Schematics: Valve numbers are to be labeled on Engineer schematic drawings, plastic laminated and schematic shall be mounted in mechanical room.

2.3 PIPE MARKERS

- A. Color: Conform to the following:

1.	Chilled water supply	Dark green	CWS
2.	Chilled water return	Dark green	CWR
3.	Heating water supply	Maroon	HWS
4.	Heating water return	Maroon	HWR
5.	Preheat water supply	Maroon	PHWS
6.	Preheat water return	Maroon	PHWR
7.	Low pressure steam	Orange	LPS
8.	Medium pressure steam	Orange	MPS
9.	High pressure steam	Orange	HPS
10.	Steam condensate return	Yellow	COND
11.	Condensate drain	Dark blue	CD
12.	For services not included in the list above, conform to ASME A13.1-2007.		

- B. Plastic Tape Pipe Markers: Preformed plastic markers. For up to 6" OD to be snap on type. For pipe greater than 6" OD to be formed plastic attached with metal springs or plastic straps with printed markings. Minimum information indicating flow direction arrow and color coded identification of fluid being conveyed.
- C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service. Provide tape with printing which most accurately indicates the type of service of buried pipe.
- D. Color code as follows:
 - 1. Yellow - HVAC equipment

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2. Red - Fire dampers/smoke dampers, sprinkler/standpipe system valves
3. Green - Plumbing valves
4. Blue - Heating/cooling valves

2.4 DUCT MARKERS

- A. Plastic Tape Duct Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed marking; minimum information indicating flow direction arrow and identification of fluid being conveyed.

3. EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe and duct markers in accordance with manufacturer's instructions. Directional arrow tape shall be overlapped to ensure proper adhesion and no peeling of tape in future.
- D. Identify air handling units, exhaust fans, chillers, pumps, heat generating, heat rejecting, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- E. Identify pressure reducing valves, backflow preventers, valves, and meters with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves in main and branch piping with tags.
- H. Tag automatic controls, instruments, and relays. Key to control schematic.

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- I. Identify piping, concealed or exposed, with plastic tape pipe markers. For pipes $\frac{3}{4}$ " and smaller, identify piping with tags. Identify service, flow direction, and pressure when applicable, i.e. low pressure steam, high pressure steam. Install in clear view from floor and align with axis of piping. Locate identification not to exceed 15 feet on straight runs including risers and drops, more often in congested areas, adjacent to each valve and tee, at each side of penetration of structure or wall, and at each obstruction. Provide a minimum one label per pipe per room. Where pipes are racked, install pipe markers on each pipe in the same location to aid in differentiating each pipe in the rack.
- J. Provide ceiling stickers or machine generated labels to locate valves, dampers, or HVAC equipment above T-bar type panel ceilings. Locate ceiling sticker on the ceiling grid closest to equipment. Label each sticker with the device located above the ceiling, i.e. VBR-33.
- K. Identify ductwork with plastic tape duct markers. Identify service, flow direction and pressure when applicable, i.e. low pressure supply air, high pressure supply air. Install in clear view from floor and align with centerline of duct. Locate identification not to exceed 15 feet on straight runs including risers and drops, more often in congested areas, at each side of penetration of structure or wall, and at each obstruction. When several ducts from different units are located in concealed congested areas, locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

1. GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing (TAB) of air systems.
- B. TAB of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to work of this section.

1.3 REFERENCES

- A. AABC - National Standards for Total System Balance.
- B. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- C. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- D. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 SUBMITTALS

- A. Submit name of adjusting and balancing agency for approval within 90 days after award of Contract.
- B. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- C. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
- D. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
- E. Provide reports in letter size, soft cover or 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

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F. Test Reports: Indicate data on of the following forms:

1. AABC National Standards for Total System Balance forms.
2. Forms prepared following ASHRAE 111.
3. NEBB forms.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of all sensors, flow measuring stations, balancing valves and rough setting.

1.6 QUALITY ASSURANCE

1. Perform total system balance in accordance with one of the following:
2. AABC National Standards for Field Measurement and Instrumentation, Total System Balance.
3. NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.7 QUALIFICATIONS

- A. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.8 SEQUENCING

- A. See Section 230500.
- B. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.9 SCHEDULING

- A. See Section 230500.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 EXAMINATION

- A. Before commencing work and prior to convening the pre-balancing conference, the TAB agency shall coordinate with the appropriate mechanical contractors that the following conditions have been met:
1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

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5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Hydronic systems are flushed, filled, and vented.
12. Pumps are rotating correctly.
13. Proper strainer baskets are clean and in place.
14. Service and balance valves are open.

B. Submit field reports at the pre-balancing conference. Report ALL defects and deficiencies noted during performance of services which prevent system balance.

C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

A. Air Inlets in Non-Pressurized Spaces: Adjust total to within 0 to -10 percent of design from space.

B. Hydronic Systems: Adjust to within +0 to 10 percent of design.

3.4 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by traverse of entire cross sectional area of duct.

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- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by dampers.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- K. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

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3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

1. All air handling units, exhaust fans, VAV boxes, heat exchanger, new heating water pumps, existing chilled water pump, diffusers, registers, grilles, unit heaters.

B. Report Forms

1. Title Page:

1. Name of Testing, Adjusting, and Balancing Agency
2. Address of Testing, Adjusting, and Balancing Agency
3. Telephone number of Testing, Adjusting, and Balancing Agency
4. Project name
5. Project location
6. Project Architect
7. Project Engineer
8. Project Contractor
9. Project altitude
10. Report date
11. Design versus final performance
12. Notable characteristics of system
13. Description of systems operation sequence
14. Summary of outdoor and exhaust flows.
15. Nomenclature used throughout report
16. Test conditions

2. Instrument List:

1. Instrument
2. Manufacturer
3. Model number
4. Serial number
5. Range
6. Calibration date

3. Electric Motors:

1. Manufacturer
2. Model/Frame
3. HP/BHP
4. Phase, voltage, amperage; nameplate, actual, no load
5. RPM
6. Service factor
7. Starter size, rating, heater elements
8. Sheave Make/Size/Bore

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4. V-Belt Drive:

1. Identification/location
2. Required driven RPM
3. Driven sheave, diameter and RPM
4. Belt, size and quantity
5. Motor sheave diameter and RPM
6. Center to center distance, maximum, minimum, and actual

5. Pump Data:

1. Identification/number
2. Manufacturer
3. Size/model
4. Impeller
5. Service
6. Design flow rate, pressure drop, BHP
7. Actual flow rate, pressure drop, BHP
8. Discharge pressure
9. Suction pressure
10. Total operating head pressure
11. Shut off, discharge and suction pressures
12. Shut off, total head pressure

6. Chillers:

1. Identification/number
2. Manufacturer
3. Capacity
4. Model number
5. Serial number
6. Evaporator entering water temperature, design and actual
7. Evaporator leaving water temperature, design and actual
8. Evaporator pressure drop, design and actual
9. Evaporator water flow rate, design and actual
10. Condenser entering water temperature, design and actual
11. Condenser pressure drop, design and actual
12. Condenser water flow rate, design and actual

7. Heat Exchanger:

1. Identification/number
2. Location
3. Service
4. Manufacturer
5. Model number
6. Serial number

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7. Primary water entering temperature, design and actual
8. Primary water leaving temperature, design and actual
9. Primary water flow, design and actual
10. Primary water pressure drop, design and actual
11. Secondary water leaving temperature, design and actual
12. Secondary water leaving temperature, design and actual
13. Secondary water flow, design and actual
14. Secondary water pressure drop, design and actual

8. Cooling Coil Data:

1. Identification/number
2. Location
3. Service
4. Manufacturer
5. Air flow, design and actual
6. Entering air DB temperature, design and actual
7. Entering air WB temperature, design and actual
8. Leaving air DB temperature, design and actual
9. Leaving air WB temperature, design and actual
10. Water flow, design and actual
11. Water pressure drop, design and actual
12. Entering water temperature, design and actual
13. Leaving water temperature, design and actual
14. Air pressure drop, design and actual

9. Heating Coil Data:

1. Identification/number
2. Location
3. Service
4. Manufacturer
5. Air flow, design and actual
6. Water flow, design and actual
7. Water pressure drop, design and actual
8. Entering water temperature, design and actual
9. Leaving water temperature, design and actual
10. Entering air temperature, design and actual
11. Leaving air temperature, design and actual
12. Air pressure drop, design and actual

10. Air Moving Equipment

1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Arrangement/Class/Discharge

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6. Air flow, specified and actual
7. Return air flow, specified and actual
8. Outside air flow, specified and actual
9. Total static pressure (total external), specified and actual
10. Inlet pressure
11. Discharge pressure
12. Sheave Make/Size/Bore
13. Number of Belts/Make/Size
14. Fan RPM
15. Return Air/Outside Air Data:
16. Identification/location
17. Design air flow
18. Actual air flow
19. Design return air flow
20. Actual return air flow
21. Design outside air flow
22. Actual outside air flow
23. Return air temperature
24. Outside air temperature
25. Required mixed air temperature
26. Actual mixed air temperature
27. Design outside/return air ratio
28. Actual outside/return air ratio

11. Exhaust Fan Data:

1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Air flow, specified and actual
6. Total static pressure (total external), specified and actual
7. Inlet pressure
8. Discharge pressure
9. Sheave Make/Size/Bore
10. Number of Belts/Make/Size
11. Fan RPM

12. Duct Traverse:

1. System zone/branch
2. Duct size
3. Area
4. Design velocity
5. Design air flow
6. Test velocity
7. Test air flow

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8. Duct static pressure
9. Air temperature
10. Air correction factor

13. Terminal Unit Data:

1. Manufacturer
2. Type, constant, variable, single, dual duct
3. Identification/number
4. Location
5. Model number
6. Size
7. Minimum static pressure
8. Minimum design air flow
9. Maximum design air flow
10. Maximum actual air flow
11. Inlet static pressure

14. Air Distribution Test Sheet:

1. Air terminal number
2. Room number/location
3. Terminal type
4. Terminal size
5. Area factor
6. Design velocity
7. Design air flow
8. Test (final) velocity
9. Test (final) air flow
10. Percent of design air flow

END OF SECTION 230593

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SECTION 230650 – CONDENSING HEATING WATER FIRE TUBE BOILERS

1. GENERAL

1.1 SECTION INCLUDES

- A. Boilers.
- B. Controls and boiler trim.
- C. Hot water connections.
- D. Fuel burning system and connection.
- E. Chimney connection.

1.2 RELATED SECTIONS

- A. Section 23 05 00 - Basic HVAC Requirements.
- B. Section 23 21 16 - Hydronic Specialties
- C. Section 23 51 00 - Breechings, Chimneys, and Stacks.

1.3 REFERENCES

- A. Reference Section 23 05 00.

1.4 SUBMITTALS FOR REVIEW

- A. Reference Section 23 05 00.

1.5 QUALITY ASSURANCE

- A. Reference Section 23 05 00

1.6 REGULATORY REQUIREMENTS

- A. Conform to State of Nebraska CSD-1 requirements.
- B. Conform to ASME SEC 4 and SEC 8D AGA Z21.13 Code UL 726 for construction of boilers.
- C. Units: AGA certified and UL labeled.
- D. Conform to applicable codes for internal wiring of factory wired equipment.

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- E. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 WARRANTY

- A. Boiler warranty shall include: heat exchanger material and workmanship to be (10) years after initial installation, burner to be (5) years after initial installation, all other parts to be (1) year after installation or (18) months from date of factory shipment.

1.8 MAINTENANCE SERVICE

- A. Provide service and maintenance of boilers for one year from Date of Substantial Completion.

2. PRODUCTS

2.1 PACKAGED VERTICAL FIRE TUBE BOILER:

A. Design

1. Boilers shall be vertical steel fire tube design certified by CSA International and meet the requirements of ANSI Z21.13 and CSA 4.9. The boiler shall be ASME "H" stamp, national board listed and include a low water cutoff and high limit with manual reset to meet ASME CSD-1. The boilers shall be fully condensing and comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. And be a Category 4 forced draft condensing boiler.
2. The thermal efficiency of the boilers will vary with return temperature and firing rate, and the boiler will be capable of condensing operation and up to 96% efficiency when return water to the boiler is 130°F and lower. Boiler will have no minimum return water temperature and no minimum flow rate requirement.
3. The heat exchanger shall be designed, inspected and tested to A.S.M.E. Section 4 requirements. The heat exchanger shall be of fully welded construction and have a maximum working pressure of 160 psi and a minimum operating pressure of 30 psig with a 10 year non-prorated warranty. Configuration shall be cylindrical, vertical, two-pass, counter-flow, fire tube design and consist of an integral combustion chamber with an inner tube bundle for primary heat transfer and an outer tube bundle for extracting latent heat from the flue gases. The combustion chamber, fire tubes and tube sheets shall be constructed of 316L stainless steel. The remainder of the heat exchanger shall be constructed of 304L stainless steel. The fire tubes shall be of an oval design with a minimum wall thickness of 0.061 inch. The upper and lower tube sheets shall have a thickness of no less that 0.375 inches. The heat exchanger design shall be capable of 40° F constant system return water temperature and be fully condensing complete with condensate trap and drains. A pressure relief valve as scheduled and a pressure gauge of code range shall be furnished with the boiler.

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4. The combustion chamber shall be an all welded stainless steel construction and an integral part of the heat exchanger. The combustion chamber shall incorporate an easily removable radial fire knitted stainless steel burner with access to the internal combustion chamber for inspection, service and cleaning. A window view port shall be provided for visual inspection of the boiler combustion during firing.
5. The casing shall be of 430 stainless steel mirror finish panels, a powder coated access top cover assembled utilizing interference fit locks and minimal non-strip self tap screws for ease of removal and access to the heat exchanger and combustion air / gas control. Cabinet includes a NEMA 250 Type 1A control compartment. The combustion chamber shall be sealed, completely enclosed, independent of the air insulated outer jacket and with a stainless steel combustion chamber designed to drain condensation to the bottom of the heat exchanger assembly.
6. The gas train shall consist of a pressure regulating electro-hydraulic proportional air/gas main gas actuator providing a slow opening, fast closing shutoff valve and proportional 1:1 air/gas ratio control, a fast closing safety shutoff gas pressure regulator with 1 PSI allowable static pressure, a low gas pressure switch, and a high gas pressure switch. A factory pre-set combination metering valve and orifice shall be provided for setting combustion parameters.
7. The combustion air fan shall draw gas under negative pressure and mix it with air to generate a fine tuned air gas mixture which is delivered under positive pressure to the radial knitted stainless steel burner. Combustion modulation shall be established by either a pulse width modulation signal or variable frequency motor drive. The burner shall be a 100% stainless steel vertical mounted radial fired type with stainless knitted metal fiber construction and shall have a five year non-prorated warranty.
8. The burner shall combust a precise amount of premixed combustion air and gas to provide equal distribution of heat for heat transfer throughout the entire heat exchanger. Combustion shall operate with a minimum 23:1 burner turn down ratio while sustaining combustion characteristics throughout the entire modulating range. Operation of up to 99% thermal efficiency and shall be certified for Oxides of Nitrogen (Nox) of 9 ppm corrected to 3% oxygen. The burner combustion shall operate as proportional modulating with a minimum 23:1 turndown ratio with a minimum 4% firing rate. Multiple boiler firing algorithms shall be proportional modulation. Light off shall be at no more than 50% input to assure rattle free soft start. Combustion shall be optionally suitable for natural gas, propane and dual fuels operation as scheduled. The ignition module shall employ a proven pilot system. Trial for ignition shall proceed with 15 seconds between retries. Ignition shall include times for pre-purge, pre-ignition and post purge.

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9. Each boiler shall include the same CSA certified control module with an electronic proportional integrated combination ignition limit/operator control accurate to 1°F (0.5°C) having a 4-20 mA output signal suitable for control of a variable frequency motor drive or a pulse width modulation signal output for modulating fan speeds. Controls shall sequence boilers with indoor/outdoor reset and shall utilize a PID loop energy management firing rate tuning constant and parallel positioning of the firing rate of each boiler to track load and limit cycling to maximize all boiler operating efficiencies. Control shall be equipped and ready with 4-20 mA remote set point or modulating control, capable with 0-10 VDC remote set point or modulating control. Control shall be standard with a BMS Modbus RTU protocol ready and also shall include an optional BACnet MSTP Metasys gateway protocol converter as required by the temperature control contractor. Control shall be supplied with a factory mounted seven inch touch screen display which shall also provide for control system configuration and set up, readouts of boiler target, flame signal and inlet/outlet temperatures as well as accumulated runtime, enunciator diagnostics, and firing rates.
10. The display will be equipped with two RS485 communication ports with battery backup and a USB port to extract boiler operation parameters for troubleshooting. If the master boiler cannot fire the master control shall continue to operate all other boilers (if applicable) as originally programmed. If the master boiler cannot operate altogether then all of the other boiler's controls shall automatically revert to their standalone settings. The boilers controllers shall be field wired in daisy-chain fashion to each other for communications, firing and sequence control in multiple boiler installations if applicable.
11. Boiler shall have a seven inch control display shall provide full diagnostics including real time data logging and support for all of the boilers in the sequencing application. The complete control package shall be mounted on the front panel with a hinged door for easy access to all control modules. The boiler safety control string shall be furnished with controls for low gas pressure, optional high gas pressure, fan air proving, blocked flue, water pressure, high limit, stack limit and flow switch. Additional control safeties shall include flue gas stack temperature, flame rectification, fan speed and an auto recycling high limit.
12. Boiler pump(s) shall be provided by the boiler manufacture along with necessary controls described herein and shall be field mounted and wired to the boiler's pump control relay. The boiler controls shall enable/disable the pumps.
13. Boilers shall include a factory mounted and wired flow switch. Low water cutoff shipped loose for field mounting and wiring.
14. Boilers shall be fully factory fire tested and include all electrical and combustions tests to the owner including flue gas analyzer settings from 4% input up through 100% input. Boilers shall be fully factory tested for ASME CSD-1 and the required test reports provided to the contractor and owner.
15. Boiler shall have all access for service and inspection, clearances for front, sides and rear to be 36 inches as per local code.

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16. Vent requirements and capabilities: The boiler will vent through a category IV, positive pressure vent using a UL, ETL or CSA approved double wall material. The boiler will be able to vent under positive pressure for 100 equivalent feet through six-inch diameter material. Concurrently, the appliance will be capable of drawing remote combustion air through up to 100 equivalent feet of 8-inch diameter duct.

B. Electric service is 115/60/1

C. Natural gas service: 0.25 psig

D. Start-up, Adjustments, and Operating Instruction

1. Provide (3) Operating and maintenance Manuals. Factory trained personnel shall adjust all burners and controls and instruct operating personnel. The service person will complete the start-up report form supplied by the heater manufacturer and forward to the installing contractor.

3. EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54.

C. Install boiler on existing concrete housekeeping base.

D. Provide connection of natural gas service in accordance with NFPA 54 and AGA Z223.1. Pipe gas connections in accordance with Section 22 10 00.

E. Provide piping connections and accessories as indicated; refer to Sections 23 21 13 and 23 21 16.

F. Pipe full size relief valve to floor sink.

G. Connect breeching to boiler outlet. Refer to Section 23 51 00

H. Connect combustion air to boiler inlet.

I. Provide for connection to electrical service.

3.2 CLEANING

A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's instructions

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3.3 MANUFACTURER'S FIELD SERVICE

- A. Provide the services of an authorized factory service representative to perform start-up and operation demonstration services.
- B. Perform services in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- C. Maintenance and Operation Training: As a part of the maintenance and operating instructions, review data in operating and maintenance manual, including preventative maintenance schedule and procedures, and procedures for obtaining repair parts and technical assistance. Demonstrate all phases of operation including start-up and shut-down.
- D. Submit a copy of the results of the boiler start-up to the Engineer.
- E. Include a copy of the results of the boiler start-up in the Operation and Maintenance Manuals.

3.4 RESPONSIBILITY

- A. Performance and Compatibility: All complete packaged boilers and sequence control system shall be purchased from one manufacturer who will be responsible for performance, furnishing ASME data sheets, mechanical installation and wiring instructions.
- B. Electrical: The Electrical Contractor will only be responsible for supplying power to each of the boilers and the master cabinet as per electrical drawings and specifications. The Temperature Control Contractor will be responsible for wiring between master cabinet and each boiler (normally 5 wires), wires to outside sensors located on north wall (4 wires), wires to sensors located in return header (4 wires) and connections to outside air dampers and other safety interlock on alarm devices.
- C. These items are to be supplied by the contractor in the field
 - 1. ASME CSD-1 Part CE-100 Electrical Requirements; Remote emergency power off, one per boiler room door as indicated on plans.

END OF SECTION 230650

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SECTION 230713 - DUCTWORK INSULATION

1. GENERAL

1.1 SECTION INCLUDES

- A. Ductwork insulation.
- B. Insulation jackets.

1.2 REFERENCE SECTION 230500 FOR THE FOLLOWING:

- A. References
- B. Submittals
- C. Delivery, Storage, and Handling

1.3 QUALITY ASSURANCE

- A. Materials: Flame spread/smoke developed rating of 25/50 or less.

1.4 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation as recommended by the manufacturer.

2. PRODUCTS

2.1 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: ASTM C518, 0.30 at 75 degrees F.
 - 2. Maximum service temperature: 250 degrees F.
 - 3. Maximum moisture absorption: less than 3 percent by volume.

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4. Density: .75 lb/cu ft.

B. Vapor Barrier Jacket

C. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.

1. Moisture vapor transmission: ASTM E96; 0.02 perm maximum.
2. Secure with pressure sensitive tape.

D. Vapor Barrier Tape

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Tie Wire: Annealed steel, 16 gage (1.5 mm).

2.2 GLASS FIBER, RIGID BOARD

A. Insulation: ASTM C612; rigid, noncombustible blanket.

1. 'K' value: ASTM C518, 0.23 at 75 degrees F.
2. Maximum service temperature: 250 degrees F.
3. Maximum moisture absorption: less than 3 percent by volume.
4. Density: As required to meet K-value above with rigid insulation material.

B. Vapor Barrier Jacket

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Secure with pressure sensitive tape.

C. Vapor Barrier Tape

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.3 JACKETS

A. Canvas Jacket: UL listed.

1. Fabric: ASTM C921, 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
2. Lagging Adhesive: Compatible with insulation.

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- B. Aluminum Jacket: ASTM B209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1. Jacket: Aluminum construction, stucco embossed finish, 0.032" thick, with minimum 3-mil thick heat-bonded polyethylene and kraft paper vapor barrier.
 - 2. Lagging Adhesive: Compatible with insulation and application.

3. EXECUTION

3.1 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- C. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
- E. Secure insulation without vapor barrier with staples, tape, or wires.
- F. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
- G. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
- H. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- I. Do not overtighten and/or compress flexible glass fiber duct insulation.
- J. At duct access doors or other openings, insulation shall be properly framed and finished.

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3.3 GLASS FIBER DUCTWORK INSULATION SCHEDULE

Ductwork Application:	Type:	Thickness:	Vapor Barrier Required (Y/N):
Exposed combustion air duct in mechanical rooms	Flexible	2"	Y

Schedule Notes:

1. All ductwork in mechanical rooms shall be insulated as though it were "Exposed".

END OF SECTION 230713

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SECTION 230719 – HVAC PIPING INSULATION

1. GENERAL

1.1 SECTION INCLUDES

- A. Piping insulation.

1.2 REFERENCE SECTION 230500 FOR THE FOLLOWING GUIDELINES

- A. References
- B. Submittals
- C. Delivery, Storage and Handling

1.3 QUALITY ASSURANCE

- A. See Section 230500.
- B. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, and UL 723.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

2. PRODUCTS

2.1 GLASS FIBER

- A. Insulation: ASTM C547; rigid molded, noncombustible.
 - 1. 'K' ('ksi') value : ASTM C335, 0.24 at 75 degrees F.
 - 2. Minimum Service Temperature: -20 degrees F.
 - 3. Maximum Service Temperature: 300 degrees F (850 degrees F for high pressure steam/condensate piping).
 - 4. Maximum Moisture Absorption: 0.2 percent by volume.

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B. Vapor Barrier Jacket

1. ASTM C921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
3. Secure with self sealing longitudinal laps and butt strips.
4. Secure with outward clinch expanding staples and vapor barrier mastic.

C. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12 inch centers.

D. Vapor Barrier Lap Adhesive: compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

F. Fibrous Glass Fabric: Cloth, untreated; 9 oz/sq yd weight with 1.0 lb/cu ft density blanket.

G. Indoor Vapor Barrier Finish: Vinyl emulsion type acrylic, compatible with insulation, white color.

3. EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions and in accordance with UNL Design Guidelines.
- B. On exposed piping, locate insulation and cover seams in least visible locations.
- C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory applied or field applied.
 2. Insulate fittings, joints, flanges, unions strainers, flexible connectors and valves with molded insulation of like material and thickness as adjacent pipe. PVC covers are required in all exposed locations as in mechanical rooms. PVC or aluminum covers are required in all exposed locations as in mechanical rooms.
 3. Finish with glass cloth and vapor barrier adhesive.
 4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.

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5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - a. Valves and fittings 2" and smaller shall be wrapped with strips of insulation to a thickness 1/8" less than the adjacent pipe insulation. Cover insulation with PVC tape and vapor barrier mastic. Tape shall lap insulation a minimum of 2". In exposed applications, cover the fitting with a one-piece PVC fitting cover sealed at the butt joint using PVC tape and coating of vapor barrier mastic.
 - b. Valves and fittings 2-1/2" and larger shall be insulated with premolded fiberglass insulation fittings or cut segments of pipe insulation wired in place. Cover insulation with PVC tape and vapor barrier mastic. Tape shall lap insulation a minimum of 2". In exposed applications, cover the fitting with a one-piece PVC fitting cover sealed at the butt joint using PVC tape and coating of vapor barrier mastic.

D. For insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. PVC covers are required in all exposed locations as in mechanical rooms.
 - a. Valves and fittings 2" and smaller shall be wrapped with strips of insulation to a thickness 1/8" less than the adjacent pipe insulation. Cover insulation with PVC tape and vapor barrier mastic. Tape shall lap insulation a minimum of 2". In exposed applications, cover the fitting with a one-piece PVC fitting cover sealed at the butt joint using PVC tape and coating of vapor barrier mastic.
 - b. Valves and fittings 2-1/2" and larger shall be insulated with premolded fiberglass insulation fittings or cut segments of pipe insulation wired in place. Cover insulation with PVC tape and vapor barrier mastic. Tape shall lap insulation a minimum of 2". In exposed applications, cover the fitting with a one-piece PVC fitting cover sealed at the butt joint using PVC tape and coating of vapor barrier mastic.
3. Finish with glass cloth and adhesive.
4. For hot piping conveying fluids, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
5. For steam piping, insulate flanges and unions at equipment except on underground steam and condensate piping.

E. Inserts and Shields:

1. Refer to Section 220529, Hangers and Supports for Plumbing and Piping Equipment for additional information.
2. Application: Piping 1 inch diameter or larger.
3. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
4. Insert Location: Between support shield and piping and under the finish jacket.

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5. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
6. Insert Material: ASTM C640 cork, hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
7. Provide inserts and/or shields per manufacturer recommendations for cellular foam insulation applications in order to maintain continuous insulation throughout the pipe system. The removal of sections of cellular foam insulation to accommodate pipe supports is not acceptable. Manufacturer products specifically designed for supporting insulation and maintaining the integrity of the insulation system at pipe hanger locations, such as Armaflex Armafix Insulation Pipe Hangers, are acceptable.

F. Finish insulation at supports, protrusions, and interruptions.

G. All valves in insulated systems shall have valve stem extensions. Insulation installer shall notify the contractor and Owner if valves without stem extensions are encountered. All valves without stem extensions in areas where stem extensions are required shall be replaced.

3.3 TOLERANCE

A. Substituted insulation materials, where allowed, shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 GLASS FIBER INSULATION SCHEDULE

A. Heating Systems

<u>PIPING SYSTEM:</u>	<u>PIPE SIZE:</u>	<u>THICKNESS:</u>
Heating Water Supply and Return	1-1/2" & smaller	1"
Heating Water Supply and Return	2" & larger	2"

END OF SECTION 230719

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SECTION 230900 – TEMPERATURE CONTROL SYSTEM

1. GENERAL

1.1 RELATED DOCUMENTS

- A. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.

1.2 BMS DESCRIPTION

- A. The Building Management System (BMS) shall include extending the existing Johnson Controls, Inc. Extended Architecture, by adding a Field Equipment Controller (FEC) and Input/Output Module (IOM) to the existing system to serve the new equipment installed in this project and also have the capability to monitor and adjust additional owner coordinated chilled water system equipment in the future. The Johnson Controls, Inc. Extended Architecture will be a direct extension to the existing state wide network. All naming conventions, graphics, and system programming language shall exactly match the existing Johnson Controls, Inc. Extended Architecture standards. No gateways or integrations will be allowed.
- B. BMS to interface and monitor all available new boiler control panel's Bacnet MSTP control points, boiler HWS/HWR temperatures, BP-1 status and enable/disable the boiler control panel as necessary to satisfy the existing BMS adjustable HWS temperature setpoint with reset schedule.
- C. BMS to interface, monitor and trend the new exterior natural gas meter's binary output pulses corresponding to gas consumption. BMS system to provide necessary barriers to protect systems, coordinate available signal from meter, wiring, interface signal conversion to useful BMS consumption unit data and requirements with local gas company (Black Hills Energy Gas Company).

1.3 QUALITY ASSURANCE

- A. General:
 - 1. The Building Management System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems. Representatives, wholesalers, and distributors will not be allowed.

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2. A factory authorized representative of Johnson Controls, Inc. shall install the controls. The installing contractor shall have factory trained personnel for the application, engineering, installation and programming of the Johnson Controls, Inc. Extended Architecture.

1.4 SUBMITTALS

A. Shop Drawings, Product Data, and Samples

1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 60 days of contract award.
2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS work.

1.5 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals:

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:
 - a. Table of contents.
 - b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturers product data sheets or catalog pages for all products including software.
 - d. System Operator's manuals.
 - e. Archive copy of all site-specific databases and sequences.
 - f. BMS network diagrams.
 - g. Interfaces to all third-party products and work by other trades.
2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

- ##### B. On-Line Documentation:
- After completion of all tests and adjustments the Contractor shall provide a copy of all as-built information and product data to be installed on a customer designated computer workstation or server.

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1.6 WARRANTY

A. Standard Material and Labor Warranty:

1. Provide a one-year labor and material warranty on the BMS.
2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at the cost of the BMS Contractor.
3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMS Contractor's normal business hours.

2. PRODUCTS

2.1 GENERAL DESCRIPTION

A. The Building Management System (BMS) products shall be that of Johnson Controls, Inc. No other products will be allowed.

B. The Building Management System shall consist of the following:

1. JCI Metasys Network Automation Engine (MS-NAE5500)
2. JCI Metasys Field Equipment Controller (MS-FEC2600)
3. JCI Metasys Input/Output Module (MS-IOM4700)
4. Local Display Device(s)
5. Distributed User Interface(s)
6. Network processing, data storage and communications equipment
7. Other components required for a complete and working BMS

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
2. The System shall maintain all settings and overrides through a system reboot.

E. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

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2.2 SYSTEM ARCHITECTURE

A. Automation Network:

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard “off the shelf” products available through normal PC vendor channels.
2. The BMS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Provide application and data server(s) as required for systems operation.
3. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
4. Network Automation Engines (NAE) shall reside on the automation network.
5. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with by way of standard networking devices and practices.

B. Control Network:

1. Network Automation Engines (NAE) shall provide supervisory control over the control network and shall support all three (3) of the following communication protocols:
 - a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9:
 - 1) The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL label.
 - 2) The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
 - b. LonWorks enabled devices using the Free Topology Transceiver (FTT-10a).
 - c. The Johnson Controls N2 Field Bus.
2. Control networks shall provide either “Peer-to-Peer”, Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
5. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
6. The PICS shall be submitted 10 days prior to bidding.

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2.3 NETWORK AUTOMATION ENGINES (NAE)

A. Network Automation Engine (NAE):

1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
2. Automation Network – The NAE shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
 - a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
 - b. The NAE shall support up to a minimum of four (4) concurrent users.
 - c. The web based user shall have the capability to access all system data through one NAE.
 - d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
 - e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
 - f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
 - g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
 - h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
 - 1) Configuration.
 - 2) Commissioning.
 - 3) Data Archiving.
 - 4) Monitoring.
 - 5) Commanding.
 - 6) System Diagnostics.
 - i. Systems that require workstation software or modified web browsers are not acceptable.
 - j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
4. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

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5. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Hardware Real Time Clock – The NAE shall include an integrated, hardware-based, real-time clock.
7. The NAE shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power – On/Off.
 - b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic.
 - c. Ethernet Connection Speed – 10 Mbps/100 Mbps.
 - d. FC Bus A – Normal Communications/No Field Communications.
 - e. FC Bus B – Normal Communications/No Field Communications.
 - f. Peer Communication – Data Traffic between NAE Devices.
 - g. Run – NAE Running/NAE in Startup/NAE Shutting Down/Software Not Running.
 - h. Bat Fault – Battery Defective, Data Protection Batter Not Installed.
 - i. 24 VAC – 24 VAC Present/Loss of 24 VAC.
 - j. Fault – General Fault.
 - k. Modem RX – NAE Modem Receiving Data.
 - l. Modem TX – NAE Modem Transmitting Data.
8. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.
 - a. Two (2) USB port.
 - b. Two (2) URS-232 serial data communication port.
 - c. Two (2) RS-485 port.
 - d. One (1) Ethernet port.
9. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
10. Power Failure – In the event of the loss of normal power, the NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
 - a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
 - b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
11. Certification – The NAE shall be listed by Underwriters Laboratories (UL).

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12. Controller Network – The NAE shall support the following communication protocols on the controller network:
 - a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1) The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2) The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
 - 3) A BACnet Protocol Implementation Conformance Statement shall be provided for the NAE.
 - 4) The Conformance Statements shall be submitted 10 days prior to bidding.
 - 5) The NAE shall support a minimum of 100 control devices.
 - b. The NAE shall support LonWorks enabled devices using the Free Topology Transceiver FTT10.
 - 1) All LonWorks control devices shall be LonMark certified.
 - 2) The NAE shall support a minimum of 255 LonWorks enabled control devices.
 - c. The NAE shall support the Johnson Controls N2 Field Bus.
 - 1) The NAE shall support a minimum of 100 N2 control devices.
 - 2) The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.
 - 3) The Bus shall employ a master/slave protocol where the NAE is the master.
 - 4) The Bus shall employ a four (4) level priority system for polling frequency.
 - 5) The Bus shall be optically isolated from the NAE.
 - 6) The Bus shall support the Metasys Integrator System.

2.4 DDC SYSTEM CONTROLLERS

A. Field Equipment Controller (FEC):

1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - a. The FEC shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1) The FEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2) The FEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).

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- 3) A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
 - 4) The Conformance Statement shall be submitted 10 days prior to bidding.
2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
 3. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
 4. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 5. The FEC shall include a removable base to allow pre-wiring without the controller.
 6. The FEC shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On.
 - b. Power Off.
 - c. Download or Startup in progress, not ready for normal operation.
 - d. No Faults.
 - e. Device Fault.
 - f. Field Controller Bus – Normal Data Transmission.
 - g. Field Controller Bus – No Data Transmission.
 - h. Field Controller Bus – No Communication.
 - i. Sensor-Actuator Bus – Normal Data Transmission.
 - j. Sensor-Actuator Bus – No Data Transmission.
 - k. Sensor –Actuator Bus – No Communication.
 7. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
 8. The FEC shall support the following types of inputs and outputs:
 - a. Universal Inputs – shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode.
 - 2) Analog Input, Current Mode.
 - 3) Analog Input, Resistive Mode.
 - 4) Binary Input, Dry Contact Maintained Mode.
 - 5) Binary Input, Pulse Counter Mode.
 - b. Binary Inputs – shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode.
 - 2) Pulse Counter Mode.
 - c. Analog Outputs – shall be configured to output either of the following:
 - 1) Analog Output, Voltage Mode.

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- 2) Analog Output, Current Mode.
- d. Binary Outputs – shall output the following:
 - 1) 24 VAC Triac.
- e. Configurable Outputs – shall be capable of the following:
 - 1) Analog Output, Voltage Mode.
 - 2) Binary Output Mode.
9. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
 - a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The FC Bus shall support communications between the FECs and the NAE.
 - c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.
 - d. The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.
 - e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.
10. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices per trunk.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.
11. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
12. The FEC shall support, but not be limited to, the following:
 - a. Hot water, chilled water/central plant applications.
 - b. Built-up air handling units for special applications.
 - c. Terminal units.
 - d. Special programs as required for systems control.
13. The FEC shall support a Local Controller Display (DIS1710) either as an integral part of the FEC or as a remote device communicating over the SA Bus.
 - a. The Display shall use a BACnet Standard SSPC-135, clause 9 Master-Slave/Token-Passing protocol.

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- b. The Display shall allow the user to view monitored points without logging into the system.
- c. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.
- d. The Display shall provide password protection with user adjustable password timeout.
- e. The Display shall be menu driven with separate paths for:
 - 1) Input/Output.
 - 2) Parameter/Setpoint.
 - 3) Overrides.
- f. The Display shall use easy-to-read English text messages.
- g. The Display shall allow the user to select the points to be shown and in what order.
- h. The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.
- i. The Display shall be a minimum of 4 lines and a minimum of 20 characters per line.
- j. The Display shall have a keypad with no more than 6 keys.
- k. The Display shall be panel mountable.

2.5 FIELD DEVICES

A. Input/Output Module (IOM):

- 1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
- 2. The IOM shall communicate with the FEC over the FC Bus or the SA Bus.
- 3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC=135, Clause 9 on the controller network.
 - a. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - c. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
 - d. The Conformance Statement shall be submitted 10 days prior to bidding.
- 4. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
- 5. The IOM shall have a minimum of 4 points to a maximum of 17 points.
- 6. The IOM shall support the following types of inputs and outputs:
 - a. Universal Inputs – shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode.
 - 2) Analog Input, Current Mode.
 - 3) Analog Input, Resistive Mode.
 - 4) Binary Input, Dry Contact Maintained Mode.

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- 5) Binary Input, Pulse Counter Mode.
 - b. Binary Inputs – shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode.
 - 2) Pulse Counter Mode.
 - c. Analog Outputs – shall be configured to output either of the following:
 - 1) Analog Output, Voltage Mode.
 - 2) Analog Output, Current Mode.
 - d. Binary Outputs – shall output the following:
 - 1) 24 VAC Triac.
 - e. Configurable Outputs – shall be capable of the following:
 - 1) Analog Output, Voltage Mode.
 - 2) Binary Output Mode.
7. The IOM shall include troubleshooting LED indicators to identify the following conditions:
- a. Power On.
 - b. Power Off.
 - c. Download or Startup in progress, not ready for normal operation.
 - d. No Faults.
 - e. Device Fault.
 - f. Normal Data Transmission.
 - g. No Data Transmission.
 - h. No Communication.

B. Networked Thermostat (TEC 26X6):

1. The networked thermostat shall be capable of controlling two- or four-pipe fan coils, cabinet unit heaters or other similar equipment.
2. The TEC shall communicate over the Field Controller Bus using BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.
3. The TEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - a. The TEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the TEC.
 - c. The Conformance Statement shall be submitted 10 days prior to bidding.

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4. The Networked Thermostat shall support remote read/write and parameter adjustment from the web based User Interfaceable through a Network Automation Engine.
5. The Networked Thermostat shall support remote read/write and parameter adjustment from the web based User Interface providing plain text messages.
 - a. Two line, 8 character backlit display.
 - b. LED indicators for Fan, Heat and Cool status.
 - c. Five (5) User Interface Keys
 - 1) Mode.
 - 2) Fan.
 - 3) Override.
 - 4) Degrees C/F.
 - 5) Up/Down.
 - d. The display shall continuously scroll through the following parameters:
 - 1) Room Temperature.
 - 2) System Mode.
 - 3) Schedule Status – Occupied/Unoccupied/Override.
 - 4) Applicable Alarms.
6. The Networked Thermostat shall provide the flexibility to support any one of the following inputs:
 - a. Integral Indoor Air Temperature Sensor.
 - b. Duct Mount Air Temperature Sensor.
 - c. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator.
 - d. Two configurable binary inputs.
7. The Networked Thermostat shall provide the flexibility to support any one of the following outputs:
 - a. Three Speed Fan Control.
 - b. Two On/Off.
 - c. Two Floating.
 - d. Two Proportional (0 to 10V).
8. The Networked Thermostat shall provide a minimum of six (6) levels of keypad lockout.
9. The Networked Thermostat shall provide the flexibility to adjust the following parameters:
 - a. Adjustable Temporary Occupancy from 0 to 24 hours.
 - b. Adjustable heating/cooling deadband from 2° F to 5°F.
 - c. Adjustable heating/cooling cycles per hour from 4 to 8.

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10. The Networked Thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.

C. VAV Modular Assembly (VMA):

1. The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.
2. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - a. The VMA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the VMA.
 - c. The Conformance Statement shall be submitted 10 days prior to bidding.
3. The VAV Modular Assembly shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.
4. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
5. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.
6. The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
7. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
8. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.
9. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature/humidity effects.
10. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
11. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
12. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
13. Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
14. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.

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15. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
16. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
17. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.
 - a. Absolute temperature loop error.
 - b. Signed temperature loop error.
 - c. Absolute airflow loop error.
 - d. Signed airflow loop error.
 - e. Average damper actuator duty cycle.
18. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:
 - a. Unreliable space temperature sensor.
 - b. Unreliable differential pressure sensor.
 - c. Starved box.
 - d. Actuator stall.
 - e. Insufficient cooling.
 - f. Insufficient heating.
19. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.
20. The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow based on the percent of outdoor air in the primary air stream.
21. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.
22. Inputs:
 - a. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
 - 1) 0-10 VDC Sensors.
 - 2) 1000ohm RTDs.
 - 3) NTC Thermistors.

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- b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing”.
- c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.

23. Outputs:

- a. Analog outputs shall provide the following control outputs:
 - 1) 0-10 VDC.
- b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
- c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

24. Application Configuration:

- a. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

25. Sensor Support:

- a. The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
- b. The VMA shall support an LCD display room sensor.
- c. The VMA Shall also support standard room sensors as defined by analog input requirements.
- d. The VMA shall support humidity sensors defined by the AI side loop.

D. Network Sensors (NS):

- 1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
 - a. Zone Temperature.
 - b. Zone Humidity.
 - c. Zone Setpoint.
 - d. Discharge Air Temperature.
- 2. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BacNet Standard Protocol SSPC-135, Clause 9.
- 3. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - a. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
 - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.
 - c. The Conformance Statement shall be submitted 10 days prior to bidding.

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4. The Network Zone Sensors shall include the following items:
 - a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint.
 - b. An LED to indicate the status of the Override feature.
 - c. A button to toggle the temperature display between Fahrenheit and Celsius.
 - d. A button to initiate a timed override command.
 - e. Available in either surface mount or wall mount.
 - f. Available with either screw terminals or phone jack.

5. The Network Discharge Air Sensors shall include the following:

- a. 4 inch or 8 inch duct insertion probe.
- b. 10 foot pigtail lead.
- c. Dip Switches for programmable address selection.
- d. Ability to provide an averaging temperature from multiple locations.
- e. Ability to provide a selectable temperature from multiple locations.

E. Many-To-One Wireless Room Temperature Sensor System (WRS):

1. The Many-To-One System Receiver (WRS Receiver) shall receive wireless Radio Frequency (RF) signals containing temperature data from multiple Wireless Room Temperature Sensors (WRS Sensors).
 - a. The WRS Receiver shall use direct sequence spread spectrum RF technology.
 - b. The WRS Receiver shall operate on the 2.4 GHZ ISM Band.
 - c. The WRS Receiver shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
 - d. The WRS Receiver shall be FCC compliant to CFR Part 15 subpart B Class A.
 - e. The WRS Receiver shall operate as a bidirectional transceiver with the sensors to confirm and synchronize data transmission.
 - f. The WRS Receiver shall be capable of communication with WRS Sensors up to a distance of 200 feet.
 - g. The WRS Receiver shall be assembled in a plenum rated plastic housing with flammability rated to UL94-5VB.
 - h. The WRS Receiver shall have LED indicators to provide information regarding the following conditions:
 - 1) Power On/Off.
 - 2) Ethernet – Receiver Activity/No Activity.
 - 3) Wireless Normal Mode – Transmission from sensors/No Transmission.
 - 4) Wireless Rapid Transmit Mode – No transmission/weak signal/Adequate signal/Excellent signal.
 - 5) Ethernet Connection – No connection/10Mbps connection/100Mbps connection.
 - 6) Network Activity – No Network Activity/Half-Duplex Communication/Full-Duplex Communication.

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2. The WRS Sensors shall sense and report room temperatures to the WRS Receiver.
 - a. The WRS Sensors shall use direct sequence spread spectrum RF technology.
 - b. The WRS Sensors shall operate on the 2.4 GHZ ISM Band.
 - c. The WRS Sensors shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
 - d. The WRS Sensors shall be FCC compliant to CFR Part 15 subpart B Class A.
 - e. The WRS Sensors shall be available with:
 - 1) Warmer/Cooler Set Point Adjustment.
 - 2) No Set Point Adjustment.
 - 3) Set Point Adjustment Scale – 55 to 85° F.
 - f. The WRS sensors shall be assembled in NEMA 1 plastic housings.

F. ZFR1800 Series Wireless Field Bus System:

1. The ZFR1800 Series System shall employ ZigBee technology to create a wireless mesh network to provide wireless connectivity for Metasys BACnet devices at multiple system levels. This includes communications from FEC and VMA field controllers to sensors and from engines to these field controllers. Wireless devices shall co-exist on the same network with hardwired devices. Hardwired controllers shall be capable of retrofit to wireless devices with no additional software.
2. The ZFR1810 Wireless Field Bus Coordinator shall provide a wireless interface between supported field controllers and an NAE35/45/55 or NCE25 supervisory controller via the BACnet MS/TP field bus. Each wireless mesh network shall be provided with a ZFR1810 Coordinator for initiation and formation of the network.
 - a. The ZFR Coordinator shall use direct sequence spread spectrum RF technology.
 - b. The ZFR Coordinator shall operate on the 2.4 GHZ ISM Band.
 - c. The ZFR Coordinator shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
 - d. The ZFR Coordinator shall be FCC compliant to CFR Part 15 subpart B Class A.
 - e. The ZFR Coordinator shall operate as a bidirectional transceiver with the sensors and routers to confirm and synchronize data transmission.
 - f. The ZFR Coordinator shall be capable of communication with sensors and routers up to a maximum distance of 250 feet (line of site).
 - g. The ZFR Coordinator shall be assembled in a plenum rated plastic housing with flammability rated to UL-94-5VB.
 - h. The ZFR Coordinator shall have LED indicators to provide diagnostic information required for efficient operation and commissioning.
3. The ZFR1811 Wireless Field Bus Router shall be used with any model Field Equipment Controller (FEC) or VMA1600 series VAV Modular Assembly to provide a wireless interface to supervisory engines, via the ZFR1810 Coordinator, and associated WRZ Wireless Mesh Room Temperature Sensors.
 - a. The ZFR1811 Router shall use direct sequence spread spectrum RF technology.

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- b. The ZFR1811 Router shall operate on the 2.4 GHZ ISM Band.
 - c. The ZFR1811 Router shall meet the IEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
 - d. The ZFR1811 Router shall be FCC compliant to CFR Part 15 subpart B Class A.
 - e. The ZFR Coordinator shall operate as a bidirectional transceiver with the sensors and routers to confirm and synchronize data transmission.
 - f. The ZFR1811 Router shall be capable of communication with other mesh network devices at a maximum distance of 250 feet (line of sight).
 - g. The ZFR1811 Router shall be assembled in a plenum rated plastic housing with flammability rated to UL94-5VB.
 - h. The ZFR1811 Router shall provide LED indication for use in commissioning and troubleshooting.
4. The WRZ-TT Series Wireless Room Temperature Sensors shall sense and transmit room temperatures, room set point, room occupancy notification and low battery condition to an associated ZFR1811 Router.
- a. The WRZ sensors shall use direct sequence spread spectrum RF technology.
 - b. The WRZ sensors shall operate on the 2.4 GHZ ISM Band.
 - c. The WRZ sensors shall meet the IEEE 802.15.4 standard for low-power, low duty-cycle RF transmitting systems.
 - d. The WRZ sensors shall operate on standard off-the-shelf AA batteries using alkaline technology.
 - e. The WRZ sensors shall provide LED indication for use in commissioning and troubleshooting.
 - f. The WRZ sensors shall be FCC compliant to CFR part 15 subpart B Class A.
 - g. The WRZ sensors shall be available with:
 - 1) Warmer/Cooler Set Point Adjustment.
 - 2) No Set Point Adjustment.
 - 3) Set Point Adjustment Scale – 55 to 85° F.
 - h. The WRZ sensors shall be available with the capability to address with up to four unique addresses per controller.
 - i. The WRZ sensors shall be assembled in NEMA 1 plastic housings.
5. The ZFR Checkout Tool shall be provided to allow the installer to quickly check and document connectivity of the entire ZFR series wireless network, before leaving the jobsite.
- a. The ZFR Checkout Tool shall verify wireless network performance including online status verification and signal strength for all wireless connected devices.
 - b. The ZFR Checkout Tool shall provide a printed report detailing network and wireless device status.
 - c. The ZFR Checkout Tool shall be integrated with and operate as an integral part of the Controller Configuration Tool (CCT) specified elsewhere in this document.

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2.6 SYSTEM TOOLS

A. System Configuration Tool (SCT):

1. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a Network Automation Engine (NAE) or a Network Integration Engine (NIE).
2. The configuration tool shall provide an archive database for the configuration and application data.
3. The configuration tool shall have the same look-and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.
4. The configuration tool shall include the following features:
 - a. Basic system navigation tree for connected networks.
 - b. Integration of Metasys N1, LonWorks, and BACnet enabled devices.
 - c. Customized user navigation trees.
 - d. Point naming operating parameter setting.
 - e. Graphic diagram configuration.
 - f. Alarm and even message routing.
 - g. Graphical logic connector tool for custom programming.
 - h. Downloading, uploading, and archiving databases.
5. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:
 - a. BACnet Devices.
 - b. LonWorks Devices.
 - c. N2 Bus Devices.
 - d. Metasys N1 Networks.
6. The configuration tool shall be capable of programming the Field Equipment Controllers.
 - a. The configuration tool shall provide the capability to configure, simulate, and commission the Field Equipment Controllers.
 - b. The configuration tool shall allow the FECs to be run in Simulation Mode to verify the applications.
 - c. The configuration tool shall contain a library of standard applications to be used for configuration.
7. The configuration tool shall be capable of programming the field devices.
 - a. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
 - b. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.

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- c. The configuration tool shall contain a library of standard applications to be used for configuration.
 8. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.
 - a. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
 - b. The wireless use of configuration tool shall be the same as a wired connection in every respect.
 - c. The wireless connection shall use the Bluetooth Wireless Technology.
- B. Wireless MS/TP Converter (BTCVT):
 1. The converter shall provide a temporary wireless connection between the SA or FC Bus and a wireless enabled portable PC.
 2. The converter shall support downloading and troubleshooting FEC and field devices from the PC over the wireless connection.
 3. The converter shall employ Bluetooth Wireless Technology.
 4. The converter shall be powered through a connection to either the Sensor-Actuator (SA) or the Field Controller (FC) Bus.
 5. The converter shall operate over a minimum of thirty three (33) feet within a building.
 6. The converter shall have LED indicators to provide information regarding the following conditions:
 - a. Power – On/Off.
 - b. Fault – Fault/No Fault.
 - c. SA/FC Bus – Bus Activity/No Bus Activity.
 - d. Blue – Bluetooth Communication Established/Bluetooth Communication Not Established.
 7. The SWCVT shall comply with FCC Part 15.247 regulations for low-power unlicensed transmitters.
- C. Handheld VAV Balancing Sensor (ATV7003):
 1. The sensor shall be a light weight portable device of dimensions not more than 3.2 x 3.2 x 1.0 inches.
 2. The sensor shall be capable of displaying data and setting balancing parameters for VAV control applications.
 3. The sensor shall be powered through a connection to either the Sensor-Actuator (SA) or the Field Controller (FC) Bus.
 4. The sensor shall be a menu driven device that shall modify itself automatically depending upon what type of application resides in the controller.
 5. The sensor shall contain a dial and two buttons to navigate through the menu and to set balancing parameters.
 6. The sensor shall provide an adjustable time-out parameter that will return the controller to normal operation if the balancing operation is aborted or abandoned.

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7. The sensor shall include the following:
 - a. 5 foot retractable cable.
 - b. Laminated user guide.
 - c. Nylon carrying case.

8. The sensor shall be Underwriters Laboratory UL 916 listed and CSA certified C22.2 N.205, CFR47.

2.7 INPUT DEVICES

A. General Requirements:

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors:

1. General Requirements:

- a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
- b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
- c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	± .5°F.
Room Temp	± .5°F.
Duct Temperature	± .5°F.
All Others	± .75°F.

2. Room Temperature Sensors:

- a. Room sensors shall be constructed for either surface or wall box mounting.
- b. Room sensors shall have the following options when specified:
 - 1) Setpoint reset slide switch providing a ±3 degree (adjustable) range.
 - 2) Individual heating/cooling setpoint slide switches.
 - 3) A momentary override request push button for activation of after-hours operation.
 - 4) Analog thermometer.

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3. Room Temperature Sensors with Integral Display:
 - a. Room sensors shall be constructed for either surface or wall box mounting.
 - b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
 - 1) Display room and outside air temperatures.
 - 2) Display and adjust room comfort setpoint.
 - 3) Display and adjust fan operation status.
 - 4) Timed override request push button with LED status for activation of after-hours operation.
 - 5) Display controller mode.
 - 6) Password selectable adjustment of setpoint and override modes.
4. Thermo Wells:
 - a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
 - b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
 - c. Thermo wells and sensors shall be mounted in a threadolet or ½" NPT saddle and allow easy access to the sensor for repair or replacement.
 - d. Thermo wells shall be constructed of 316 stainless steel.
5. Outside Air Sensors:
 - a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
 - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
 - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
6. Duct Mount Sensors:
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
 - b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
7. Averaging Sensors:
 - a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.

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- b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
- c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

8. Acceptable Manufacturers: Johnson Controls.

C. Humidity Sensors:

1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
7. Acceptable Manufacturers: Johnson Controls.

D. Differential Pressure Transmitters:

1. General Air and Water Pressure Transmitter Requirements:
 - a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
 - b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
 - c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
 - d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
 - e. Acceptable Manufacturers: Johnson Controls and Setra.
 - f. Static Pressure Traverse Probe:
 - 1) Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.
 - 2) Acceptable Manufacturers: Cleveland Controls.

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2. Water Flow Monitoring:

- a. Water flow meters shall be electromagnetic type with integral microprocessor-based electronics. The meter shall have an accuracy of 0.25%.
- b. Acceptable Manufacturers: Onicon.

E. Power Monitoring Devices:

1. Current Measurement (Amps):

- a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
- b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.

- 1) Operating Frequency – 50 – 400 Hz.
- 2) Insulation – 0.6 Kv class 10Kv BIL.
- 3) UL recognized.
- 4) Five amp secondary.
- 5) Select current ration as appropriate for application.
- 6) Acceptable Manufacturers: Veris Industries.

- c. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:

- 1) 6X input over amp rating for AC inrushes of up to 120 amps.
- 2) Manufactured to UL 1244.
- 3) Accuracy: +.5%, Ripple +1%.
- 4) Minimum load resistance 30kOhm.
- 5) Input 0-20 amps.
- 6) Output 4-20 mA.
- 7) Transducer shall be powered by a 24 VDC regulated power supply (24 VDC +5%).
- 8) Acceptable Manufacturers: Veris Industries.

F. Status and Safety Switches:

1. General Requirements:

- a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

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2. Current Sensing Switches:

- a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
- b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
- c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
- d. Acceptable Manufacturers: Veris Industries.

3. Air Filter Status Switches:

- a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
- b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
- c. Provide appropriate scale range and differential adjustment for intended service.
- d. Acceptable Manufacturers: Johnson Controls, Cleveland Controls.

4. Air Flow Switches:

- a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
- b. Acceptable Manufacturers: Johnson Controls, Cleveland Controls.

5. Air Pressure Safety Switches:

- a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
- b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
- c. Acceptable Manufacturers: Johnson Controls, Cleveland Controls.

6. Water Flow Switches:

- a. Water flow switches shall be equal to the Johnson Controls P74.

7. Low Temperature Limit Switches:

- a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.

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- b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
- c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
- d. The low temperature limit switch shall be equal to Johnson Controls A70.

2.8 OUTPUT DEVICES

A. Actuators:

1. General Requirements:

- a. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.

2. Electronic Damper Actuators:

- a. Electronic damper actuators shall be direct shaft mount.
- b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
- c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
- d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting", shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
- e. Acceptable Manufacturers: Johnson Controls.

3. Electronic Valve Actuators:

- a. Electronic valve actuators shall be manufactured by the valve manufacturer.

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- b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
- c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
- d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
- e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/top the associated pump or chiller.
- f. Acceptable Manufacturers: Johnson Controls.

B. Control Dampers:

- 1. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
- 2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
- 3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
- 4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
- 5. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g. Acceptable Manufacturers are Johnson Controls D-7250 or D-1250 or D-1300, Ruskin CD50, and Vent Products 5650.

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6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Johnson Controls, Ruskin CD36, and Vent Products 5800.
7. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

C. Control Relays:

1. Control Pilot Relays:

- a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
- b. Mounting Bases shall be snap-mount.
- c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
- d. Contacts shall be rated for 10 amps at 120VAC.
- e. Relays shall have an integral indicator light and check button.
- f. Acceptable Manufacturers: Johnson Controls, Lectro.

2. Lighting Control Relays:

- a. Lighting control relays shall be latching with integral status contacts.
- b. Contacts shall be rated for 20 amps at 277 VAC.
- c. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
- d. Lighting control relays shall be controlled by:
 - 1) Pulsed Tri-State Output – Preferred Method.
 - 2) Pulsed Paired Binary Outputs.
 - 3) A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.
- e. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

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D. Control Valves:

1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this specification.
2. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving **variable** flow air handling units coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving **constant** flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.
3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.
4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.
5. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.
6. Acceptable Manufacturers: Johnson Controls.

E. Electronic Signal Isolation Transducers:

1. A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.
4. Acceptable Manufacturers: Advanced Control Technologies.

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F. Electronic/Pneumatic Transducers:

1. Electronic to Pneumatic transducers shall provide:
 - a. Output: 3-15 PSIG.
 - b. Input: 4-20 mA or 0-10 VDC.
 - c. Manual output adjustment.
 - d. Pressure gauge.
 - e. External replaceable supply air filter.
 - f. Acceptable Manufacturers: Johnson Controls.

2.9 MISCELLANEOUS DEVICES

A. Local Control Panels:

1. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices – such as relays, transducers, and so forth – that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be provided via removable or fixed screw terminals.
4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

B. Power Supplies:

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

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C. Thermostats:

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

3. EXECUTION

3.1 INSTALLTION PRACTICES

A. BMS Wiring:

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring;
 - a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BMS Line Voltage Power Source:

1. 120-volt AC circuits used for the Building Management System shall be taken from panelboards and circuit breakers provided by Division 26.

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2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BMS Raceway:

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size $\frac{1}{2}$ ".
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment.

D. Penetrations:

1. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

E. BMS Identification Standards:

1. Node Identification: All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location. Cable types specified in item A shall be color coded for easy identification and troubleshooting.

F. BMS Panel Installation:

1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BMS Contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices:

1. All input devices shall be installed per the manufacturer's recommendations.
2. Locate components of the BMS in accessible local control panels wherever possible.

H. HVAC Input Devices – Genera1

1. All input devices shall be installed per the manufacturer's recommendation.

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2. Locate components of the BMS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors:
 - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b. Sensors shall be installed with a rain proof, perforated cover.
6. Water Differential Pressure Sensors:
 - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location wherever possible.
7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a. Air bleed units, bypass valves and compression fittings shall be provided.
8. Building Differential Air Pressure Applications (-1" to +1" w.c.):
 - a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b. The interior tip shall be inconspicuous and located as shown on the drawings.
9. Air Flow Measuring Stations:
 - a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
 - b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
10. Duct Temperature Sensors:
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.

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11. Space Sensors:

- a. Shall be mounted per ADA requirements.
- b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

12. Low Temperature Limit Switches:

- a. Install on the discharge side of the first water or steam coil in the air stream.
- b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
- c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

13. Air Differential Pressure Status Switches:

- a. Install with static pressure tips, tubing, fittings, and air filter.

14. Water Differential Pressure Status Switches:

- a. Install with shut off valves for isolation.

I. HVAC Output Devices:

1. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems.

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3.2 TRAINING

A. The BMS Contractor shall provide the following training services:

1. 2 hours of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations, and monitored and adjustable control points.
2. Two (2) 2 hour follow-up additional on-site training at a time designated by the owner's representative consisting of additional review or adjustments of the BMS system as necessary or as requested by the contractor, owner and/or engineer.
3. All training session to be recorded and a flash drive or DVD provided to the owner.

END OF SECTION 230900

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SECTION 232113 - HYDRONIC PIPING

1. GENERAL

1.1 SECTION INCLUDES

- A. Pipe and pipe fittings for:
 - 1. Heating water piping system.
 - 2. Equipment drains and overflows.
- B. Valves.

1.2 REFERENCES

- A. Reference Section 230500.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- C. Use full-port bronze ball valves or dielectric unions whenever jointing dissimilar metals.
- D. Provide pipe hangers and supports in accordance with International Mechanical Code limits unless indicated otherwise.
- E. Use gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers or as shown on plans.
- F. Use lug end butterfly valves to isolate equipment.

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1.4 SUBMITTALS

- A. See Section 230500.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of valves.

1.6 OPERATION AND MAINTENANCE DATA

- A. See Section 230500.

1.7 QUALIFICATIONS

- A. See Section 230500.

1.8 DELIVERY, STORAGE AND HANDLING

- A. See Section 230500.

1.9 REGULATORY REQUIREMENTS

- A. Conform to International Mechanical Code for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state and local labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.11 EXTRA MATERIALS

- A. Provide two repacking kits for each size and valve type.

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2. PRODUCTS

2.1 HEATING WATER PIPING AND PREHEAT WATER PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53, Schedule 40, black, with welded or threaded joints.
 - 1. Fittings: ASTM B16.3, Class 150, malleable iron; ASTM B16.4, Class 125, cast-iron, or ASTM B16.9, steel butt weld fittings.
 - 2. Joints: Threaded (2" and smaller), or AWS D1.1, welded (all sizes).
 - 3. Branch Tees: Weld-O-Lets and Thread-O-Lets are acceptable for branch piping when main piping is 2" or larger than branch piping.
- B. Copper Tubing: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
 - 2. Joints: AWS A5.8, BCuP silver braze
 - a. Minimum 15% silver bearing filler material for copper-to-copper joints.
 - b. Minimum 45% silver bearing filler material for dissimilar metal joints

2.2 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tubing: ASTM B88, Type DWV, hard drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.3 CALIBRATED BALANCE VALVES

- A. Pre-Set Balance Feature. Valves to be designed to allow Installing Contractor to pre-set balance points for proportional system balance prior to system start-up in accordance with scheduled flow rates.
- B. Valve Design and Construction. All valves shall have a calibrated orifice or venturi section, two 1/4" threaded pressure tap ports with integral seals, and memory stop to retain the set position. Valves should be rated for 125 psig working pressure and 250 Deg. F maximum operating temperature.
- C. Valves shall be selected based on flow rate, not on pipe size dimensions.
- D. Preformed Insulation. All valves to be provided with molded insulation to permit access for balance and read-out.

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2.4 PIPE HANGERS AND SUPPORTS

- A. See Section 230529.

2.5 UNIONS, FLANGES, AND COUPLINGS

- A. Unions for Pipe 2 Inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

- B. Flanges for Pipe Over 2 Inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick preformed neoprene.

- C. Dielectric Connections: Where connecting ferrous and non-ferrous piping materials, use "ClearFlow" nipples to separate piping materials.

2.6 GATE VALVES

- A. Up To and Including 2 Inches:

1. Bronze body, bronze trim, union bonnet, rising stem, lockshield stem handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, solder or threaded ends, Class 125, MSS SP-80. Add valve stem extensions to all valves that will be installed in insulated piping systems.

- B. Over 2 Inches:

1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends, Class 125, MSS SP-70. Add valve stem extensions to all valves that will be installed in insulated piping systems.
2. Chainwheel: On valves 4" and larger and installed higher than 8-feet above finished floor, provide sprocket rim, brackets, and chain compatible with valve.

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2.7 BALL VALVES

A. Up To and Including 2 Inches:

1. Bronze two piece body, chrome plated brass full-port ball on closed systems, stainless steel full-port ball on open systems, Teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends. Include stem extensions on valves used in insulated piping systems.

2.8 BUTTERFLY VALVES

A. 2-1/2 Inches and Larger:

1. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck.
2. Disc: Aluminum bronze on closed systems and stainless steel on open systems.
3. Stem: Stainless steel, extended on insulated systems as required to allow valve operation without damage to the insulation.
4. Operator: 10 position lever handle with memory stop, gear drive.
5. Chainwheel: On valves 4" and larger and installed higher than 8-feet above finished floor, provide sprocket rim, brackets, and chain compatible with valve.

2.9 SWING CHECK VALVES

A. Up To and Including 2 Inches:

1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.

B. Over 2 Inches:

1. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.10 SPRING LOADED CHECK VALVES

- ### A.
1. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

3. EXECUTION

3.1 PREPARATION

- #### A.
1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

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- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, preheat water, chilled water, and heat recovery water piping in accordance with ASME B31.9.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls and floors.
- G. Slope piping and arrange to drain at low points.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Refer to Section 230529 for installation of supports and hangers.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 220719.
- K. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with General Contractor and requirements of Section 230500.
- L. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- M. Install unions on both sides of each control valve and on one side of all other valves. Install unions on the equipment side of final connections to each piece of equipment. Unions are not required at flanged valves or equipment.

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- N. Space hangers for plastic piping according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- P. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Division 09.
- Q. Install isolation valves on every branch line, whether shown on Drawings or not, to facilitate future shutdowns.
- R. Install valves with stems upright or horizontal, not inverted.
- S. Provide insulated valve stem extensions on all valves installed in insulated piping systems.
- T. Install chainwheel operators on valves 4" and larger that are installed 8-feet above finished floor or greater. Extend chain down to maximum 5-feet above finished floor.
- U. All branch taps shall be made off the top of the mains. Taps from the bottom of the main shall not be allowed.

3.3 SYSTEM FLUSHING, FILLING, PRESSURE TESTING AND CLEANING

- A. Flush, fill, pressure test and clean all new hydronic systems and parts of existing systems which have been altered, extended or repaired.
- B. Flush and fill systems with all valves open to coils. Bleed air from coils and piping. Clean strainers. Refer to Section 232500.
- C. Pressure Test Procedure:
 - 1. Submit copy of Pipe Pressure Test Log provided in section 230500 for each section of piping tested. Refer to 230500 for general pipe pressure testing requirements (i.e., test pressure gages, inspections, etc.).
 - 2. Leave joints including welds uninsulated and exposed for examination during the test.
 - 3. Provide temporary restraints for expansion joints which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
 - 4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.

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5. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.
6. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test.
7. After the hydrostatic test pressure has been applied for at least 12 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.

D. Clean systems. Refer to Section 232500 for cleaning procedure.

END OF SECTION 232113

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SECTION 232116 - HYDRONIC SPECIALTIES

1. GENERAL

1.1 SECTION INCLUDES

- A. Air vents.
- B. Strainers.
- C. Relief valves.
- D. Flexible connections.
- E. Pipe guides.

1.2 RELATED SECTIONS

- A. Section 230500 – Basic HVAC Requirements
- B. Section 232113 - Hydronic Piping.
- C. Section 232500 - Chemical Water Treatment: Pipe Cleaning.

1.3 REFERENCES

- A. See Section 230500.

1.4 SUBMITTALS

- A. See Section 230500.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of hydronic specialties.

1.6 OPERATION AND MAINTENANCE DATA

- A. See Section 230500.

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1.7 QUALIFICATIONS

- A. See Section 230500.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Reference Section 230500.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of glycol system for one year from date of substantial completion.
- B. Monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.
- C. Provide full laboratory analysis of fluid at 6 months and 12 months from the date of substantial completion.

1.10 EXTRA MATERIALS

- A. Provide one extra 50 gallon drum of inhibited ethylene glycol Dowfrost HD for each glycol feeder.

2. PRODUCTS

2.1 AIR VENTS

- A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber. Ball valves with hose connection and cap shall be used in mechanical rooms or ceiling spaces as a manual air vent.

2.2 STRAINERS

- A. Size 2 inch and Under:
 - 1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch Type 304 stainless steel perforated screen.

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2.3 SAFETY RELIEF VALVES

- A. Cast iron or Bronze body, EPDM seat, brass internal parts, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.4 FLEXIBLE CONNECTIONS

- A. Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket, with threaded or flanged ends to match equipment, 150 psig CWP rating, 250 Deg. F maximum operating temperature, capable of withstanding 3/4-inch misalignment.

2.5 PIPE GUIDES

- A. Pipe guides shall be radial alignment type consisting of standard wall pipe guide cylinder with base and split guide spider. Cylinder shall be split. Cylinder and spider shall be of adequate length to allow for the movement due to thermal expansion.
- B. Guides shall be Adscos Model E, Hyspan Series 9500, or equivalent.

3. EXECUTION

3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions and as shown on drawings.
- B. Provide manual air vents at all system high points and as indicated.
- C. Provide drain valves at all low points and as indicated.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank as shown on drawings.
- E. Provide appropriately sized structural supports for air separators. Support air separator independently of piping system.
- F. Provide valved drain and hose connection on strainer blow down connection.
- G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- H. Support pump fittings with floor mounted pipe and flange supports.

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- I. Provide flexible connectors on pump suction and discharge.
- J. Provide flexible connectors on all pipe connections that serve vibration isolated mechanical equipment.
- K. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- L. Pipe relief valve outlet to nearest floor drain.
- M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- N. Clean and flush glycol system before adding glycol solution. Refer to Section 232500.
- O. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.
- P. Alignment guide and anchor installation
 - 1. Install alignment guides to guide expansion and to avoid end-loading and torsional stress. Coordinate with expansion joint manufacturer recommendations as required.
 - 2. Attach guides to pipe and secure guides to building structure.
 - 3. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
 - 4. Anchor Attachments:
 - a. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - b. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - c. Anchor Attachment to Steel Structural Members: Attach by welding.
 - d. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
 - e. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.
- Q. Strainer cleaning
 - 1. After 4 weeks of initial "seasonal" operation, all heating water strainers shall be disassembled and cleaned. Provide 72-hour notice to Owner representative before strainers are cleaned.

END OF SECTION 232116

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SECTION 232123 - HVAC PUMPS

1. GENERAL

1.1 SECTION INCLUDES

- A. In-line circulators.

1.2 RELATED SECTIONS

- A. Section 230500 – Basic HVAC Requirements
- B. Section 220719 – Plumbing Piping Insulation.
- C. Section 220716 – Plumbing Equipment Insulation
- D. Section 232113- Hydronic Piping.
- E. Section 232116 - Hydronic Specialties.
- F. Section 232500 - Chemical Treatment.
- G. Section 230593- Testing, Adjusting, and Balancing.

1.3 REFERENCES

- A. Reference Section 230500.

1.4 PERFORMANCE REQUIREMENTS

- A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within ± 10 percent of scheduled performance and published operating curve.

1.5 SUBMITTALS

- A. Reference Section 230500.

1.6 OPERATION AND MAINTENANCE DATA

- A. Reference Section 230500.

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1.7 QUALIFICATIONS

- A. Reference Section 230500.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Reference Section 230500.

1.9 EXTRA MATERIALS

- A. Provide one set of mechanical seals and gaskets for each pump.

2. PRODUCTS

2.1 IN-LINE CIRCULATORS

- A. See Pump Schedule on Drawings.

3. EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install and support in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
- C. Install pump and associated piping accessories supported from wall mounting brackets at mounting height of 48" above finished floor.
- D. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
- E. Provide line sized shut-off valve and pump suction fitting flexible connection on pump suction, and line sized soft seat check valve and auto flow regulator balancing valve on pump discharge.

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- F. Provide air cock and drain connection on horizontal pump casings.

3.3 START-UP AND COMMISSIONING

- A. Start-up pump in accordance to manufacturer written instructions.
- B. Before and after start-up, perform the following preventative maintenance operations and checks:
 - 1. Lubricate bearings.
 - 2. Check, align and certify alignment of base mounted pumps prior to start-up. Pump alignment shall be certified by 3rd party testing agency using laser alignment procedures.
 - 3. After pump is started, check for proper rotation, proper mechanical operation and motor load to ensure that pump is not overloaded. Close pump balancing valve as required to bring pump motor load within motor nameplate data.
 - 4. Check pumps to ensure it is not air bound or cavitating.
 - 5. After sufficient run time, remove, check and clean strainer as required. Repeat cleaning strainer until system is sufficiently flushed. Refer to Section 232500, Chemical Water Treatment.
 - 6. After completing start-up, replace pump strainer with permanent strainer.
- C. Coordinate pump testing, adjusting and balancing with Balancing Contractor. Complete additional preliminary work required by Balancing Contractor.

END OF SECTION 232123

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SECTION 232500 - CHEMICAL WATER TREATMENT

1. GENERAL

1.1 SECTION INCLUDES

- A. Cleaning of piping systems.
- B. Chemical feeder equipment.
- C. Chemical treatment.

1.2 DESCRIPTION OF WORK

- A. The mechanical contractor shall clean and flush the heating water and chilled water systems. After cleaning and flushing the system, the contractor shall have Owner's representative and Engineer inspect the installation and witness the flushing process. The contractor shall be responsible for cleaning the flushing system until the system is accepted by Owner's representative and Engineer.

1.3 RELATED SECTIONS

- A. Section 230500 – Basic HVAC Requirements.

1.4 REFERENCES

- A. Reference Section 230500.

1.5 SUBMITTALS

- A. Reference Section 230500.

1.6 PROJECT RECORD DOCUMENTS

- A. Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

1.7 OPERATION AND MAINTENANCE DATA

- A. Reference Section 230500.
- B. Provide material safety data sheets on all chemicals provided. Provide plastic laminated storage and handling instructions and mount in area where readily accessible for future referencing.

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1.8 QUALIFICATIONS

- A. Reference Section 232500.

1.9 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.
- B. Products Requiring Electrical Connection: Listed and classified by UL or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of treatment systems for one year from Date of Substantial Completion.
- B. Provide technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit. At a minimum the closed loop piping systems shall be tested at the start-up of the equipment, after the first month or equipment operation and at the end of the one year warranty period. At a minimum the open loop piping systems shall be tested at the start-up of the equipment, after the first month of equipment operation, and provide site visit at the end of the first cooling season to inspect the cooling equipment per paragraph 1.10, E.
- C. Provide laboratory and technical assistance services during this maintenance period.
- D. Include two hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.
- E. Provide on site inspections of equipment during scheduled shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

1.11 MAINTENANCE MATERIALS

- A. Provide sufficient chemicals for treatment and testing during warranty period.

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2. PRODUCTS

2.1 MATERIALS

A. System Cleaner:

1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
2. Biocide.

B. Closed System Treatment (Water):

1. Sequestering agent to reduce deposits and adjust pH.
2. Corrosion inhibitors.
3. Conductivity enhancers.

C. Steam System Treatment:

1. Sequestering agent to reduce hardness and prevent feed line congestion.
2. Base to provide alkalinity.
3. Oxygen scavenger.
4. Carbon dioxide neutralizer.
5. Filming amines.

3. EXECUTION

3.1 PREPARATION

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.

3.2 CLEANING SEQUENCE

A. Concentration:

1. As recommended by manufacturer.
2. One pound per 100 gallons (1 kg per 1000 L) of water contained in the system.
3. One pound per 100 gallons (1 kg per 1000 L) of water for hot systems and one pound per 50 gallons (1 kg per 500 L) of water for cold systems.

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B. Hot Water Heating Systems:

1. Apply heat while circulating, slowly raising temperature to 160 degrees F (71 degrees C) and maintain for 12 hours minimum.
2. Remove heat and circulate to 100 degrees F (37.8 degrees C) or less; drain systems as quickly as possible and refill with clean water.
3. Circulate for 6 hours at design temperatures, then drain.
4. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents on recommendation of system cleaner supplier and approval of UNL Representative.

D. Fill glycol closed systems with clean water for one hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

A. Introduce closed system treatment through bypass feeder when required or indicated by test.

END OF SECTION 232500

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SECTION 233113 - DUCTWORK

1. GENERAL

1.1 SECTION INCLUDES

- A. Metal ductwork.

1.2 RELATED SECTIONS

- A. Section 230500 – Basic HVAC Requirements.
- B. Section 230529 – HVAC Hangers and Supports.
- C. Section 230713 - Ductwork Insulation: External insulation and duct liner.
- D. Section 233300 - Ductwork Accessories.
- E. Section 233600 - Air Terminal Units.
- F. Section 233700 - Air inlets and Outlets.
- G. Section 230593 - Testing, Adjusting and Balancing.

1.3 REFERENCES

- A. See Section 230500.

1.4 PERFORMANCE REQUIREMENTS

- A. No variation of duct configuration or sizes shall be permitted except by written permission.

1.5 SUBMITTALS

- A. See Section 230500.

1.6 PROJECT RECORD DOCUMENTS

- A. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

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1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with the following standards:
 - 1. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
 - 2. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
 - 3. SMACNA - HVAC Air Duct Leakage Test Manual.
 - 4. SMACNA – HVAC Duct Construction Standards - Metal and Flexible.
 - 5. SMACNA - Round Industrial Duct Construction Standards
 - 6. International Mechanical Code, most current edition.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum five years experience.

1.9 REGULATORY REQUIREMENTS

- A. Construct all ductwork per codes listed in section 1.7.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures during and after installation of duct sealants.

2. PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90. Provide mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Fasteners: Rivets, bolts, or sheet metal screws.
- C. Sealant: ASTM E84 and UL rated, NFPA 90A and 90B approved, Non-hardening, water resistant, fire resistive, compatible with mating materials; and rated for all pressure duct systems. Fabric and metal backed duct tapes are not acceptable.

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- D. Hanger Rod: ASTM A36; steel or galvanized, threaded.

2.2 SHOP FABRICATED DUCTWORK

- A. Fabricate, reinforce and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, latest edition, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, and elbows in accordance with SMACNA HVAC Duct Construction Standards-Metal and Flexible, latest edition, using radius of not less than 1-1/2 times width of duct on centerline. Where mitered rectangular elbows are used or indicated, provide dual wall airfoil turning vanes.
- C. Reference SMACNA figure 2-9 to construct gradual transitions where ductwork changes size or offsets.

2.3 MANUFACTURER FABRICATED DUCTWORK

- A. Fabricate, reinforce and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, latest edition, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Round and oval duct shall be spiral lockseam duct with light reinforcing corrugations unless indicated otherwise.
- C. Construct T's, bends, and elbows with minimum bend radius elbows shall be 1.5 times the duct diameter (major or minor axis on oval ductwork depending on direction of bend). Where not possible and where mitered elbows are used or indicated, provide double wall airfoil turning vanes.
- D. Fabricate round and oval duct; fittings in accordance with SMACNA Standards. Joints shall be minimum 2 inch insertion length for joint connections.
- E. Weld ductwork is to be weld with filler rod of the same material as the metal that is being welded. Coat welded joints with protective paint to prevent damage to galvanized surfaces.
- F. On round and oval ducts, provide 45 deg wye tee take-offs or 90 deg conical tee take-offs or 45 degree low loss entry tee take-offs or other fitting as indicated on plans. Straight taps are not acceptable.

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2.4 TRANSVERSE DUCT CONNECTION SYSTEM – RECTANGULAR DUCT

- A. Slide on flange system: Ductmate and Ductmate WDCI connection system complete with interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips. Gasket material shall be chemical resistant material in all fume exhaust ductwork.
- B. Formed on flange system: TDC, TDF or equivalent connection system or equivalent. Such flanges shall be constructed as SMACNA T-24 flange (Page 1-25 and 1-37 '85 SMACNA Duct Construction Manual, 1985 Edition).

2.5 TRANSVERSE DUCT CONNECTION SYSTEM – ROUND AND OVAL DUCT

- A. Slip type connector: Keating coupler.
- B. Slide on flange system. Spiralmate and Ovalmate connection system complete with interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.
- C. Formed on flange system: Factory-applied Van Stone connection on one end of the duct with field-applied Van Stone connector on the other end of the duct. Provide factory-applied Van Stone connections on each end of fittings.

2.6 ROUND STEEL DUCT

1. Round Steel single and double wall Spiral Ducts shall exceed ASHRAE and SMACNA Class 3 leakage tests.
2. Round single wall spiral duct shall be ASTM A-653 G-90 galvanized steel.
3. Round single wall spiral duct that is to be painted shall be ASTM A-653 A60 paint grip. Refer to specification section 23 05 00 for locations where ductwork is to be painted.
4. Double Solid Wall Galvanized Round Steel Ducts: Outer shell ASTM A-60 paint grip steel with solid inner shell ASTM A-653 G-90 galvanized steel. Insulation shall be 1" 1 ½ pound density per cubic foot that comply with NFPA 90A and NFPA 90B, NAIMA Standard AHC-101, ASTM C 1071 Type 1, thermal conductance "C" of 0.28 and resistance "R" of 3.6 per ASTM C177 with mean temperature of 75°F.
5. Fittings and couplings for double wall duct shall be made with slip coupling on the interior and Keating Koupling connector on the exterior. Keating Koupler connectors shall be constructed with integral sealant pocket on both sides of central stiffening rib. A bead of butyl rubber sealant shall be factory applied in each pocket when the connector is facricated
6. Painted duct is to galvanneal or paint grip. Paint grip shall be ASTM A-653 A60 sheet metal. Refer to specification Section 23 05 00 for location where ductwork is to be painted.

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7. Practice Gym Double Wall Galvanized Round Steel Ducts: Outer shell ASTM A-60 paint grip steel with perforated inner shell ASTM A-653 G-90 galvanized steel. Insulation shall be 1" 1 ½ pound density per cubic foot that comply with NFPA 90A and NFPA 90B, NAIMA Standard AHC-101, ASTM C 1071 Type 1, thermal conductance "C" of 0.28 and resistance "R" of 3.6 per ASTM C177 with mean temperature of 75°F.

3. EXECUTION

3.1 INSTALLATION

- A. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round in lengths not less than 10 feet, unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install only low loss high efficiency fittings at takeoffs. Extractors not allowed.
- G. Install couplings tight to duct wall surface with a minimum of projections into duct.
- H. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- I. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- J. Install ducts with a clearance of 2 inch, plus allowance for insulation thickness.
- K. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- L. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- M. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

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- N. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.
- O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Firestopping."
- P. Verify location of air outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Refer to reflected ceiling plans, finish schedule, material finish specification, and shop drawings.
- Q. Coordinate routing with all other trades to establish space requirements for each.
- R. Contractor may vary route and shape of ductwork and make offsets during progress of work if required to meet structural or other interferences at no additional costs to the owner. Where such changes impair the system performance, the changes will be corrected at Contractor's expense.
- S. All ductwork shall be substantially and neatly supported on galvanized steel straps or angles riveted or bolted to duct flanges and properly anchored to the construction so that horizontal ducts are without sag or sway, vertical ducts are without buckle, and all ducts are free from the possibility of deformation, collapse or vibration. Support at each joint and at 4 feet on center maximum.
- T. Openings required for ductwork through structural elements in new construction shall be coordinated with the General Contractor. Shop drawings locating such openings shall be prepared in ample time to meet the construction schedule.
- U. Provide sleeves at all duct penetrations through walls, floors and roofs. Openings through sound-rated partitions shall have annular space stuffed with fiberglass insulation for full thickness of wall.
- V. Provide 2-inch deep bitumastic coated drip pans on all non-ducted hoods, fans or penthouses used for relief or exhaust air service. Pans shall be 12 inches larger all around than roof opening with clear vertical openings between pan and structure as indicated. Insulate pan where indicated.
- W. Install automatic control dampers where indicated on plans. Install dampers as recommended by the manufacturer.

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- X. Prevent passage of unfiltered air around filters with felt, rubber, neoprene gaskets, or other approved safing material.
- Y. Provide openings in ductwork to accommodate thermometers and controllers. Provide pitot tube openings for testing of systems, complete with metal cap with spring device or screw to prevent air leakage.
- Z. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- AA. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Keep openings covered until ready for continuing duct run or final connections.
- BB. Paint ductwork visible behind wall-mounted air outlets and inlets matte black.
- CC. Change duct sizes gradually, not exceeding 30 degrees (15 degrees ideally) divergence and 45 degrees (30 degrees ideally) convergence.
- DD. Use crimp joints with or without bead for joining round duct sizes 8 inches and smaller and install with crimp in direction of air flow.
- EE. Provide closure flanges around exposed ductwork at wall and ceiling penetrations, 1-1/4 inches wide minimum.
- FF. Provide return air grilles open to ceiling plenum with duct boot with minimum longitudinal dimension 2' X 2'.
- GG. Provide flexible connection between ductwork and all moving equipment.
 - 1. Provide 1-inch slack for free movement.
- HH. Join VAV boxes to medium pressure supply duct mains with minimum straight length of duct equal to 5 times box inlet diameter size. Duct to be rigid. Flexible ductwork is not allowed to join boxes to supply duct main.
- II. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction".
- JJ. Incidental work:
 - 1. The following incidental work shall be furnished by the Contractor:
 - a. The Contractor shall install all automatic dampers furnished by FMS contractor.

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- b. The Contractor shall provide all fire and fire/smoke dampers throughout the air distribution system. Install dampers with angle provision for access/service/electrical connection.
- c. The Contractor shall provide access doors or other approved means of access through ducts for service to control equipment.
- d. Supply and return air motorized smoke dampers shall be provided by the Contractor as isolation dampers on all air handling units 15,000 cfm and larger, as required by NFPA 90A and indicated on the plans.
- e. The contractor shall assist the asbestos abatement contractor by removing and reinstalling existing RA fire dampers if necessary to allow access into RA chases.

KK. Threaded cap test holes shall be provided in all ductwork. Test holes shall be installed after the reheat coil in all VAV boxes. Additional test holes shall be provided where advised by UNL BSM for their use in inserting pitot tubes. Provide extensions to allow for insulation thickness. Test holes shall be "Ventlok" or equal.

3.2 GENERAL

- A. Install in accordance with manufacturer's instructions; SMACNA HVAC Duct Construction Standards - Metal and Flexible, current edition and International Mechanical Code requirements.
- B. Seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, current edition. In addition, seal all adjustable elbows with mastic in and around the gores.
- C. Duct sizes are inside clear dimensions.
- D. Provide openings in ductwork where required to accommodate thermometers and controllers.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Use double nuts and lock washers on threaded rod supports.
- G. Vertical ducts shall be supported at each floor.
- H. Cover all exposed fiberglass insulation with duct tape and mastic. The use of duct tape without mastic is not acceptable.
- I. During construction provide temporary closures of metal or tape polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- J. Connect flexible ducts to metal ducts with nylon bands and foil faced duct tape on the interior and exterior surfaces of the flex duct.

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- K. Duct transition from round to rectangular and vice versa shall be made with rectangular to round duct transition fitting.
- L. Provide flange-type joint at transverse joints or seal as specified. All transverse joints shall be inspected by the owner prior to insulating ductwork.
- M. Duct work upstream of air terminal units shall be rigid duct with minimum four diameters of straight ductwork upstream of air terminal units.
- N. Air terminal take-offs from rectangular main ducts shall be lo-loss 45° take-offs, extractors are not allowed.
- O. Diffusers and register take-offs from rectangular duct mains shall be lo-loss 45° fittings, with integral balancing damper that is provided with stand-off bracket and quadrant lock. Extractors are not allowed.
- P. Exhaust grille/register branch duct connections to rectangular mains shall be lo-loss 45° entry fittings with integral balancing damper.
- Q. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- R. Cap ductwork seal all existing ductwork to remain for reuse with sheetmetal caps and duct sealant on all demolished branch take-offs and on the exterior surface of all existing duct seams, prior to re-insulation.

3.3 INSTALLATION OF 2" AND GREATER PRESSURE CLASS DUCTWORK (POSITIVE OR NEGATIVE PRESSURE)

- A. All round and oval duct elbows installed shall be die-formed, gored, pleated or mitered. All mitered elbows shall be equipped with turning vanes.
- B. On round and oval ducts, provide 45 deg wye or 90 deg conical tee take-offs as indicated on plans. Straight taps are not acceptable.
- C. All diverging flow fittings shall be constructed such that no excess material projects from the body into the branch tap entrance.
- D. Transverse joints of all rectangular ducts greater than 24" wide or deep shall be fabricated with flanging system as called out previously (Ductmate or equivalent).

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3.4 DUCTWORK SCHEDULE

Duct System:	Material:	Longitudinal Joints:	Transverse Joints:	Pressure Class:	Sealant Class:	Leakage Class:	Additional Notes:
Round combustion air upstream of boiler	Galv. Steel	3C	4B	-2"	A	12	N/A

DUCTWORK SCHEDULE NOTES:

Longitudinal Joint Options:

- 3A: Pittsburgh lock. Refer to Figure 1-5, SMACNA.
- 3B: Button punch snap lock. Refer to Figure 1-5, SMACNA.
- 3C: Spiral lockseam.
- 3D: Snaplock.
- 3E: Welded.
- 3F: Double-wall, pre-manufactured sheet metal plenum.

Transverse Joint Options:

- 4A: Pre-manufactured flanged duct connection system specified under "Products" section of this specification.
- 4B 0-24" Major Axis Diameter: Interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening.
 26" Major Axis Diameter and Up: Pre-manufactured flanged duct connection system specified under "Products" section of this specification.
- 4C: Any standard transverse joint as shown in Figure 1-4 of SMACNA is acceptable.
- 4D: Welded

Sealant Class Options:

- 6: Seal class is defined by the following table (refer to Table 4-1, SMACNA HVAC Air Duct Leakage Test Manual):

Seal Class:	Sealing Required:
A	All transverse joints, longitudinal seams, and ductwork penetrations. Pressure sensitive tape shall not be used as a primary sealant on metal ducts.
B	All transverse and longitudinal seams. Pressure sensitive tape shall not be used as a primary sealant on metal ducts.
C	Transverse joints only.

Leakage:

- 7: Leakage Class is defined by Figure 4-1, SMACNA HVAC Air Duct Leakage Test Manual.

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3.5 PRESSURE TESTING

- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 3. Maximum Allowable Leakage: Refer to paragraph 3.7.
 4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

END OF SECTION 233113

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SECTION 235100 - BREECHINGS, CHIMNEYS AND STACKS

1. GENERAL

1.1 SECTION INCLUDES

- A. Manufactured double wall chimneys for fuel fired equipment.

1.2 RELATED SECTIONS

- A. Section 230500 - Basic Mechanical Requirements.

1.3 REFERENCES

- A. Reference Section 230500.

1.4 SUBMITTALS FOR REVIEW

- A. Reference Section 230500.

1.5 QUALITY ASSURANCE

- A. Reference Section 230500.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Reference Section 230500.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code, NFPA 54 (ANSI Z223.1) code for installation of natural gas burning appliances and equipment.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction] as suitable for the purpose specified and indicated.

2. PRODUCTS

2.1 DOUBLE WALL POSITIVE PRESSURE FLUE STACKS

- A. Provide double wall positive pressure air insulated metal stacks, tested to UL 1738 / ULC S636 and UL listed for use with listed natural gas or propane burning equipment that produce continuous flue gas temperatures not above 550 deg. F. Approved for use on ANSI Category I, II, III, and IV gas burning appliances and Direct Vent Application with building heating equipment, burning gas, solid or liquid fuel, in compliance with NFPA 211.
- B. Fabricate with 1 inch minimum air space between walls. Construct inner and outer jacket of AL 29-4C stainless steel equivalent to Heat Fab model CI Plus double wall or equivalent.

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- C. Tees: UL-labeled tees 45 degree laterals, 90 degree wye, elbows, increasers adjustable lengths, draft hood connectors, drain tee cap, metal cap with bird barrier, wall and floor guide assemblies, wall, floor and plate support assemblies, adjustable roof flashing, storm collar, support assembly, vented thimbles, fire stop spacers, and fasteners fabricated of similar materials and designs as vent pipe straight sections for a complete and operable system.

3. EXECUTION

3.1 INSTALLATION OF FLUE SYSTEM

- A. Install per all system manufacturer recommendations and per equipment manufacturer recommendations.
- B. Connect to equipment per manufacturer recommendations.
- C. Inner pipe joints shall be sealed by use of factory supplied overlapping V bands and sealant as specified in the manufacturer's installation instructions.
- D. Roof penetrations shall be suitable for the roof type and shall be according to the manufacturer's detail drawings and installation instructions. Field verify existing roof construction.
- E. When installed according to the manufacturer's installation instructions, the flue piping and its supporting system shall resist side loads at least 1.5 times greater than the weight per foot of the piping for both horizontal and vertical portions of the system.
- F. Flue support system shall be constructed to be compatible with new flue materials as recommended by the flue manufacturer, coordinated with existing conditions, and supported from existing building structure.
- G. The flue system shall be installed according to the manufacturer's installation instructions and shall conform to all applicable state and local codes.
- H. Provide all supports, guides, bellows type expansion joints, pressure relief valves, guy sections, roof thimbles, roof flashings, storm collars and terminations as required to provide a complete system per the manufacturer's installation instructions for actual required installation.
- I. The entire flue system from the equipment discharge to the termination point, including all accessories, except as noted, shall be from one manufacturer.
- J. For horizontal offsets, slope flue system back toward equipment according to equipment manufacturer recommendations.
- K. Terminate a minimum of 3'-0" to max. 5'-0" above the light well parapet and adjacent roof, coordinate with project engineer.

3.2 INSTALLATION - GENERAL

- A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

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- B. Support at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- C. Lap joints in direction of flow.
- D. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.
- E. Install all positive pressure, double wall gas vents and Type B gas vents in accordance with manufacturer's installation instructions and UL listing. Maintain minimum clearances from combustibles specified in UL listing.
- F. Seal joints between sections of positive pressure vents in accordance with manufacturer's instructions, and using only sealants recommended by manufacturer.
- G. Support vents at intervals recommended by the manufacturer to support the weight of the vent and all accessories, without exceeding loading of supplies.
- H. Install in accordance with NFPA 54 .
- I. Maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.
- J. Level and plumb chimney and stacks.
- K. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.
- L. Finish: All aluminized surfaces exposed to the atmosphere shall be protected by a minimum of one base coat and one finish coat of paint.

3.3 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

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3.4 SCHEDULES

A. EQUIPMENT

BREECHING

CHIMNEY/STACK

Boilers

Double Wall

Double Wall

END OF SECTION 235100

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SECTION 260000 - ELECTRICAL WORK

1. GENERAL

1.1 RELATED DOCUMENTS

- A. The General Conditions and Supplementary Conditions are applicable to all contracts for the project.

1.2 DESCRIPTION OF WORK

- A. The work included under this Section consists of providing all work, supervision, and construction procedures necessary for the installation of the complete electrical systems required by these specifications and/or shown on the drawings of the contract.
- B. Install and connect all appliances and equipment as specified and indicated for this project, in accordance with the manufacturer's instructions and recommendations. Furnish and install complete electric connections and devices as recommended by the manufacturer or required for proper operation.

1.3 ACCESS TO EQUIPMENT

- A. Starters, switches, receptacles, pull boxes, etc., shall be located to provide for easy access for operations, repair and maintenance; if concealed, access doors shall be provided.

2. SHOP DRAWINGS

2.1 The Contractor shall furnish shop drawing portfolios and proper transmittal forms for all materials, equipment, and lighting fixtures to be incorporated in the work, in accordance with the General Conditions, Supplementary Conditions, and all other applicable Conditions.

2.2 Shop drawings on component items forming a system or that are interrelated shall be submitted at one time as a single submittal in order to demonstrate that the items have been properly coordinated and will function properly as a system. A notation shall be made on each shop drawing submitted as to the items specific use, either by a particular type number referenced on the drawings or in the specifications, or by a reference to the applicable paragraph of the specifications or by a description of its specific location. The shop drawings shall be organized and bound into sets with each set collated.

2.3 The Architect/Engineer shall have the final authority as to whether the fixture is equal to the specified item. The proposed substitution may also be rejected for the aesthetic value if felt necessary or desirable. In the event the proposed substitutions described are rejected, the Contractor shall furnish the specified item.

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3. CODES AND STANDARDS

- 3.1 The electrical work shall be in accordance with all applicable state and local codes, building ordinances and the N.E.C. The electrical work shall merit the approval of the state and local enforcing authorities.

4. PERMITS AND FEES

- 4.1 The Contractor shall pay for all permits and/or fees required for the work.

5. MATERIALS AND WORKMANSHIP

- 5.1 All materials shall be new and of the quality specified. Materials shall be standard products of manufacturer's regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design. Electrical material and equipment used in the work shall meet the requirements as specified under paragraph three of this section, CODES AND STANDARDS.

- 5.2 All work installed under this Division of the Specifications shall be first class and complete in both effectiveness and appearance, whether finally concealed or exposed, and shall be executed by experienced mechanics.

6. INSTALLATION METHODS

- 6.1 Conductors shall be installed in concealed raceways except as shown or specified on the Contract Documents. Exposed conduits and wires shall be installed parallel or perpendicular to all building surfaces. Conduits and wires in the space above ceilings shall be supported adequately and not laid on the top of ceiling systems. All conduits and wires installed above ceilings shall be considered exposed.

- 6.2 Electrical conduits shall not be hung on hangers with any other service foreign to the electrical systems, nor shall they be attached to other foreign services.

- 6.3 The lighting and power branch circuit conductors shall be installed in separate raceway systems unless specifically shown or noted otherwise.

- 6.4 Outlet Box Locations. Outlet boxes shall be located so they are not placed back-to-back in the same wall in order to limit sound transmission from room to room.

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6.5 PROTECTION FROM WEATHER

- A. Raceway stub ups shall be capped or otherwise protected from moisture and debris until such time that the conductors are pulled. Conductors shall not be installed in raceways until the building is protected from the weather, all concrete and plastering is completed and raceways in which moisture has collected have been swabbed or blown out.

6.6 WIRING - NUMBER OF WIRES REQUIRED

- A. The number of wires for lighting and receptacle branch circuits is not shown on the drawings. The number of wires in any circuit shall be determined in accordance with the National Electrical Code, and wiring shall be provided to perform all functions of the devices being installed. Additionally, wires shall be provided as required by the contract documents, i.e. equipment grounds, etc. Provide the number of wires required for a complete and workable system.

6.7 PAINTING, FINISHING

- A. Painting of electrical work exposed in occupied spaces, except mechanical and electrical machine rooms and maintenance/service spaces; and work exposed on the exterior is specified and performed under other divisions of these specifications.
- B. Factory finishes, shop priming, and special protective coatings are specified in the individual equipment specification sections.
- C. Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

6.8 CABLE AND CONDUIT SEALS

- A. Seals shall be provided around conduits and cables which penetrate smoke walls, fire walls, and floors. Nelson Flameseal system shall be used to seal penetrations of electrical cables and conduits.
- B. Materials used shall be as follows:
 - 1. Flameseal putty.
 - 2. Ceramic fiber insulation.
 - 3. Ceramic fiber board shall be required to provide rigid support on large oversized openings. Board shall be rigid and able to withstand temperatures in excess of 2000 degrees F.
 - 4. Accessory hardware shall be required on oversized openings.
- C. Follow manufacturer's instructions in selecting the type of seals and accessories. Also follow the manufacturers instructions on installation of the cable and conduit seals.

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- D. Equal quality equipment by OZ Gedney and 3M shall be acceptable.

7. WORK IN EXISTING BUILDING

- 7.1 Where drawings indicate work to be done in the existing building, the Contractor shall carefully examine such areas to determine the nature and extent of work involved before submitting his bid. The Contractor shall be responsible for all damage to existing items and utilities due to the progress of his work, and shall repair all such items or replace same to an approved condition at his own expense.

8. EXISTING MATERIAL

- 8.1 Refer to the Supplementary Conditions Section of this specification for the disposition of all salvageable material.

9. ELECTRICAL-MECHANICAL EXTENT OF WORK

- 9.1 The responsibility of work specified under Division 22 and 23 is clarified under Section 230500, Electrical Requirements for Mechanical Equipment. Said Section 230500 is incorporated herein by reference.

10. CUTTING AND PATCHING

- 10.1 The Contractor shall be responsible for all cutting and patching of holes in the building which are required for the electrical work. Cutting, patching and painting shall conform to the requirements of the General Conditions of this specification.
- 10.2 Cutting of structural framing, walls, floors, decks and other members intended to withstand stress is not permitted.
- 10.3 All patching shall be finished and painted to match existing.

11. COORDINATION

- 11.1 Coordinate the locations and purchasing of equipment between other trades to ensure proper interfacement and placement of equipment requiring electrical power.
- 11.2 Coordinate other work of the different trades so that:
 - A. Interference's between mechanical, electrical, architectural, and structural work, including existing services, is avoided.
 - B. Within the limits indicated on the drawings, the maximum practicable space for operation, repair, removal and testing of electrical, and other equipment will be provided.

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- C. Pipe, conduits, ducts, and similar items, shall be kept as close as possible to ceilings, walls, columns, to take up a minimum amount of space. Pipes, conduits, ducts, and similar items shall be located so that they will not interfere with the intended use of other equipment.

12. OUTLET BOXES, PULL BOXES AND CONDUIT FITTINGS

12.1 Furnish and install outlet boxes, pull boxes, and conduit fittings as described below. Catalog numbers shown are Appleton Electric Company. Equal materials by Steel City, O.Z., and Raco, are acceptable.

12.2 OUTLET BOXES

- A. Flush Switches, Receptacles - Telephone and Flush Junction Boxes No. 4S-3/4 (with box covers or No. 225) where extension or plaster ring cannot be used. (Provide Extension Ring or Plaster Ring as required)
- B. Switch, Receptacle and Telephone-Boxes (exposed) 4S-3/4 with 8360 or 8370 Series raised surface cover.

12.3 Extension and plaster rings shall be installed as required by the NEC.

12.4 Outlet boxes shall comply with the National Electrical Code in regard to the allowable fill.

12.5 PULL BOXES

- A. Pull boxes shall be fabricated of code gauge galvanized sheet metal and shall be sized in accordance with National Electrical Code requirements, or as shown on the drawings. Provide removable cover on the largest access side of the box. In-line conduit pull boxes may be O.Z., Type PBW, or equal.

13. RACEWAYS AND FITTINGS

13.1 Steel Conduit. Rigid steel conduit, intermediate conduit and electric metallic tubing shall be hot dipped, galvanized as manufactured by Youngston Sheet and Tube Company, National Electric or equal.

13.2 Wiremold shall be used only after Owner's approval. Wiremold shall be painted to match walls, or in accordance with the Architects' direction.

13.3 Joints. All threaded joints shall be made up wrench-tight and rain-tight. Compression joints shall be made up mechanically secure and snug so as to take continuous current-carrying electrical contacts.

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- 13.4 Provide marking of conduit and junction boxes to indicate which distribution system they are serving. Concealed junction boxes shall be legibly marked with a magic marker to indicate the panel and circuit number that junction box serves.

14. CONDUCTORS

- 14.1 All conductors shall be 600 volt and shall be copper with THW or THHN insulation. No wire shall be smaller than No. 12.
- 14.2 All wires shall be installed in conduit.
- 14.3 Conductors shall be continuous from outlet to outlet and no splices shall be made except within outlet or junction boxes. Junction boxes may be used where required.

15. GROUNDING

- 15.1 Green ground conductor shall be installed in each conduit.
- 15.2 Grounding and bonding of electrical circuit and equipment shall be accomplished as set forth in the NEC.
- 15.3 Ground HVAC ductwork and equipment to the C.O. equipment ground. (Not C.O. ground window). Use No. 6 insulated conductor.

16. SAFETY SWITCHES

- 16.1 Furnish and install heavy duty type safety switches having the electrical characteristics, ratings and modifications shown on the drawings. All switches shall have:
- A. NEMA 1 general purpose (indoor) enclosures unless otherwise noted;
 - B. Handle that is padlockable in "OFF" position;
 - C. Non-teasible, positive quick-make, quick-break mechanism;
 - D. UL approved and shall bear the UL label;
 - E. All fusible switches shall have Class R fuse rejection clips.

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17. LOCK-OUT PUSH BUTTONS

17.1 Lock-out push buttons where shown on the drawings, or wherever required, for remote lock-out of motors shall be Westinghouse Catalog No. 1033-321 (surface mounted) 1033-410 (flush mounted) push button with enclosure and Catalog No. 1032907 padlock type rotary latch. At the Contractor's option where, lock-out push buttons are shown, the contractor may provide non-fusible disconnect switches for the motor circuit if space is adequate.

18. MANUFACTURERS

18.1 Safety switches, motor controllers, and lock-out pushbuttons manufactured by Westinghouse, Square D, ITE, Gould, or General Electric are acceptable. All major components shall be of the same manufacturer.

19. FUSES

19.1 Fuses shall be furnished and installed in each fused switch, and shall have ratings as shown on the drawings.

19.2 All cartridge fuses shall be dual element Bussman Fusetron Class R Type unless otherwise noted. Three spare fuses shall be furnished for each size used. Each fused switch shall be provided with a mastic backed label clearly identifying the type and size of fuse required. Bussman HICAP Class R fuses shall be provided for fuses larger than 600 amps.

20. MOUNTING HEIGHTS

20.1 Mounting heights to center of box and above finished floor for the below-named items shall be as follows, unless otherwise shown. All other device mounting heights shall be as shown on the drawings.

- A. Safety switches 54"
- B. Lock-out push button 36" minimum

20.2 Contractor shall check all equipment layouts and verify exact mounting heights.

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21. NAMEPLATES

21.1 Nameplates shall be provided for all items such as safety switches, individual breakers and controllers in switchboards and motor control centers, control devices and other significant equipment.

- A. Nameplates shall be 1" x 2-1/2" laminated black phenolic resin with a white core with engraved lettering, a minimum of 3/16-inch high. Manufacturers factory installed nameplates shall be acceptable provided all information is furnished.
- B. Nameplates shall identify the equipment item that the device is serving and also from where the device is being fed from.

22. PROTECTION

22.1 Protection of existing equipment and facilities shall be provided and coordinated with the Owner.

23. OUTAGES

23.1 All outages shall be scheduled and approved by the Owner. Contractor shall submit in writing a document indicating the times of day and duration of all electrical outages.

24. ASBESTOS

24.1 If asbestos is encountered or suspected during the course of work, stop all work and notify the Architect/Engineer immediately.

25. AS-BUILT DRAWINGS

25.1 Contractor shall provide the Owner as-built drawings for all systems including electrical and special systems described in specifications. This shall consist of all drawings, wiring schematics, and diagrams for the fire alarm, telephone and data systems, as well as, any change to the systems shown on the drawings.

END OF SECTION 260000