THE MEDICAL CENTER OF AURORA

DOMESTIC HOT WATER SYSTEM UPGRADE

1501 S. POTOMAC ST.
AURORA, CO 80012

PREPARED BY:
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PROJECT LOCATION:



SALAS O'BRIEN
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MEP/FP Engineering
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Health ONE The Medical Center of Aurora

Seal / Signature

COLORADO LICENSED
MICHAEL P THOMPSON
56150
PROFESSIONAL ENGINEER

No.	Date	Description

Project Name
DOMESTIC HOT WATER SYSTEM UPGRADE

Project Address
THE MEDICAL CENTER OF AURORA
1501 S POTOMAC ST,
AURORA, CO 80012

Salas O'Brien Project Number
2022-02900-00

Consultant Project Number

Sheet Title
COVER SHEET

Sheet Number
G000

Scale

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MECHANICAL ABBREVIATIONS

AAV	AUTOMATIC AIR VENT (VALVE)
AB	AIR BLENDER
AC	AIR CONDITIONING UNIT OR AIR COMPRESSOR
ACH	AIR CHANGES PER HOUR
AD	ACCESS DOOR
AF	AIR FILTER
AFC	AUTOMATIC FLOW CONTROL DEVICE
AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
ALUM	ALUMINUM
AMP	AMPERE
AMS	AIR FLOW MEASURING STATION
AP	ACCESS PANEL
APD	AIR PRESSURE DROP
ARCH	ARCHITECT/ARCHITECTURAL
AS	AIR SEPARATOR
AUTO	AUTOMATIC
AVG	AVERAGE
BAS	BUILDING AUTOMATION SYSTEM
BD	BALANCING DAMPER
BDD	BACK-DRAFT DAMPER
BHP	BRAKE HORSEPOWER
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
BTUH	BRITISH THERMAL UNIT PER HOUR
CAP	CAPACITY
CC	COOLING COIL
CCW	COUNTER CLOCKWISE
CD	CONDENSATE DRAIN
CF	CUBIC FEET
CFH	CUBIC FEET PER HOUR
CFM	CUBIC FEET PER MINUTE
CH	CHILLER
CL	CENTER LINE
CO	CLEAN OUT OR CARBON MONOXIDE
CONT	CONTINUOUS, CONTINUATION
CP	COIL PUMP
CT	COOLING TOWER
CU	CONDENSING/ER UNIT
CU FT	CUBIC FEET
CV	CONSTANT AIR VOLUME
CW	COLD WATER OR CLOCKWISE
D	DRAIN
DB	DECIBEL OR DRY BULB TEMPERATURE
DDC	DIRECT DIGITAL CONTROL
DE	DRYER EXHAUST
DER	DRYER EXHAUST RISER
DEG.F	DEGREE FARENHEIT
DG	DOOR GRILLE
DIA	DIAMETER
DIFF	DIFFUSER
DISCH	DISCHARGE
DN	DOWN
DP	DIFFERENTIAL PRESSURE
DWG	DRAWING
DX	DIRECT EXPANSION
(E)	EXISTING
E	EXHAUST
EA	EACH
EAT	ENTERING AIR TEMPERATURE
EBB	ELECTRIC BASEBOARD HEATER
EC	ELECTRICAL CONTRACTOR
ECH	ELECTRIC CABINET HEATER
EER	ENERGY EFFICIENCY RATIO
EF	EXHAUST FAN
EFF	EFFICIENCY
EG	ETHYLENE GLYCOL-WATER SOLUTION (% GLYCOL BY VOLUME)
EHC	ELECTRIC HEATING COIL
ELEC	ELECTRIC/ELECTRICAL
EL/ELEV	ELEVATION
ENT	ENTERING
EQUIP OR EQT	EQUIPMENT
E/RF	EXHAUST/RETURN FAN
ESP	EXTERNAL STATIC PRESSURE
ET	EXPANSION TANK
EUH	ELECTRIC UNIT HEATER
EWT	ENTERING WATER TEMPERATURE
EXH	EXHAUST
EXIST	EXISTING
F	FILTER
°F	DEGREE FARENHEIT
FA	FREE AREA
FD	FIRE DAMPER
FLA	FULL LOAD AMPERES
FLEX	FLEXIBLE
FOR	FUEL OIL RETURN
FOS	FUEL OIL SUPPLY
FOV	FUEL OIL VENT

FPB	FAN POWERED TERMINAL UNIT
FP	FIRE PROTECTION
FPM	FEET PER MINUTE
FPS	FEET PER SECOND
FS	FREEZE STAT
F/SD	COMBINATION FIRE/SMOKE DAMPER
FT	FEET OR FLASH TANK
FTR	FIN TUBE RADIATION (HOT WATER)
FV	FACE VELOCITY
GA	GAUGE
GAL	GALLON
GC	GENERAL CONTRACTOR
GD	GRAVITY DAMPER
GEN	GENERAL
GE	GENERAL EXHAUST
GER	GENERAL EXHAUST RISER
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
H	HUMIDISTAT
HC	HEATING COIL
HORIZ	HORIZONTAL
HP	HORSEPOWER OR HEAT PUMP
HR	HOUR
HTG	HEATING
HUM	HUMIDIFIER
HVAC	HEATING, VENTILATION & AIR CONDITIONING
HX	HEAT EXCHANGER
HZ	HERTZ
ID	INSIDE DIAMETER
IN OR "	INCH
INSUL.	INSULATION
IN W.C.	INCHES WATER COLUMN
IN W.G.	INCHES WATER GAUGE
KE	KITCHEN EXHAUST
KER	KTICHEN EXHAUST RISER
KW	KILOWATT
KWH	KILOWATT HOUR
LAT	LEAVING AIR TEMPERATURE
LBS	POUNDS
LL	LOW LIMIT OR LANDLORD
LP	LOW PRESSURE GAS
LRA	LOCKED ROTOR AMPERES
LVG	LEAVING
LWT	LEAVING WATER TEMPERATURE
MAX	MAXIMUM
MB	MIXING BOX
MBH	THOUSAND BTU PER HOUR
MIN	MINIMUM OR MINUTE(S)
MD	MOTORIZED DAMPER
MP	MEDIUM PRESSURE GAS
NC	NORMALLY CLOSE OR NOISE CRITERIA
NIC	NOT IN CONTRACT
NK	NECK
NO	NORMALLY OPEN
NO OR #	NUMBER
NR	NOT REQUIRED
NTS	NOT TO SCALE
NV	NATURAL VENTILATION
OA	OUTSIDE AIR
OAI	OUTSIDE AIR INTAKE
OBD	OPPOSED BLADE DAMPER
OD	OUTSIDE DIAMETER
OPNG	OPENING
OV	OUTLET VELOCITY OR OVAL
P	PUMP
CTP	COOLING TOWER PUMP
CWP	CONDENSER WATER PUMP
PC	PLUMBING CONTRACTOR
PCD	PUMPED CONDENSATE DISCAHRGE
PG	PROPYLENE GLYCOL-WATER SOLUTION (%GLYCOL BY VOLUME)
PLBG	PLUMBING
PRESS	PRESSURE
PRV	PRESSURE REDUCING VALVE
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAUGE
R	RETURN OR RISER
RA	RETURN AIR
REQ'D	REQUIRED
RH	RELATIVE HUMIDITY
RHC	REHEAT COIL
RO	RELIEF OPENING
RP	RADIANT PANEL
RPM	REVOLUTIONS PER MINUTE
RV	RELIEF VALVE (VENT) OR ROOF VENTILATOR
S	SUPPLY
SA	SOUND ATTENUATOR

SF	SUPPLY FAN OR SQUARE FEET
SHT	SHEET
SL	SENSIBLE LOAD
SP	STATIC PRESSURE
SPECS	SPECIFICATIONS
SQ	SQUARE
SQ.FT.	SQUARE FEET
SS	STAINLESS STEEL
STD	STANDARD
STRUC	STRUCTURE/STRUCTURAL
T	THERMOSTAT/TEMPERATURE SENSOR
TD	TEMPERATURE DIFFERENCE OR TRANSFER DUCT
TEF	TOILET EXHAUST FAN
TER	TOILET EXHAUST RISER
TEMP	TEMPERATURE
TO	TRANSFER OPENING
TSP	TOTAL STATIC PRESSURE
TYP	TYPICAL
UC	UNDER-CUT (DOOR)
UH	UNIT HEATER
UON	UNLESS OTHERWISE NOTED
V	VENT
VAV	VARIABLE AIR VOLUME
VD	VOLUME DAMPER
VEL	VELOCITY
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
VOL	VOLUME
VSD	VARIABLE SPEED DRIVE
W	WATT
W/	WITH
WC	WATER COLUMN
WFD	WATER PRESSURE DROP
WMS	WIRE MESH SCREEN
WT	WEIGHT
XA	VARIABLE LENGTH ACCESS

SOUND ATTENUATOR

UC OR DG — DG: DOOR GRILLE; UC: DOOR UNDERCUT

T — THERMOSTAT

T — THERMOSTAT MOUNTED TO THERMOISOLATING PAD IF ON EXTERIOR COLUMN

T — DUCT MOUNTED THERMOSTAT

H — HUMIDISTAT

SD — SMOKE DETECTOR

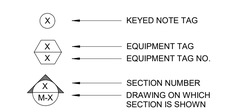
CD — CARBON MONOXIDE DETECTOR

CO2 — CARBON DIOXIDE DETECTOR

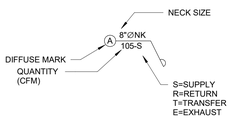
N.I.C. - FUTURE TENANT BUILDOUT

REQUIRED MAINTENANCE CLEARANCE

IDENTIFICATION SYMBOLS



AIR DEVICES DATA TAG



DUCTWORK SYMBOLS

DOUBLE LINE

(E)12X12 — EXISTING DUCT

EXISTING DUCT OR ITEM TO BE REMOVED

EXISTING DUCT OR ITEM TO REMAIN

BRANCH TAKE-OFF

RADIUS ELBOW

SQUARE TAP COLLAR

RADIUS TEE

BELLMOUTH CONNECTION TO RECT. DUCT

CONICAL TEE

WYE OR TEE

EXHAUST/RETURN AIR DEVICE

24X12 — RECT. DUCT DIMENSIONS (SIZE IN INCHES. FIRST DIM. IS SHOWN)

24Ø — ROUND DUCT DIMENSIONS DIAMETERS

24/12 — FLAT OVAL (SIZE IN INCHES) (FIRST DIM. IS SHOWN)

DUCT TRANSITION

ELBOW TURNED DOWN

ROUND DUCT DN

SUPPLY AIR DUCT

EXHAUST AND RETURN DUCT

OUTSIDE AIR INTAKE

FLEX. DUCT CONNECTION

FD — FIRE DAMPER

CLEAN OUT

MANUAL DAMPER

MD — MOTORIZED (AUTOMATIC) DAMPER

LLMD — LOW LEAKAGE MOTORIZED DAMPER

AD — ACCESS DOOR

CAP

DN — DUCT OFF-SET DN (IN DIRECTION OF FLOW)

UP — DUCT OFF-SET UP (IN DIRECTION OF FLOW)

FLEXIBLE DUCT

AIR TERMINAL UNIT

AIR TERMINAL UNIT W/REHEAT

PIPING SYMBOLS

(E)SERVICE — EXISTING PIPE

EXISTING PIPE OR ITEM TO BE REMOVED

EXISTING PIPE OR ITEM TO REMAIN

CD — CONDENSATE DRAIN

CHWR — CHILLED WATER RETURN

CHWS — CHILLED WATER SUPPLY

CWR — CONDENSER WATER RETURN

CWS — CONDENSER WATER SUPPLY

D — DRAIN

G — NATURAL GAS

HWR — HOT WATER HEATING RETURN

HWS — HOT WATER HEATING SUPPLY

DHWR — DOMESTIC HOT WATER RETURN

DHWS — DOMESTIC HOT WATER SUPPLY

DCW — DOMESTIC COLD WATER

HPS — HIGH PRESSURE STEAM

LPS — LOW PRESSURE STEAM

V V — VENT

AIR SEPARATOR

DIRECTION OF FLOW ARROW

CONCENTRIC REDUCER

ECCENTRIC REDUCER

TEE

TEE TURNED DOWN

TEE TURNED UP

ELBOW 45°

ELBOW TURNED UP

ELBOW TURNED DOWN

PRESSURE GAUGE

FLANGE

CAPPED END CONNECTION

EXPANSION JOINT

FLEXIBLE CONNECTION

FM — FLOW METER

EXPANSION COMPENSATOR

BALL VALVE

PRESSURE INDEPENDANT FLOW CONTROL AND SHUT-OFF VALVE

BUTTERFLY VALVE

CHECK VALVE

HOSE END DRAIN VALVE

TRIPLE DUTY CHECK VALVE

GATE VALVE

GLOBE VALVE

MANUAL AIR VENT

M M — MOTORIZED 2-WAY OR 3-WAY CONTROL VALVE

SOLENOID VALVE

PRESSURE REDUCING VALVE

PRESSURE RELIEF VALVE

GAS COCK

PIPE UNION

STRAINER

SAFETY VALVE

VACUUM BREAKER

IN-LINE PUMP

PRESSURE GAUGE WITH COCK

THERMOMETER

FLOW SWITCH

PIPE ANCHOR

PIPE GUIDE

UNION

Y-TYPE STRAINER

Y-TYPE STRAINER WITH HOSE ENDED DRAIN VALVE

BASKET STRAINER

FILTER/DRYER

M — MOTOR ACTUATOR

T — CONDENSATE TRAP

PRESSURE-TEMPERATURE PORT

MECHANICAL CODE REFERENCE

2018 INTERNATIONAL EXISTING BUILDING CODE (IEBC)
2018 INTERNATIONAL BUILDING CODE (IBC)
2018 INTERNATIONAL MECHANICAL CODE (IMC)
2018 INTERNATIONAL PLUMBING CODE (IPC)
2018 INTERNATIONAL ENERGY CONSERVATION CODE (IECC)
LOCAL AMENDMENTS BY THE CITY OF AURORA, CO

MECHANICAL DRAWING LIST

SHEET #	SHEET NAME
M001	MECHANICAL ABBREVIATIONS, SYMBOLS, AND NOTES
M002	MECHANICAL SPECIFICATIONS
M003	MECHANICAL SPECIFICATIONS
M004	MECHANICAL SPECIFICATIONS
M005	MECHANICAL FLOW DIAGRAM
M006	MECHANICAL DETAILS & SCHEDULES
M100	CENTRAL PLANT PIPING PLAN

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Health ONE The Medical Center of Aurora

Seal / Signature

COLORADO LICENSED MICHAEL P. THOMPSON 53450 PROFESSIONAL ENGINEER

No.	Date	Description
	9/16/2022	100% CONSTRUCTION DOCUMENTS

Project Name
DOMESTIC HOT WATER SYSTEM UPGRADE

Project Address
THE MEDICAL CENTER OF AURORA
1501 S POTOMAC ST,
AURORA, CO 80012

Salas O'Brien Project Number
2022-02900-00

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Sheet Title
MECHANICAL SYMBOLS, ABBREVIATIONS & NOTES

Sheet Number
M000

Scale 1/8" = 1'-0"

RSN: 1686562
Permit#: 23-2272046-CT

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MECHANICAL SPECIFICATIONS

GENERAL PROVISIONS FOR MECHANICAL WORK

1.1 DESCRIPTION

A. The Drawings and Specifications shall be understood to cover systems of Heating, Ventilation and Air Conditioning, Building Automation Systems and Temperature Control, Medical Gas, and Insulation and Pipe Covering as shown on the drawings and as specified. The drawings and specifications are to be taken together. Work specified and not shown, or work shown and not specified, shall be as binding as though required by both, the drawings and specifications.

B. Minor items and accessories or devices not shown but reasonably referred as necessary to the complete and proper operation of any system shall be provided for such systems, whether or not they are specifically called for by the specifications or the drawings.

1.2 CONTRACTOR

A. Where the term "Mechanical Contractor" or "Contractor" is used it shall be understood to be a contractor providing singly or in combination Plumbing systems, Fire Protection systems, Heating, Ventilating and Air Conditioning systems, Temperature Control and Building Automation systems, Medical Gas Systems, Testing and Balancing, or Insulation and Pipe Covering as described in Division 23.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. Perform work strictly as required by rules, regulations, standards, codes, ordinances, and laws of Local, State, and Federal Governments, and any other authorities that have legal jurisdiction over the site.

B. Prior to commencement of work, notify State and authorities having jurisdiction as required and submit all of the applicable notifications for construction, operation and/or demolition.

C. This project and all fixtures, equipment and materials shall conform to the following agencies:
1. City of Aurora Building Code
2. State of Colorado Codes
3. Underwriters' Laboratories, Inc. (UL)
4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
5. Sheet Metal and Air Conditioning Contracts National Association, Inc. (SMACNA)
6. American National Standard Institute (ANSI)
7. American Society of Mechanical Engineers (ASME)
8. American Standard Testing Materials (ASTM)
9. National Fire Protection Association (NFPA)
10. American Gas Association (AGA)
11. National Electric Code (NEC)
12. Americans with Disabilities Act (ADA)

1.4 OWNER REQUIREMENTS

A. HCA maintains purchasing agreements for select equipment and materials which are outlined in the HCA Innovation Memorandums. All materials and equipment purchased under this contract shall comply with the Innovation memorandums.
1. Innovation Memorandum 07: All piping related items are to be purchased through Ferguson Enterprise (Alton Lassiter - 615-316-1848, alton.lassiter@ferguson.com). Items include but are not limited to:
a. Copper piping
b. Carbon steel piping
c. Polypropylene piping
d. Cross-linked polyethylene (PEX) piping and fittings
e. High-density polyethylene (HDPE)
f. Soil pipe and fittings
g. PVC/ABS pipe and fittings
h. Valves (all)
i. Steel pipe fittings and flanges
j. Brazed and sweat fittings.

1.5 RULES AND REGULATIONS

A. All work shall be installed in conformity with all governmental jurisdictional authorities regulations, laws, rules, or ordinances in effect and governing same; such rules and regulations and local ordinances to be considered part of Specifications. The Contractor shall be held strictly responsible for any violation of same and shall change his work to conform without additional cost to Owner.

B. All work shall also conform to the published standards of the National Fire Protection Association and electrical work and equipment shall conform to requirements of the current issue of the National Electrical Code.

C. All materials, in general, shall be Underwriters' Laboratories listed and shall bear UL label where labeling service is available.

D. All Contractors on job shall cooperate and assist each other in conforming with all trade jurisdictional rulings. They shall perform all work covered by drawings and specifications which properly comes under the jurisdiction of the particular trade he represents. In addition, they shall include, by sub-contract if necessary, such work of other trades that is either incidental to his trade, or is specified to be included in his contract or sub-contract.

E. Where jurisdictional rules require assistance of mechanics of trades other than those ordinarily employed by a particular Mechanical Contractor in the handling, storage or setting of special equipment, the Mechanical Contractor shall employ such tradesmen so as to be in conformance with local jurisdictional agreements.

1.6 SCOPE

A. It is the intent of the Specifications and Drawings to establish minimum requirements for methods, products, and equipment, and to ensure systems be finished, tested and ready for operation. Incidental details not usually shown or specified, but necessary for proper installation and operation, shall be included in the work the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation determine the exact route and location of each raceway, pipe and piece of equipment to minimize conflicts with other trades.

1.7 CONTRACT DOCUMENTS

A. Extent of Drawings does not limit responsibility of determining full extent of work required. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, Site Utility and all other Drawings and other Documents that indicate types of construction in which work is to be installed and work of other trades with which work of this Division must be coordinated.

B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

C. When requirements cited in this specification conflict with each other or with other Contract Documents, the most stringent shall govern work.

D. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

E. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a system's components, the configuration of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the Contractor shall provide all other components and materials necessary to make the systems fully complete and operational.

F. The layout of the piping, ductwork, equipment, etc., as shown on the Drawings shall be checked and exact locations shall be determined by the dimensions of equipment approved and Mechanical Contractor shall obtain the Architect/Engineer's approval for any revised layout before the apparatus is installed.

G. Inspect Architectural, Structural, Mechanical, Plumbing, Fire Protection and Electrical Drawings for all dimensions, locations, partitions and walls, structural details and locations of mechanical pipes and ducts so that installation shall be coordinated with the work of the other trades.

H. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.

I. Data that may be furnished electronically by the Architect (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not substitute for Architect's/Engineers, sealed or stamped construction documents.

1.8 CAD DISKS

A. CAD Discs for the preparation of shop drawings for HVAC, Plumbing, Fire Protection, or Electrical drawings can be furnished by WMA at Contractor's request. A minimum processing fee of $300 will be charged, plus $50 per drawing for each drawing above a total of six. Contractor shall sign a disclaimer regarding the use of the drawings so transmitted.

1.9 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are ambiguous, advise Architect/Engineer in writing before Award of Contract. Otherwise, Architect's/Engineer's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or ambiguities thus resolved.

B. Where Drawings or Specifications do not conform to manufacturer's recommendations, or to applicable codes and standards, alert Architect/Engineer of such non-conformance in writing before installation. Otherwise, make changes in installed work as Architect/Engineer requires within Contract Price.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specifications, this Contractor shall provide that material, installation, or work which is of the higher, more stringent standard.

D. It is the requirement of these Contract Documents to have the Contractor provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information is given to precisely describe a certain component or subsystem, or the routing of a component for its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

E. In cases covered by Paragraph (D) above, where the Contractor believes he needs engineering guidance, he shall submit a sketch identifying his proposed solution to Architect/Engineer for review and approval.

1.10 MODIFICATIONS IN LAYOUT

A. Division 23 Drawings are diagrammatic. They indicate general arrangements of mechanical and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.

B. In order to obtain the Architect's desired aesthetics in areas of the building where the finishes and appearances of material and equipment are visible, (including access panels) review architectural drawings for desired locations, finishes, etc., and where not definitely indicated, request information from architect.

C. Check Contract Documents as well as Shop Drawings of all subcontractors to verify and coordinate spaces in which work of this Division will be installed.

D. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside or structure as possible.

E. Make modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C, D above.

1.11 INTERFERENCES

A. Before making any installation, the Mechanical Contractor shall confer with all other Contractors whose work may affect the work under their sections and make the necessary changes to avoid interferences or improper effect on work to be performed by all other Sections. In the event that interferences develop, the Architect's decision will be final and no additional compensation will be allowed for moving of misplaced piping, ducts, conduit and/or equipment.

1.12 REQUEST FOR INFORMATION (RFI'S)

A. If the RFI is a request to resolve a conflict or an ambiguity, or a request for an additional detail, Contractor's RFI shall include a sketch or equivalent description of Contractor's proposed solution, in accordance with paragraphs 1.13 (E).

1.13 PERMITS AND FEES

A. The Mechanical Contractor shall procure and pay for all necessary reviews of plans, permits, license fees, make arrangements for inspections, pay all fees in connection therewith, and pay all applicable Federal, State and Local taxes.

1.14 QUALITY ASSURANCE

A. Code Ratings, labels or other data which are die-stamped or otherwise affixed to the surface of the equipment shall be in visible location.

B. All equipment provided under Division 23 to perform with the least possible noise and vibration consistent with its duty. Quietness of operation of all equipment is a requirement. Any equipment, as determined by the Owner's Representative, or Engineer to be producing objectionable noise or transmitting noise or vibration to the building to be repaired or removed and replaced.

C. All workmanship shall be first class in every respect and shall be performed only by skilled mechanics.

D. Project Certification:
1. Each trade shall submit a project certification, guaranteeing that this project was constructed and will operate in accordance with the performance requirements of the drawings and specifications. This certification shall be signed by a principal of the firm and shall be delivered to the Architect prior to final payment.

1.15 GUARANTEE

E. Guarantee Work in writing for one year following the date of Acceptance. Repair or replace promptly and to the Architect's/Engineer's satisfaction defective materials, equipment, workmanship and installation that develop within this period. Correct damage caused in making necessary repairs and replacements under guarantee within Contract Price. Any part or component repaired or replaced shall be fully warranted for one year from the date of repair.

F. In addition to guarantee requirements of Division 1 and of Paragraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

G. Replace material and equipment that require excessive service during guarantee period as defined and as directed by Architect.

H. Submit copies of equipment and material warranties to Architect before final payment.

I. At end of guarantee period, transfer manufacturer's equipment and material warranties still in force to Owner.

J. This article shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

K. Problems that develop during the guarantee period should be addressed promptly by the Contractor with the help of the manufacturers engineering and the technical staff if required. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will suggest course of action.

1.16 SHUTDOWN AND NOTIFICATIONS

A. It is imperative that service interruptions on the various existing utilities be held to an absolute minimum. Wherever possible, the Mechanical Contractor shall provide suitable temporary services or connections, where continuity of service for essential systems can be maintained by this means. Consult with Owner/Architect to determine which systems are to be considered essential, and to establish the maximum allowable shutdown time, if any, for each system.

B. No less than 72 hours advance written notice must be given, for the interruption of service in any system is desired. Such notice shall identify the system or systems involved, and shall be submitted in duplicate, one copy of which will be signed and returned by the Owner's authorized representative stating whether the requested shutdown will be permitted or not.

1.17 OVERTIME WORK

A. Work included shall be done during regular working hours on a "straight time" basis.

B. When shutdowns, which interrupt the Owner's operations will require overtime work, the Mechanical Contractor shall include the cost for such overtime work as a part of the Base Bid proposal.

1.18 EXISTING UTILITIES

A. Location of utilities as shown on the drawings has been determined from the best available information and is given for the convenience of the Mechanical Contractor. However, Owner does not assume responsibility that the utilities are in the exact locations shown and that there may be other unrecorded utilities in the area of construction. The Mechanical Contractor shall exercise reasonable care and caution in the performance of his work so that unrecorded utilities are not disturbed.

B. The Mechanical Contractor shall be responsible for any interference with or damage to any existing utilities whether shown on the drawing or not, and shall repair or replace any damaged utilities with the least possible delay and hold the Owner harmless in the event that there is any damage.

C. The Mechanical Contractor shall notify Architect of all broken or open pipes discovered during construction.

1.19 LINES AND LEVELS

A. Each Contractor or Sub_Contractor shall lay out and establish at the job all lines and levels necessary for his own work by Bench Mark established by him.

1.20 MINOR DEVIATIONS

A. The dimensions of equipment herein specified or indicated on the drawings are intended to establish the outlines and characteristics of such equipment in-general. Minor deviations in dimensions will be permitted to allow the manufacturers specified to bid on their nearest stock equipment, provided the specified ratings are met or exceeded.

B. Where manufacturer's catalog numbers or types are mentioned in the Specifications or indicated on the drawings, they are intended to be used as a guide only and shall not be interpreted as taking precedence over the basic rating and duty specified. In all cases, manufacturers shall verify the duty specified with particular characteristics of the equipment he intends to offer for approval and shall also pay all additional charges as may be required under this section and section 2.03 hereinafter.

C. Where the equipment furnished differs in physical size, electrical or other requirements or arrangement from that indicated on the Drawings, Contractor shall provide all alterations necessary to accommodate such equipment at no additional cost to the Owner. This shall include any and all additional work required by any other Contractors, the Architect or Engineer.

1.21 MECHANICAL WORK EXPOSED TO WEATHER

A. General: Provide corrosion protection for all ferrous metal portions of mechanical work which are to be exposed to weather including fans, piping and accessories, supports and other items.

B. Protection: All ferrous metal, after fabrication, shall be hot dip galvanized, cadmium plated, painted or similarly protected against corrosion prior to installation as approved by the Architect.

1.22 SAFETY MEASURES TO BE TAKEN

A. The Engineer has no contractual responsibility in connection with job site safety measures or precautions as related to means, methods, techniques, sequences or procedures in that regard. The Mechanical Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The Architect/Engineer's observations of the Mechanical Contractor's performance are not intended to include review of the adequacy of the Mechanical Contractor's safety measures in, on or near the construction site. It shall be the Mechanical Contractor's responsibility to comply with all government "Safety and Health Regulations for Construction". The Contractor shall be responsible for providing all such safety measures and shall consult with the State or Federal Safety Inspector for interpretation whenever in doubt as to whether safe conditions do or do not exist; or whether he is or is not in compliance with State or Federal Regulations.

1.23 SUBMITTALS

A. Shop Drawings of all fixtures, equipment, materials, etc., shall be submitted as specified in General Requirements.

B. Definitions:
1. Shop Drawings are
a. Information prepared by the Contractor to illustrate portions of the work, such as ductwork layout arrangements in more detail than shown in the Contract Documents.
b. Coordinated Drawings are detailed, large-scale layout Shop Drawings showing HVAC, Electrical, Plumbing and Fire Protection work superimposed in order to identify conflicts and ensure inter-coordination of Mechanical, Electrical, Architectural, Structural and other work.

C. Installation, maintenance, operating manuals and instructions for all equipment shall be provided as specified in the General Provisions.

D. Any materials, fixtures, apparatus or equipment installed without stamped or written acceptance shall be removed and replaced with designated equipment by the Contractor and without recourse for additional cost incurred.

E. Field review and record copy of shop drawings for all work shall be submitted to all jurisdictional authorities, the City, Local Fire Prevention Bureau and State Fire Marshall as may be required.

1.24 AS-BUILT DRAWINGS

A. On a daily basis, the Mechanical Contractor shall maintain at the job site a set of drawings to accurately locate and record all underground and concealed piping, and all changes from the original design. He shall have these drawings available at all times for periodic review by the Architect/Engineer.

B. At completion of the project, all changes and deviations from the Contract Documents shall be recorded by the Mechanical Contractor on As_Built Drawings. Drawings shall be prepared using the same CAD program, version, and operating system as the original Contract Drawings. Submit CAD drawings on electronic media prior to project completion. Drawings shall be the same size and with the same border lines and title blocks as the Architect's/Engineer's drawings with the Contractor's name added.

C. The Engineer/Architect will not certify the accuracy of the record drawings - this is the sole responsibility of the Contractor.

1.25 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Furnish 6 complete sets of shop drawings for all work shall be submitted to all jurisdictional authorities, the City, Local Fire Prevention Bureau and State Fire Marshall as may be required.

B. Provide a competent engineer for a period of 8 hour day for total operation of equipment and a representative of Owner's personnel in operation and maintenance of system, and to start up all systems.

C. Furnish six (2) sets of manuals in bound form containing data covering capacities, maintenance and operation of each major item of equipment and apparatus. Operating instructions shall cover all phases of control and shall also include the following for pumps, fans and compressors and similar equipment at operating conditions:
1. Indicate type and frequency of lubrication required.
2. List of Spares: Recommended for normal service.

E. Parts List: Identifying various parts of equipment for repair and replacement purposes. In particular, sheaves, V-belts, bearings and similar items should be clearly identified as to manufacturers, sizes, type and stop points.

F. Instruction Books: May be standard booklets but shall be clearly marked to indicate applicable equipment and paragraphs.

G. Provide to the Owner, plastic laminated wiring diagrams, charts, schedules, control diagrams and schematic systems diagrams as installed.

1.26 OCCUPANCY

A. Refer to General Requirements 01 Section Summary 01100.

B. The Owner, Architect, Engineer or others who they may designate shall be privileged to enter and occupy the building or portions thereof, at any time prior to completion of the mechanical work without prejudice.

1.27 LOCAL CONDITIONS

A. The Mechanical Contractor shall visit the Site prior to submitting bids and determine all existing local conditions which may affect the work. He shall examine the General Contract Drawings and the Structural Drawings to familiarize himself with the various types of constructions and their effect on the installation of work under this Division. Failure of the Mechanical Contractor to do so shall not be cause for additional compensation.

1.30 MANUFACTURER'S RECOMMENDATIONS

A. All materials and/or equipment shall be installed in accordance with manufacturer's recommendations and instructions.

1.31 MANUFACTURER'S NAMEPLATES

A. Each major component of the equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent is not acceptable. ASME Code ratings, or other data which is die_stamped into the surface of the equipment shall be in a visible location.

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

A. This Section includes the following:
3. Piping materials and installation instructions common to most piping systems.
4. Transition fittings.
5. Dielectric fittings.
6. Mechanical sleeve seals.
7. Sleeves.
8. Escutcheons.
9. Grout.
10. HVAC demolition.
11. Equipment installation requirements common to equipment sections.
12. Painting and finishing.
13. Concrete bases.
14. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. "Install" means to furnish, unload, store, protect. Move into final position, set, connect, provide any miscellaneous material, test, adjust as required and put into service.

G. "Provide" means to furnish and install.

H. The following are industry abbreviations for rubber materials:
15. EPDM: Ethylene-propylene-diene terpolymer rubber.
16. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

I. Welding certificates.

1.5 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements with Installing Trade for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08311 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorous alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
1. Manufacturers:
a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
1. Manufacturers:
a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
1. Manufacturers:
a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
1. Manufacturers:
a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic, carbon steel or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
1. Finish: Polished chrome-plated or rough brass.

D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.8 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 EXCAVATING, TRENCHING AND BACKFILLING

A. Excavation and backfilling of trenches for installation of all underground utility services and underground piping shall be performed by each trade for its work. Separate trenches shall be provided for water and sewer lines. Different services shall be run in separate trenches.

B. Subsurface Soil Data: Boring logs of subsoil investigations are for information only and not a Contract Document. Information applies only to conditions encountered at locations and depths to which borings were made. Contractor will be permitted to make his own additional soil investigation, as approved, but same shall be made with no cost to the Owner.

C. Trenching: Excavate to required depths, and grade the bottoms of trenches to secure required slope for pipe. Where mud or otherwise unstable soil is encountered in bottom of trench which is incapable of supporting the pipe or utility lines, such soil shall be removed to firm bearing and trench shall be backfilled with sand to proper grade and tamped to provide uniform firm support. Pipe shall not be laid on frozen subgrade or rock.

D. Grade trench at a point 6 inches above top of pipe shall be not more than O.D. of pipe, expressed in inches, plus 12 inches. Above this point, sides of trenches shall be kept as nearly vertical as possible and shall be braced and shored to protect foundations, utility pipe lines and workmen.

E. Where machines are used to excavate pipe trenches, such machine excavation shall terminate 3 in. above invert of pipe. Final excavation and shaping of trench shall be performed only a few feet in advance of pipe laying.

F. Bottom of trench shall be accurately excavated by hand to provide firm uniform bearing for bottom quarter of pipe. Pipe having bells, couplings or other enlargements at joints shall have recesses excavated to accommodate these joints.

G. Provide elevations and lines required for underground plumbing installation. Provide stakes and batterboards. Elevation, grades and lines shall be set with aid of transit, or level. Maintain and protect same from alteration.

H. Provide and maintain dewatering pumping equipment as necessary to keep trench and other excavation free of water, refer to Division 312319 - Dewatering in the specifications.

I. After installation and piping and equipment test has been completed, backfill all excavations carefully. Place backfill in 6 inch layers and compact to at least 85% of maximum dry density. Compaction under paved areas and streets shall not be less than 95% of maximum dry density and shall be determined according to ASTM 1557.

J. Backfilling material for all storm and sewer drain trenches within walls of building shall consist of lake or bank run sand, or selected excavated material for walls, provided no stones are contained. (Foundry sands are not acceptable.)

K. Backfilling: The trenches shall not be backfilled until piping has been tested as required and approved by the Architect/Engineer and any local authorities having jurisdiction thereof.

L. Exercise special care in backfilling trenches in which sewers are laid to guard against disturbing joints. Such backfilling shall be placed evenly in 6 in. layers and carefully tamped under and around pipe. Puddling with water will not be permitted until backfill has been placed and tamped to a point 24 in. above top of pipe.

M. Remove and dispose off-site any material not used for backfill.

N. Where excavation is necessary in existing pavements or streets, Contractor shall pay fee and costs of opening street or pavement and all costs of filling and repaving in accordance with requirements of and to the satisfaction of the Municipality, Utility or Owner or such paving.

O. Where excavation is necessary in an existing lawn, carefully remove and store sod. After backfilling trench, replace sod or apply top dressing of black dirt and seed to match existing lawn.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
1. New Piping:
a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
2. Existing Piping: Use the following:
a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel (or PVC where allowed by authorities having jurisdiction) Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with

MECHANICAL SPECIFICATIONS (CONT.)

1.3 PRESSURE GAGES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. KOBOLD Instruments, Inc.
6. Marsh Bellofram.
7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Case: Liquid-filled type, drawn steel or cast aluminum, metal 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass.
8. Ring: Metal.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure
11. Range for Fluids under Pressure: Two times operating pressure.

1.4 TEST PLUGS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.
B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
D. Core Inserts: One or two self-sealing rubber valves.
1. Insert material for air, water, oil, or gas service at 20 to 200 deg F (minus 7 to plus 93 deg C) shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F (minus 35 to plus 136 deg C) shall be EPDM.

1.5 VENTURI FLOWMETERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong Pumps, Inc.
2. Badger Meter, Inc.; Industrial Div.
3. Bailey-Fischer & Porter Co.
4. Flow Design, Inc.
5. Gerand Engineering Co.
6. Hyspan Precision Products, Inc.
7. Leeds & Northrup.
8. McCrometer, Inc.
9. Preso Meters Corporation.
10. Victaulic Co. of America.
B. Description: Differential-pressure design for installation in piping; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.
C. Construction: Bronze, brass, or factory-primed steel; with brass fittings and attached tag with flow conversion data.
D. Pressure Rating: 250 psig (1725 kPa).
E. Temperature Rating: 250 deg F (121 deg C).
F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged or welded.
H. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
I. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- (150-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
1. Scale: Gallons per minute (Liters per second).
2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
J. Operating Instructions: Include complete instructions with each flowmeter.

1.6 TURBINE FLOWMETERS
A. Manufacturers: Subject to compliance with requirements:
1. ONICON Incorporated.
B. Description: Insertion type for inserting turbine into piping and measuring flow directly in gallons per minute (liters per second).
C. Construction: Bronze or stainless-steel body; with plastic turbine or impeller and integral direct-reading scale.
D. Pressure Rating: 150 psig (1035 kPa) minimum.
E. Temperature Rating: 180 deg F (82 deg C) minimum.
F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons (liters).
G. Accuracy: Plus or minus 2-1/2 percent.

1.7 FLOW INDICATORS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brooks Instrument Div., Emerson Electric Co.
2. Dwyer Instruments, Inc.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. McCrometer, Inc.
6. OPW Engineered Systems; Dover Corp.
7. Penberthy, Inc.
B. Description: Instrument for installation in piping systems for visual verification of flow.
C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.
D. Pressure Rating: 125 psig (860 kPa).
E. Temperature Rating: 200 deg F (93 deg C).
F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

1.8 INSERTION-TURBINE, THERMAL-ENERGY METER SYSTEMS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ONICON Incorporated.
B. Description: Flow sensor, strainer, two temperature sensors, transmitter, meter, and connecting wiring.
C. Flow Sensor: Insertion-type turbine or paddle-wheel element with corrosion-resistant-metal body and transmitter.
1. Pressure Rating: 125 psig (860 kPa).
2. Temperature Range: 40 to 250 deg F (5 to 121 deg C).
D. Meter: Solid-state integrating type with integral battery pack.
1. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
2. Accuracy: Plus or minus 1 percent.
3. Battery Pack: Five-year lithium battery.
E. Strainer: Full size of main line piping.

1.9 ULTRASONIC, THERMAL-ENERGY METER SYSTEMS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Controlotron Corporation.
2. Engineering Measurements Company.
3. Mesa Laboratories, Inc.; Nusonics Div.
B. Description: Flow sensor, two temperature sensors, transmitter, meter, and connecting wiring.
C. Flow Sensor: Strap-on or integral ultrasonic type with transmitter.
D. Meter: Solid-state integrating type with integral battery pack.
1. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
2. Accuracy: Plus or minus 1 percent.
3. Battery Pack: Five-year lithium battery.
E. Strainer: Full size of main line piping.

PART 2 - EXECUTION

2.1 THERMOMETER APPLICATIONS
A. Install liquid-in-glass thermometers in the following locations:
1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler and chiller.
3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
4. Inlet and outlet of each hydronic heat exchanger.
5. Inlet and outlet of each hydronic heat-recovery unit.
6. Inlet and outlet of each thermal storage tank.
7. Outside-air, return-air, and mixed-air ducts.
B. Install solar digital thermometers in the following locations:
1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler and chiller.
3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
4. Inlet and outlet of each hydronic heat exchanger.
5. Inlet and outlet of each hydronic heat-recovery unit.
6. Inlet and outlet of each thermal storage tank.
C. Provide the following temperature ranges for thermometers:
1. Heating Hot Water: 50 to 400 deg F, with 5-degree scale divisions (10 to 205 deg C, with 2-degree scale divisions).
2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions (Minus 18 to plus 38 deg C, with 1-degree scale divisions).
3. Steam and Condensate: 30 to 300 deg F, with 5-degree scale divisions (Minus 1 to plus 150 deg C, with 2-degree scale divisions).
4. Air Ducts: 0 to plus 110 deg F, with 2-degree scale divisions.

2.2 GAGE APPLICATIONS
A. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.
B. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

2.3 INSTALLATIONS
A. Install direct-mounting thermometers and adjust vertical and tilted positions.
B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
C. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
D. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.
E. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
F. Install remote-mounting pressure gages on panel.
G. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
H. Install needle-valve and syphon fitting in piping for each pressure gage for steam.
I. Install test plugs in tees in piping.
J. Install flow indicators, in accessible positions for easy viewing, in piping systems.
K. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
L. Install flowmeter elements in accessible positions in piping systems.
M. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
N. Install wafer-orifice flowmeter elements between pipe flanges.
O. Install permanent indicators on walls or brackets in accessible and readable positions.
P. Install connection fittings for attachment to portable indicators in accessible locations.
Q. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.
R. Assemble components and install thermal-energy meters.
S. Mount meters on wall if accessible; if not, provide brackets to support meters.

2.4 CONNECTIONS
A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
B. Connect flowmeter-system elements to meters.
C. Connect flowmeter transmitters to meters.
D. Connect thermal-energy-meter transmitters to meters.

2.5 ADJUSTING
A. Calibrate meters according to manufacturer's written instructions, after installation.
B. Adjust faces of meters and gages to proper angle for best visibility.

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - PRODUCTS

1.1 MANUFACTURERS
A. All piping related items are to be purchased through Ferguson Enterprise (Alton Lassiter - 615-316-1848, alton.lassiter@ferguson.com).
B. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

1.2 VALVES, GENERAL
A. Refer to Part 3 "Valve Applications" Article for applications of valves.
B. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.
C. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.
D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
F. Valve Actuators:
1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive: For quarter-turn valves NPS 8 (DN 200) and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.
5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
G. Extended Valve Stems: On insulated valves.
H. Extend operating handle on insulated ball valves.
I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
J. Butterfly valves: Extended necks insulated valved.
K. Valve Grooved Ends: AWWA C606.
1. Solder Joint: With sockets according to ASME B16.18.
a. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check, gate, and globe valves; below 421 deg F (216 deg C) for ball valves.
2. Threaded: With threads according to ASME B1.20.1.
L. Valve Bypass and Drain Connections: MSS SP-45.

1.3 COPPER-ALLOY BALL VALVES
A. Manufacturers:
1. Kitz
2. Nibco
3. Apollo
4. Watts
5. Milwaukee
6. Hammond
B. Copper-Alloy Ball Valves, General: MSS SP-110.
C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.
D. Three-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.
E. Safety-Exhaust, Copper-Alloy Ball Valves: Two-piece bronze body with exhaust vent opening, chrome-plated ball with vent, blowout-proof stem, locking handle, and working pressure rating of 600-psig (4140-kPa) CWP.

1.4 FERROUS-ALLOY BALL VALVES
A. Manufacturers
1. Kitz
2. Nibco
3. Crane
4. Grinnell
5. Milwaukee
B. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.
C. Ferrous-Alloy Ball Valves: Class 150, full port.
D. Ferrous-Alloy Ball Valves: Class 300, full port.

1.5 FERROUS-ALLOY BUTTERFLY VALVES
A. Manufacturers:
1. Kitz
2. Nibco
3. Crane
4. Centerline
5. Grinnell
6. Keystone
7. Hammond
B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
C. Clamp lock hand lever operator.

1.6 BRONZE CHECK VALVES
A. Manufacturers:
1. Kitz
2. Nibco
3. Grinnell
4. Milwaukee
5. Kennedy
B. Bronze Check Valves, General: MSS SP-80.
C. Type 2, Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
D. Type 2, Class 125, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
E. Type 2, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
F. Type 2, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
G. Type 2, Class 200, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
H. Type 2, Class 200, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
I. Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.
J. Type 4, Class 150, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.
K. Type 4, Class 200, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

PART 2 - EXECUTION

2.1 EXAMINATION
A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.
B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
D. Examine threads on valve and mating pipe for form and cleanliness.
E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
F. Do not attempt to repair defective valves; replace with new valves.

2.2 VALVE APPLICATIONS
A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
1. Shutoff Duty:
a. 2" and smaller: ball.
b. 2 ½" and larger: butterfly.
2. Throttling Duty:
a. 2" and smaller: globe.
b. 2-1/2" and larger: globe or butterfly.
B. Domestic Hot- and Cold-Water Systems: Use the following valve types:
1. Ball Valves: Class 150, 600-psi CWP, with solder-joint ends.
2. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or epoxy-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
3. Bronze Swing Check: Class 150, with composition seat and soldered end connections.
4. Check Valves: Iron swing, wafer, or lift type, as indicated. Swing check shall be Class 150 with bronze seat ring.
C. Steam and Condensate Return Systems: Use the following valve types:
1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
2. Check Valves: Class 150, bronze body swing check with composition seat; Class 150, cast-iron body swing check with bronze seat ring; or Class 125, cast-iron body wafer check.

2.3 VALVE INSTALLATION
A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install shutoff-duty valves at each branch connection to supply mains, at supply connections to each piece of equipment, and elsewhere as indicated.
C. Install throttling-duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
D. Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.
E. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.
F. Install check valves on each pump discharge and elsewhere as required to control flow direction.
G. Install safety relief valves on hot water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Pipe discharge to floor without valves. Comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
H. Install pressure-reducing valves on hot water generators and elsewhere as required to regulate system pressure.
I. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
J. Locate valves for easy access and provide separate support where necessary.
K. Install valves in horizontal piping with stem at or above center of pipe.
L. Install valves in position to allow full stem movement.
M. Install check valves for proper direction of flow and as follows:
Swing Check Valves: In horizontal position with hinge pin level.

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - PRODUCTS

1.1 EQUIPMENT LABELS
A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch (0.8-mm), Stainless steel, 0.025-inch (0.64-mm) Aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
C. Label Content: Include equipment's Drawing designation or unique equipment number. Coordinate final tag number with facilities.
D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

1.2 WARNING SIGNS AND LABELS
A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
B. Letter Color: Black.
C. Background Color: White.
D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
G. Fasteners: Stainless-steel rivets or self-tapping screws.
H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
I. Label Content: Include caution and warning information, plus emergency notification instructions.

1.3 PIPE LABELS
A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

1.5 STENCILS
A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping: minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

1.6 VALVE TAGS
A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.
B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

1.7 WARNING TAGS
A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 2 - EXECUTION

2.1 PREPARATION
A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

2.2 EQUIPMENT LABEL INSTALLATION
A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

2.3 PIPE LABEL INSTALLATION
A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 20 feet (15 m) along each run.
7. At least once in each separate space through which the pipe passes.
8. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
B. Pipe Label Color Schedule:
1. Chilled-Water Piping:
a. Background Color: Blue.
b. Letter Color: Black.
2. Heating Water Piping:
a. Background Color: Red.
b. Letter Color: Black.
3. Steam Piping:
a. Background Color: Yellow.
b. Letter Color: Black.

2.5 VALVE-TAG INSTALLATION
A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
a. Chilled Water: 1-1/2 inches (38 mm), square.
b. Hot Water: 1-1/2 inches (38 mm), square.
2. Valve-Tag Color:
a. Chilled Water: Green.
b. Hot Water: Green.
3. Letter Color:
a. Chilled Water: Black.
b. Hot Water: Black.

2.6 WARNING-TAG INSTALLATION
A. Write required message on, and attach warning tags to, equipment and other items where required.

TESTING, ADJUSTING, AND BALANCING FOR MECHANICAL WORK

PART 1 - EXECUTION

1.1 PREPARATION
A. Prepare a TAB plan that includes strategies and step-by-step procedures including instrumentation to be used.
B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
2. Water heaters are installed and functioning.
3. Piping is complete and all points of outlet are installed.
4. Water treatment is complete.
5. Systems are flushed, filled, and air purged.
6. Strainers are clean.
7. Control valves are functioning in accordance with the sequence of operation.
8. Shutoff and balance valves are 100 percent open.
9. Hot-water circulating pumps are operational and proper rotation is verified.

1.2 GENERAL PROCEDURES FOR TESTING AND BALANCING
A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
D. Take and report testing and balancing measurements in inch-pound (IP) units.

1.3 GENERAL PROCEDURES FOR DOMESTIC WATER SYSTEMS
A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
B. Prepare schematic diagrams of systems' "as-built" piping layouts.
C. Prepare domestic water systems for testing and balancing, in addition to the general preparation procedures specified above
1. Check expansion tank for proper setting.
2. Check water heater for proper discharge temperature setting.
3. Check remotest point of outlet for adequate pressure.
4. Check flow-control valves for proper position.
5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
6. Verify that motor controllers are equipped with properly sized thermal protection.
7. Check that air has been purged from the system.
D. Measure and record upstream and downstream pressure of each piece of equipment.
E. Measure and record upstream and downstream pressure of pressure-reducing valves.
F. Check settings and operation of automatic temperature control valves, pressure-reducing valves, and safety valves. Record settings.

1.4 TEMPERATURE-CONTROL VERIFICATION
A. Verify that controllers are calibrated and commissioned.
B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
C. Record controller settings and note variances between set points and actual measurements.
D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
E. Check free travel and proper operation of control devices such as damper and valve operators.
F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
G. Check the interaction of electrically operated switch transducers.
H. Check the interaction of interlock and lockout systems.
I. Check main control supply-air pressure and observe compressor and dryer operations.
J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
K. Note operation of electric actuators using spring return for proper fail-safe operations.

1.5 TOLERANCES
A. Set system water flow rates within the following tolerances:
1. Domestic Water Flow Rate: Plus 5 to minus 5 percent.

1.6 REPORTING
A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

1.7 FINAL REPORT
A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of instruments used for procedures, along with proof of calibration.

1.8 ADDITIONAL TESTS
A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

HVAC INSULATION

PART 1 - PRODUCTS

1.1 INSULATION MATERIALS
A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Cell-U-Foam Corporation; Ultra-CUF.
b. Pittsburgh Corning Corporation; Foamglas Super K.
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
H. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Fibrex Insulations Inc.; Coreplus !200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
I. Phenolic:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Kingspan Corp.; Koolphen K.
2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
a. Preformed Pipe Insulation: ASJ.

1.2 ADHESIVES
A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-96.
b. Foster Products Corporation, H. B. Fuller Company; 81-33.
C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Red Devil, Inc.; Celulon Ultra Clear.
e. Speedline Corporation; Speedline Vinyl Adhesive.

1.3 MASTICS
A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements provide one of the following:
a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.
C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.
D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc

MECHANICAL SPECIFICATIONS (CONT.)

1.7 TAPES
A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

1.8 SECUREMENTS
A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-(2.6-mm-) diameter shank, length to suit depth of insulation indicated.
a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.
b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
a. Products: Subject to compliance with requirements, provide one of the following:
1) GEMCO; Nylon Hangers.
2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
3) Midwest Fasteners, Inc.; Self Stick.
b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.
b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
a. Products: Subject to compliance with requirements, provide one of the following:
1) GEMCO
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

1.9 CORNER ANGLES
A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.
C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304.

PART 2 - EXECUTION

2.1 PREPARATION
A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

2.2 GENERAL INSTALLATION REQUIREMENTS
A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.
J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

2.3 PENETRATIONS
A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.
B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.
D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

2.4 GENERAL PIPE INSULATION INSTALLATION
A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Provide flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a treated mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this subassembly to valve body flange, with its attached insulation, to flange with a spacer ring. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

2.5 CELLULAR-GLASS INSULATION INSTALLATION
A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
4. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

2.6 MINERAL-FIBER INSULATION INSTALLATION
A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

2.7 PHENOLIC INSULATION INSTALLATION
A. General Installation Requirements:
1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

B. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

2.8 FIELD-APPLIED JACKET INSTALLATION
A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

2.9 FINISHES
A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Color to match existing color scheme. Vary first and second coats to allow visual inspection of the completed Work.
1. Domestic Water (not heated): Blue
2. Domestic Hot Water: Red
3. Steam: Bright Orange
4. Condensate: Dark Orange

2.10 FIELD QUALITY CONTROL
A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

2.11 PIPING INSULATION SCHEDULE, GENERAL
A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

2.12 INDOOR AND OUTDOOR PIPING INSULATION SCHEDULE
A. Domestic Hot and Recirculated Hot Water, 140 Deg F (60 Deg C) and below:
1. NPS 1 (DN 25) and Smaller: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inches (25 mm)
2. NPS 1 1/2 (DN 40) and Larger: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 1/2 inches (40 mm)
B. High Pressure Steam and Steam Condensate, 350 Deg F (177 Deg C) and below:
1. NPS 1 (DN 25) and Smaller: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe, Type I or II: 4 inches (90 mm).
2. NPS 1 1/2 (DN 40) and Larger: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe, Type I or II: 4 1/2 inches (115 mm).
B. Low Pressure Steam and Steam Condensate, 250 Deg F (120 Deg C) and below:
1. NPS 3 1/2 (DN 90) and Smaller: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe, Type I or II: 2 1/2 inches (65 mm).
2. NPS 4 (DN 100) and Larger: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe, Type I or II: 3 inches (80 mm).

2.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE
A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.
C. Piping, Concealed and Exposed:
1. All Service Jacket
D. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. PVC, Color-Coded by System: 20 mils (0.5 mm) thick.

END OF SECTION

DOMESTIC WATER PIPING

PART 1 - PRODUCTS

1.1 MANUFACTURERS
A. In other Part 1 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. All piping related items are to be purchased through Ferguson Enterprise.

1.2 PIPING MATERIALS
A. Refer to Part 2 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.
B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

1.3 COPPER TUBE AND FITTINGS
A. T-Drill fittings and Victaulic's PressFit couplings are not allowed.
B. Hard Copper Tube: ASTM B 88, Types L (ASTM B 88M, Types B), water tube, drawn temper. Manufacturers name or trade mark and type of tubing shall be indented or otherwise identified at 3 foot intervals.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

1.4 VALVES
A. Bronze and cast-iron, general-duty valves are specified in "General-Duty Valves."
B. Balancing and drain valves are specified in "General-Duty Valves."
C. Reducers: Reduction in horizontal water circulating piping shall be made with eccentric reducers with the straight side at the top. Use of bushings shall not be permitted.

1.5 VENTING
A. Provide 150 lb. manual vent valves at all high points of supply and return piping and at all other points in piping necessary to prevent trapping of air. Vents shall be installed with pipe size air pockets of approved length. Vents shall be installed in accessible and approved locations.

1.6 STRAINERS
A. Furnish and install strainers where shown on the drawings and elsewhere called for. Unless otherwise noted strainers shall be "Y" pattern with removable basket screen. The basket shall be heavy gauge Monel metal having 1/32 in. perforations for water pipe.
B. A blow off valve shall be provided at the bottom of each strainer 3 in. and larger, nipple and cap for smaller strainers shall be as manufactured by Boylestion, Illinois Engineering Co., Yarkway, Keckley, Sarco or McLear. Maximum pressure drop through the strainer shall not exceed 1 psi at designed flow.

1.7 PIPE COVERING SADDLES
A. In general, all piping systems will be covered systems.
B. Confer with the subcontractor for the insulation section before ordering hangers, supports, sleeves, etc., to determine the thickness of insulation which will be installed on the various piping systems. Provide saddles for all insulated pipe.
C. Provide all proper blocking as required for piping systems.

PART 2 - EXECUTION

2.1 PIPE AND FITTING APPLICATIONS
A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
B. Flanges shall be used on aboveground piping only.
C. Grooved joints shall not be used unless approved due to site limitations.
D. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:
1. NPS 8 (DN 200) and smaller: Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder joint fittings; and soldered joints.
E. Non-Potable-Water Piping: Use the same piping materials for each size range as specified in aboveground domestic water piping.

2.2 ANCORAGE INSTALLATION
A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
1. Concrete thrust blocks.
2. Pipe clamps and tie rods.
B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Fire-Service-Main Piping: According to NFPA 24.
C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

2.3 VALVE APPLICATIONS
A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use bronze gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
2. Throttling Duty: Use bronze globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
3. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.
B. Cast-iron, grooved-end valves may be used with grooved-end piping.
C. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
D. Install NPS ¾ (DN 15) drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.
E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow.

2.4 PIPING INSTALLATION
A. Basic piping installation requirements are specified in "Common Work Results."
B. Arrange with the utilities company for tap of size and location indicated in the water main. Tap water main according to the requirements of the water utility company and of size and in location indicated.
C. Bury piping with depth of cover over top at least 60 inches (1524 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:
1. Under Driveways: With at least 66 inches (1676 mm) cover over top.
2. Under Railroad Tracks: With at least 78 inches (1981 mm) cover over top.
3. In Loose Gravelly Soil and Rock: With at least 12 inches (300 mm) additional cover.
D. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
E. Extend water-service piping and connect to water-supply source and building-water-piping systems at inside of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping in the at building for continuation of building-water-piping systems. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
F. Sleeves are specified in "Common Work Results."
G. Mechanical sleeve seals are specified in "Common Work Results."
H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
I. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."
J. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in "Common Work Results."
K. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in "Common Work Results."
L. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in "Meters and Gages for Piping," and drain valves and strainers are specified in "Domestic Water Piping Specialities."
M. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in "Domestic Water Piping Specialities."
N. Install domestic water piping level unless otherwise noted on drawings.
O. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

2.5 JOINT CONSTRUCTION
A. Basic piping joint construction requirements are specified in "Common Work Results."
B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

2.6 HANGER AND SUPPORT INSTALLATION
A. Pipe hanger and support devices are specified in "Hangers and Supports for Piping and Equipment." Install the following:
1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Hor

MECHANICAL SPECIFICATIONS (CONT.)

STEAM AND CONDENSATE HEATING PIPING

1.1 GENERAL
1.2 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
1.3 SUMMARY
A. This Section includes the following for LP and HP steam and condensate piping:
1. Pipe and fittings.
2. Strainers.
3. Flash tanks.
4. Safety valves.
5. Pressure-reducing valves.
6. Steam traps.
7. Thermostatic air vents and vacuum breakers.
8. Steam and condensate meters.
1.4 DEFINITIONS
A. LP Systems: Low-pressure piping operating at 15 psig (104 kPa) or less as required by ASME B31.9.
B. HP Systems: High-pressure piping operating at more than 15 psig (104 kPa) as required by ASME B31.1.
1.5 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:
1. LP Steam Piping: 15 psig
2. HP Steam Piping: 60 psig
3. Condensate Piping: 15 psig at 250 deg F.
4. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
5. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.
1.6 SUBMITTALS
A. Product Data: For each type of the following.
1. Pressure-reducing and safety valve.
2. Steam trap.
3. Air vent and vacuum breaker.
4. Flash tank.
5. Meter.
B. Shop Drawings: Detail, to scale, flash tank assemblies and fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops.
C. Qualification Data: For Installer.
D. Welding certificates.
E. Field quality-control test reports.
F. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.
1.7 QUALITY ASSURANCE
A. Installer Qualifications:
B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code - Steel."
C. Pipe Welding: Qualify processes and operators according to the following:
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
D. ASME Compliance: Comply with ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS
A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated.
B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated.
C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 125, 150, and 300 as indicated.
D. Malleable-Iron Unions: ASME B16.39; Classes 125, 150, and 300 as indicated.
E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.2; Classes 125, 150, and 300 as indicated; raised ground face, and bolt holes spot faced.
F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
G. Wrought-Steel Flanges and Flanged Fittings: ASTM B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.
H. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.
I. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150-psig (1045-kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).
2.2 JOINING MATERIALS
A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
C. Welding Filler Metals: Comply with AWS D10.12 (AWS D10.12M) for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
D. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
2.3 DIELECTRIC FITTINGS
A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.
C. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries, International Inc.
d. Watts Water Technologies, Inc.
e. Zurn Plumbing Products Group.
2. Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
D. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Water Technologies, Inc..
2. Factory-fabricated companion-flange assembly, for 150-psig (1035-kPa) minimum working pressure as required to suit system pressures.
E. Dielectric-Flange Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150-psig (1035-kPa) minimum working pressure as required to suit system pressures.
2.4 VALVES
A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section "General-Duty Valves for HVAC Piping."
B. Stop-Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.
b. Jenkins Valves; a Crane Company.
c. Lunkenheimer Valves.
d. A.Y. McDonald Mfg. Co.
2. Body and Bonnet: Malleable iron.
3. End Connections: Flanged.
4. Disc: Cylindrical with removable liner and machined seat.
5. Stem: Brass alloy.
6. Operator: Outside screw and yoke with cast-iron handwheel.
7. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
8. Pressure Class: 250.
2.5 STRAINERS
A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 (DN 50) and smaller; flanged ends for strainers NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. CWP Rating: 250-psig (1725-kPa) working steam pressure.
B. Basket Strainers:
1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 (DN 50) and smaller; flanged ends for strainers NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 250-psig (1725-kPa) working steam pressure.
2.6 SAFETY VALVES
A. Bronze or Brass Safety Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong International, Inc.
b. Kunkle Valve; a Tyco International Ltd. Company.
c. Spirax Sarco, Inc.
d. Watts Water Technologies, Inc.
2. Disc Material: Forged copper alloy.
3. End Connections: Threaded inlet and outlet.
4. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.
7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.
2.7 STEAM TRAPS
A. Thermostatic Traps:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong International, Inc.
b. Barnes & Jones, Inc.
c. Dunham-Bush, Inc.
d. Hoffman Specialty; Division of ITT Industries.
e. Spirax Sarco, Inc.
f. Sterling.
2. Body: Bronze angle-pattern body with integral union tailpiece and screw-in cap.
3. Trap Type: Balanced-pressure.
4. Bellows: Stainless steel or monel.
5. Head and Seat: Replaceable, hardened stainless steel.
6. Pressure Class: 125.
B. Thermodynamic Traps:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong International, Inc.
b. Barnes & Jones, Inc.
c. Dunham-Bush, Inc.
d. Hoffman Specialty, Division of ITT Industries.
e. Spirax Sarco, Inc.
2. Body: Stainless steel with screw-in cap.
3. End Connections: Threaded.
4. Disc and Seat: Stainless steel.
5. Maximum Operating Pressure: 600 psig (4140 kPa).
C. Float and Thermostatic Traps:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong International, Inc.
b. Barnes & Jones, Inc.
c. Dunham-Bush, Inc.
d. Hoffman Specialty; Division of ITT Industries.
e. Spirax Sarco, Inc.
f. Sterling.
2. Body and Bolted Cap: ASTM A 126, cast iron.
3. End Connections: Threaded.
4. Float Mechanism: Replaceable, stainless steel.
5. Head and Seat: Hardened stainless steel.
6. Trap Type: Balanced pressure.
7. Thermostatic Bellows: Stainless steel or monel.
8. Thermostatic air vent capable of withstanding 45 deg F (25 deg C) of superheat and resisting water hammer without sustaining damage.
9. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
10. Maximum Operating Pressure: 125 psig (860 kPa).
D. Inverted Bucket Traps:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong International, Inc.
b. Barnes & Jones, Inc.
c. Dunham-Bush, Inc.
d. Hoffman Specialty, Division of ITT Industries.
e. Spirax Sarco, Inc.
f. Sterling.
2. Body and Cap: Cast iron.
3. End Connections: Threaded.
4. Head and Seat: Stainless steel.
5. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
6. Bucket: Brass or stainless steel.
7. Strainer: Integral stainless-steel inlet strainer within the trap body.
8. Air Vent: Stainless-steel thermostatic vent.
9. Pressure Rating: 250 psig (1725 kPa).
2.8 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS
A. Thermostatic Air Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong International, Inc.
b. Barnes & Jones, Inc.
c. Dunham-Bush, Inc.
d. Hoffman Specialty; Division of ITT Industries.
e. Spirax Sarco, Inc.
f. Sterling.
2. Body: Cast iron, bronze or stainless steel.
3. End Connections: Threaded.
4. Float, Valve, and Seat: Stainless steel.
5. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
6. Pressure Rating: 125 psig (861 kPa).
7. Maximum Temperature Rating: 350 deg F (177 deg C).
B. Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Armstrong International, Inc.
b. Dunham-Bush, Inc.
c. Hoffman Specialty; Division of ITT Industries.
d. Johnson Corporation (The).
e. Spirax Sarco, Inc.
2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
5. O-ring Seal: EPR
6. Pressure Rating: 125 psig (861 kPa).
7. Maximum Temperature Rating: 350 deg F (177 deg C).

PART 3 - EXECUTION

3.1 STEAM AND CONDENSATE PIPING APPLICATIONS
A. LP Steam Piping, NPS 2 (DN 50) and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
B. LP Steam Piping, NPS 2-1/2 through NPS 12 (DN 65 through DN 300): Schedule 40, Type E, Grade B, steel pipe; Class 125 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
C. HP Steam Piping, NPS 2-1/2 through NPS 12 (DN 65 through DN 300): Schedule 40, Type E, Grade B, steel pipe; Class 125 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
D. Condensate piping above grade, NPS 2 (DN 50) and smaller: Schedule 80, Type S, Grade B, steel pipie; Class 125 cast-iron fittings; threaded joints.
3.2 VALVE APPLICATIONS
A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.
B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
3.3 PIPING INSTALLATION
A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Use indicated piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping to permit valve servicing.
F. Install piping free of sags and bends.
G. Install fittings for changes in direction and branch connections.
H. Install piping to allow application of insulation.
I. Select system components with pressure rating equal to or greater than system operating pressure.
J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
K. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) full port-ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to top of main pipe.
P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
R. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and full port ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
S. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
U. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.
1. Size drip legs same size as main.
3.4 STEAM-TRAP INSTALLATION
A. Install steam traps in accessible locations as close as possible to connected equipment.
B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.
3.5 PRESSURE-REDUCING VALVE INSTALLATION
A. Install pressure-reducing valves in accessible location for maintenance and inspection.
B. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.
C. Install gate valves on both sides of pressure-reducing valves.
D. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.
E. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Division 23 Section "Meters and Gages for HVAC Piping."
F. Install strainers upstream for pressure-reducing valve.
G. Install safety valve downstream from pressure-reducing valve station.
3.6 SAFETY VALVE INSTALLATION
A. Install safety valves according to ASME B31.9, "Building Services Piping."
B. Pipe safety-valve discharge without valves to atmosphere outside the building.
C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
3.7 HANGERS AND SUPPORTS
A. Comply with requirements below for maximum spacing.
B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
C. Install hangers with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 9 feet (2.7 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 9 feet (2.7 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch
D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 1/2 (DN 15): Maximum span, 4 feet (1.2 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.
3.8 PIPE JOINT CONSTRUCTION
A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
E. Welded Joints: Construct joints according to AWS D10.12 (AWS D10.12M), using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
3.9 TERMINAL EQUIPMENT CONNECTIONS
A. Size for supply and return piping connections shall be the same as or larger than equipment connections.
B. Install traps and control valves in accessible locations close to connected equipment.
C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
D. Install vacuum breakers downstream from control valve, close to coil inlet connection.
E. Install a drip leg at coil outlet.
3.10 FIELD QUALITY CONTROL
A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping," and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
B. Perform the following tests on steam and condensate piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
C. Prepare written report of testing.

END OF SECTION

DOMESTIC WATER HEAT EXCHANGERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract apply to this Section.
1.2 SUMMARY
A. This Section includes the following heat exchangers:
1. Heating-fluid-in-U-tube-coil, instantaneous heat exchangers.
2. Heat-exchanger accessories.
1.3 SUBMITTALS
A. Product Data: For each type and size of heat exchanger indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
B. Shop Drawings: Diagram power, signal, and control wiring.
C. Product Certificates: For each type of instantaneous heat exchanger, signed by product manufacturer.
D. Source quality-control test reports.
E. Field quality-control test reports.
F. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.
G. Warranty: One (1) year entire unit parts and labor.
1.4 QUALITY ASSURANCE
A. Source Limitations: Obtain same type of heat exchangers through one source from a single manufacturer.
B. Product Options: Drawings indicate size, profiles, and dimensional requirements of heat exchangers and are based on the specific system indicated.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label heat-exchanger storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with water.
1.5 COORDINATION
A. Coordinate size and location of concrete bases with Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2.2 INSTANTANEOUS HEAT EXCHANGERS
A. Heating-Fluid-in-U-Tube-Coil, Instantaneous Heat Exchangers:
1. Approved Manufacturers:
a. Armstrong International, Inc.
b. Approved equal, request for approval required prior to bid.
2. Description: Tankless, packaged assembly of heat-exchanger coil, controls, and specialties for heating domestic water in shell with steam in coil.
3. Construction: ASME-code, negligible-capacity, copper-lined, carbon-steel or copper-alloy shell with 150-psig (1035-kPa) minimum working-pressure rating.
a. Configuration: Horizontal.
b. Shell Tappings: Factory fabricated of materials compatible with water heater shell. Attach tappings to shell before testing and labeling.
1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
2) NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
c. Insulation: Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire shell and nozzle except connections and controls.
d. Heat-Exchanger Coil: Copper, single-wall, U tubes for heating fluid.
1) Tube Pressure Rating: Equal to or greater than heating-fluid supply pressure.
4. Temperature Control: Adjustable thermostat that operates steam-control valve and that is capable of maintaining outlet-water temperature within 5 deg F (3 deg C) of setting.
5. Safety Control: Automatic, high-temperature-limit cutoff device or system.
6. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into shell.
7. Miscellaneous Components for Steam Unit: Strainers, steam-control valve, steam trap, valves, pressure gage, thermometer, and piping.
8. Stand: Factory fabricated for floor mounting; capable of fiting through a standard 36" door.
9. Capacity and Characteristics: Refer to equipment schedule.
2.3 HEAT-EXCHANGER ACCESSORIES
A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select relief valves with sensing element that extends into heat-exchanger storage tank.
B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than working-pressure rating of heat exchanger.
C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
2.4 SOURCE QUALITY CONTROL
A. Test and inspect heat-exchanger storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

2.1 HEAT-EXCHANGER INSTALLATION
A. Install heat exchangers on concrete bases.
B. Install heat exchangers level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
C. Anchor heat exchangers to substrate.
D. Install combination temperature and pressure relief valves in water piping for heat exchangers without storage. Extend relief-valve outlet, with drain piping same as water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
E. Install heat-exchanger drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for heat exchangers that do not have tank drains.
F. Install thermometer on each heat-exchanger domestic-water inlet and outlet piping.
G. Install pressure gages on heat-exchanger heating-fluid piping.
H. Fill heat exchangers with water.
2.2 CONNECTIONS
A. Piping installation requirements are specified in other Sections.
B. Install piping adjacent to heat exchangers to allow service and maintenance. Arrange piping for easy removal of heat exchangers.
C. Ground equipment according to Electrical Section "Grounding and Bonding for Electrical Systems."
D. Connect wiring according to Electrical Section "Low-Voltage Electrical Power Conductors and Cables."
2.3 FIELD QUALITY CONTROL
A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:
1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
C. Remove and replace heat exchangers that do not pass tests and inspections and retest as specified above.
2.4 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers.

END OF SECTION

RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract apply to this Section.
1.2 SUMMARY
A. This Section includes resinous flooring systems.
1. Thin-film Urethane over Epoxy utility floor.
1.3 SUBMITTALS
A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
1.4 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
1.5 FIELD CONDITIONS
A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
B. Lighting: Provide permanent lighting, or if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring applications.
C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floof.
B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.
C. Flammability: Self-extinguishing according to ASTM D 635.
2.2 RESINOUS FLOORING MANUFACTURERS
A. Basis of Design: Refer to the system descriptions below. Subject to strict compliance with performance and aesthetic requirements of the listed Basis of Design product, provide the Basis of Design or an equivalent system from one of the listed systems.
1. Manufacturers that do not post their data sheets easily accessable on their websites without log-in requirements will not be allowed for consideration.
2.3 THIN-FILM URETHANCE OVER EXPOXY UTILITY FLOOR
A. Basis of Design: Neogard
B. System Description: CG-65
1. Surface Preparation: Clean and Bead Blast
2. Slab on Grade Moisture Mitigation: Per MFR
3. Base Coat: 70714/70715 + 86364 Sand Aggregate
4. Intermediate Coat(s): 70714/70715
5. Surface Texture: N/A
6. Lock-in Coat: 70817/70818
7. Color and Pattern: Grey; Yellow around edges of utility pad

PART 3 - EXECUTION

3.1 PREPARATION
A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Roughen concrete substrates as follows:
a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
2. Repair damaged and deteriorate concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
b. Relative Humidity Test: Use in site probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform test recommended by manufacturer. Proceed with application only after substrates pass testing.
C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
3.2 APPLICATION
A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

END OF SECTION

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COLORADO LICENSED 50150 PROFESSIONAL ENGINEER

No.	Date	Description
	9/16/2022	100% CONSTRUCTION DOCUMENTS

Project Name
DOMESTIC HOT WATER SYSTEM UPGRADE

Project Address
THE MEDICAL CENTER OF AURORA
1501 S POTOMAC ST,
AURORA, CO 80012

Salas O'Brien Project Number
2022-02900-00

Consultant Project Number

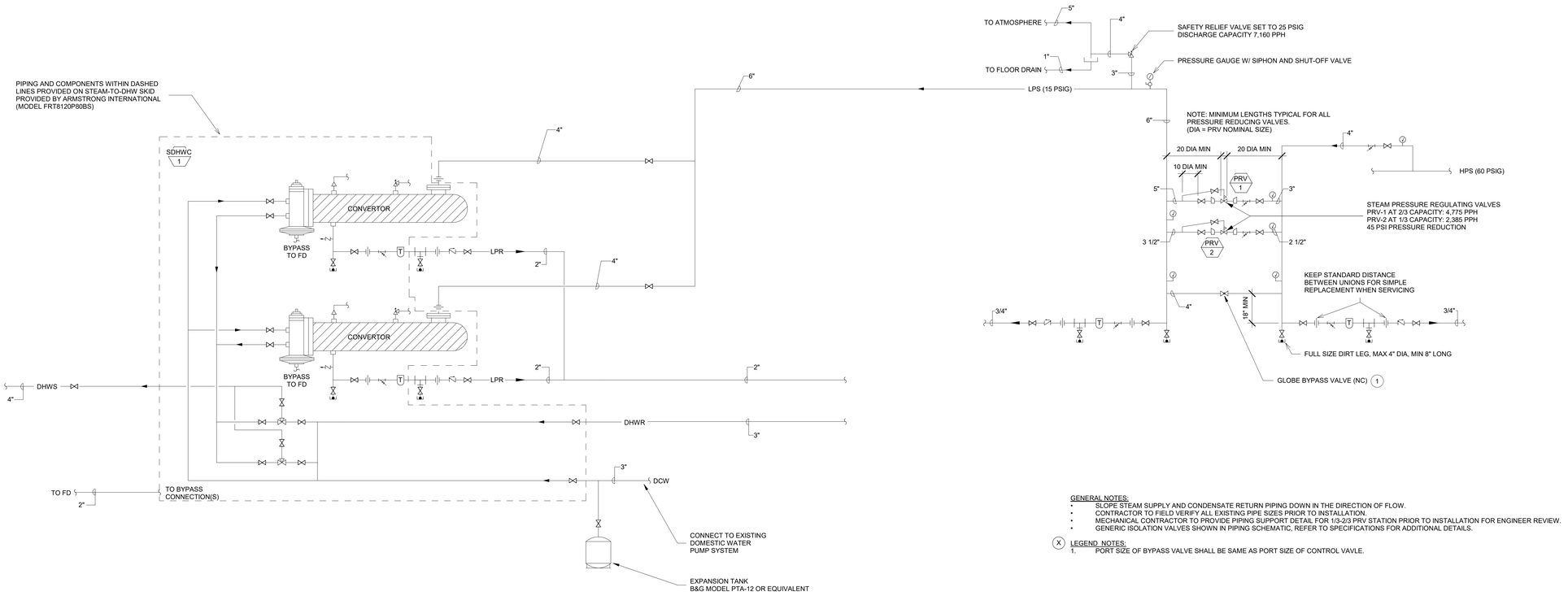
Sheet Title
MECHANICAL SPECIFICATIONS

Sheet Number
M004

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RSN: 1686562
Permit#: 23-2272046-CT

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1 STEAM TO WATER PIPING SCHEMATIC

NOT TO SCALE

GENERAL NOTES:
- SLOPE STEAM SUPPLY AND CONDENSATE RETURN PIPING DOWN IN THE DIRECTION OF FLOW.
- CONTRACTOR TO FIELD VERIFY ALL EXISTING PIPE SIZES PRIOR TO INSTALLATION.
- MECHANICAL CONTRACTOR TO PROVIDE PIPING SUPPORT DETAIL FOR 1/3-2/3 PRV STATION PRIOR TO INSTALLATION FOR ENGINEER REVIEW.
- GENERIC ISOLATION VALVES SHOWN IN PIPING SCHEMATIC, REFER TO SPECIFICATIONS FOR ADDITIONAL DETAILS.

(X) LEGEND NOTES:
1. PORT SIZE OF BYPASS VALVE SHALL BE SAME AS PORT SIZE OF CONTROL VAVLE.

DOMESTIC HOT WATER HEAT EXCHANGER AND RECIRCULATION PUMP CONTROL SEQUENCE OF OPERATION

THE HEAT EXCHANGER PACKAGE SHALL BE SUPPLIED COMPLETE WITH DDC SYSTEM CAPABLE OF STAND ALONE OPERATION AND BACNET INTEGRATION. THE PACKAGED CONTROLS SHALL BE CAPABLE OF CONTROLLING THE FOLLOWING:
- DUTY/STANDBY HEAT EXCHANGER OPERATION
- 120F HOT WATER OUTLET TEMPERATURE

THE HEAT EXCHANGER DDC CONTROLLER SHALL TIE IN TO THE EXISTING JCI BAS VIA BACNET. CREATE NEW GRAPHICS AT THE EXISTING BAS INTERFACE FOR THE HX PACKAGE INCLUDING THE FOLLOWING POINTS FOR MONITORING AND CONTROL:
- EACH HX STATUS
- 120F HOT WATER OUTLET TEMPERATURE
- 120F HOT WATER OUTLET TEMPERATURE SETPOINT
- 120F HOT WATER RECIRC TEMPERATURE
- GENERAL ALARM STATUS

ALL HEAT EXCHANGER CONTROL POINTS SHALL BE ACCESSIBLE THROUGH THE BAS.

RECIRCULATION PUMPS CONTROLS SHALL REMAIN IN PLACE.

2 DOMESTIC HOT WATER HEAT EXCHANGER AND PUMP CONTROL

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COLORADO LICENSED PROFESSIONAL ENGINEER 58150

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THE MEDICAL CENTER OF AURORA
1501 S POTOMAC ST,
AURORA, CO 80012

Salas O'Brien Project Number
2022-02900-00

Consultant Project Number

Sheet Title
MECHANICAL FLOW DIAGRAM

Sheet Number
M005

Scale As indicated

RSN: 1686562
Permit#: 23-2272045-CT

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DOMESTIC HOT WATER STEAM TO WATER HEAT EXCHANGER SCHEDULE

TAG	LOCATION	CAPACITY (MBH)	INLET				OUTLET		PRESURE DROP (PSIG)		FOULING FACTOR		PRESSURE RATING (PSI)		MAX. DIMENSIONS (IN)			OPERATING WEIGHT (LBS)	MANUFACTURER	MODEL	REMARKS
			STEAM		WATER		COND.	WATER													
			PSI	LBS/HR	EWT °F	GPM	GPM	LWT °F	SHELL	TUBE	SHELL	TUBE	SHELL	TUBE	LENGTH	WIDTH	HEIGHT				
SDHWC-1	MECH ROOM	5,800	15	7,160	40	145	14.3	120	-	8	0	0.0005	150	125	112	34	80	1500	ARMSTRONG	FRT8120PBS	ALL

REMARKS:

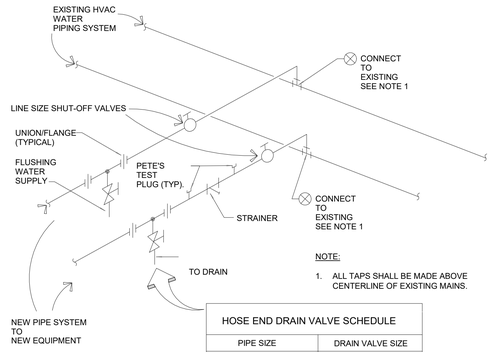
1. PROVIDE PACKAGED SKID SUITABLE FOR DOMESTIC WATER USUAGE COMPLETE WITH DDC SYSTEM CAPABLE OF STAND ALONE OPERATION AND BACNET INTEGRATION.
2. PROVIDE PARALLEL STEAM/WATER CONVERTERS FOR REDUNDANT STANDBY OPERATION.
3. PROVIDE WITH F&T TRAP AND VACUUM BREAKER PER HEAT EXCHANGER.
4. MOUNT ON 4" HOUSEKEEPING PAD.
5. PROVIDE WITH REDUNDANT DIGITAL RECIRCULATION VALVES, WATER TEMPERATURE CONTROLLERS, AND ONE SPARE MIXING VALVE.
6. PACKAGED SKID SHALL BE CAPABLE OF PASSING THROUGH STANDARD 36" DOOR.
7. PROVIDE INSULATED JACKET ON EACH HEAT EXCHANGER.

PRESSURE REDUCING VALVES (PRV)

TAG	SERVICE	INLET SIZE (IN.)	INLET PRESSURE	OUTLET PRESSURE	CAPACITY (LBS/HR)	MANUFACTURER	MODEL	REMARKS
PRV-1	STEAM/WATER CONVERTERS	SEE PLANS	60	15	4775	ARMSTRONG	GP-2000	1-3
PRV-2	STEAM/WATER CONVERTERS	SEE PLANS	60	15	2385	ARMSTRONG	GP-2000	1-3

REMARKS:

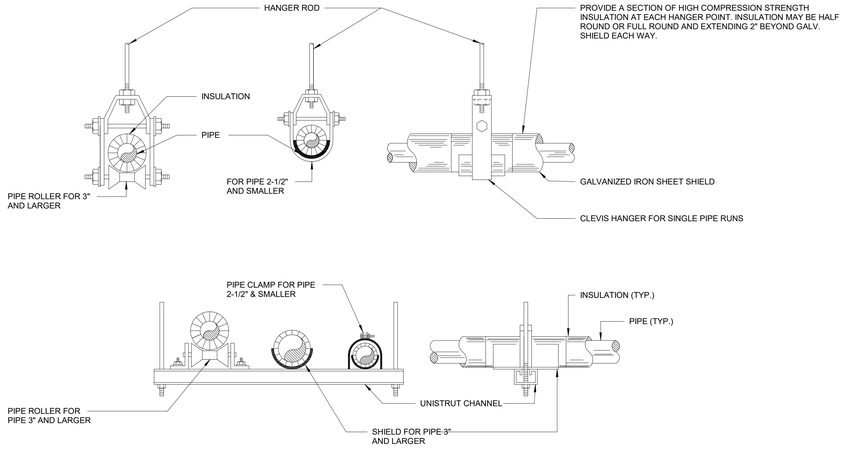
1. PROVIDE PRESSURE CONTROLLER.
2. INSTALL AND SUPPORT PER MANUFACTUR'S RECOMMENDATIONS.
3. PROVIDE MATCHED SILENCER DOWNSTREAM IF REQUIRED TO MEET 85 DBA MAXIMUM.



HOSE END DRAIN VALVE SCHEDULE

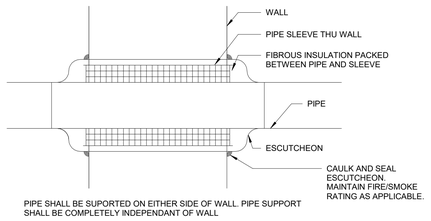
PIPE SIZE	DRAIN VALVE SIZE
UP TO 2"	¾"
2½" TO 4"	1¼"
5" TO 8"	2"
OVER 8"	2½"

1 PIPING CONNECTION DETAIL
NOT TO SCALE

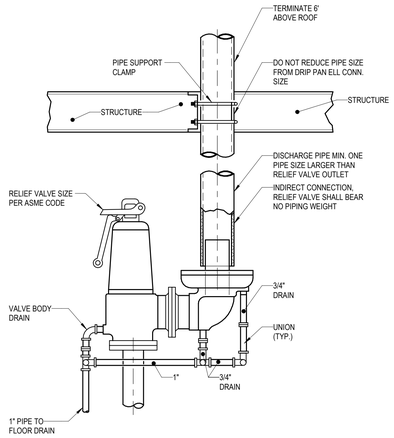


NOTE: PROVIDE SPRING VIBRATION INSOLATION HANGERS WITHIN MECHANICAL ROOMS

2 PIPE SUPPORT AND HANGERS
NOT TO SCALE



3 PIPE THRU WALL
NOT TO SCALE



4 STEAM RELIEF VALVE
NOT TO SCALE

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Denver, CO
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COLORADO LICENSED PROFESSIONAL ENGINEER 53150

No.	Date	Description
	9/16/2022	100% CONSTRUCTION DOCUMENTS

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Salas O'Brien Project Number
2022-02900-00

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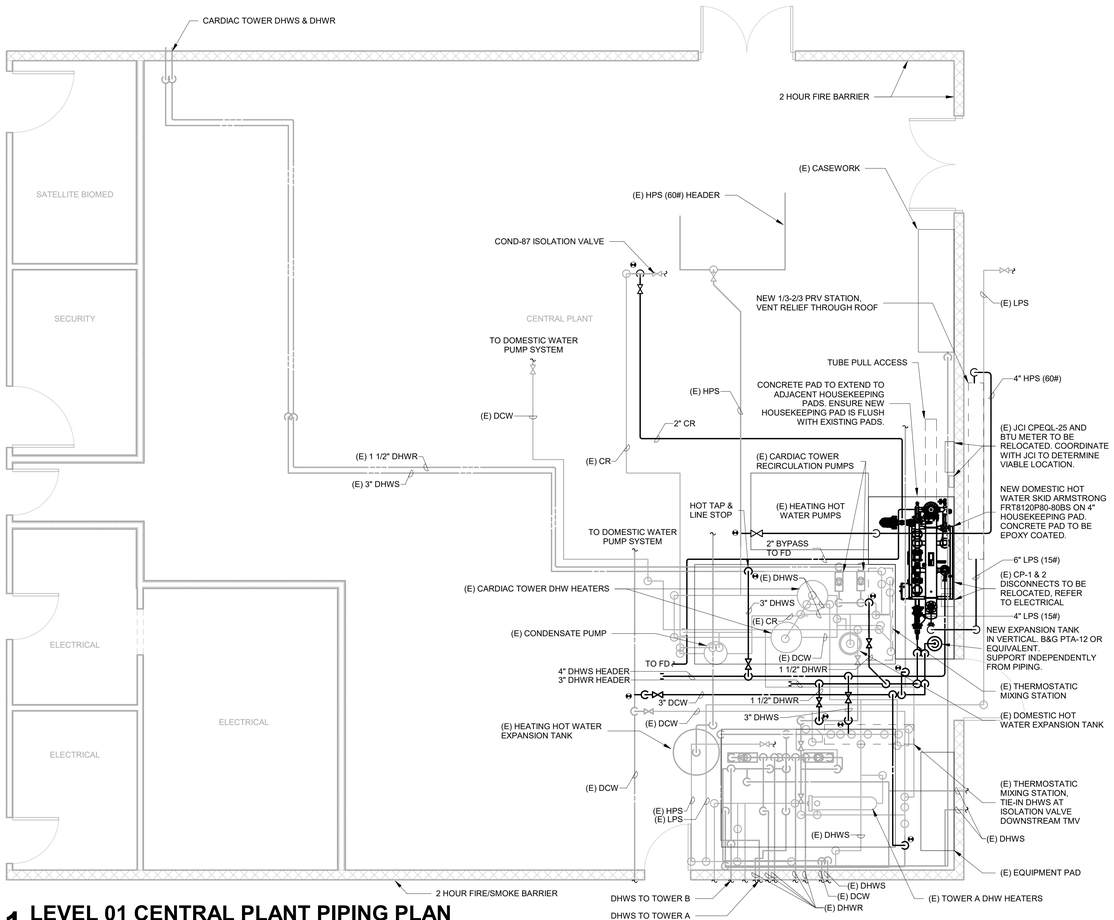
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MECHANICAL DETAILS & SCHEDULES

Sheet Number
M006

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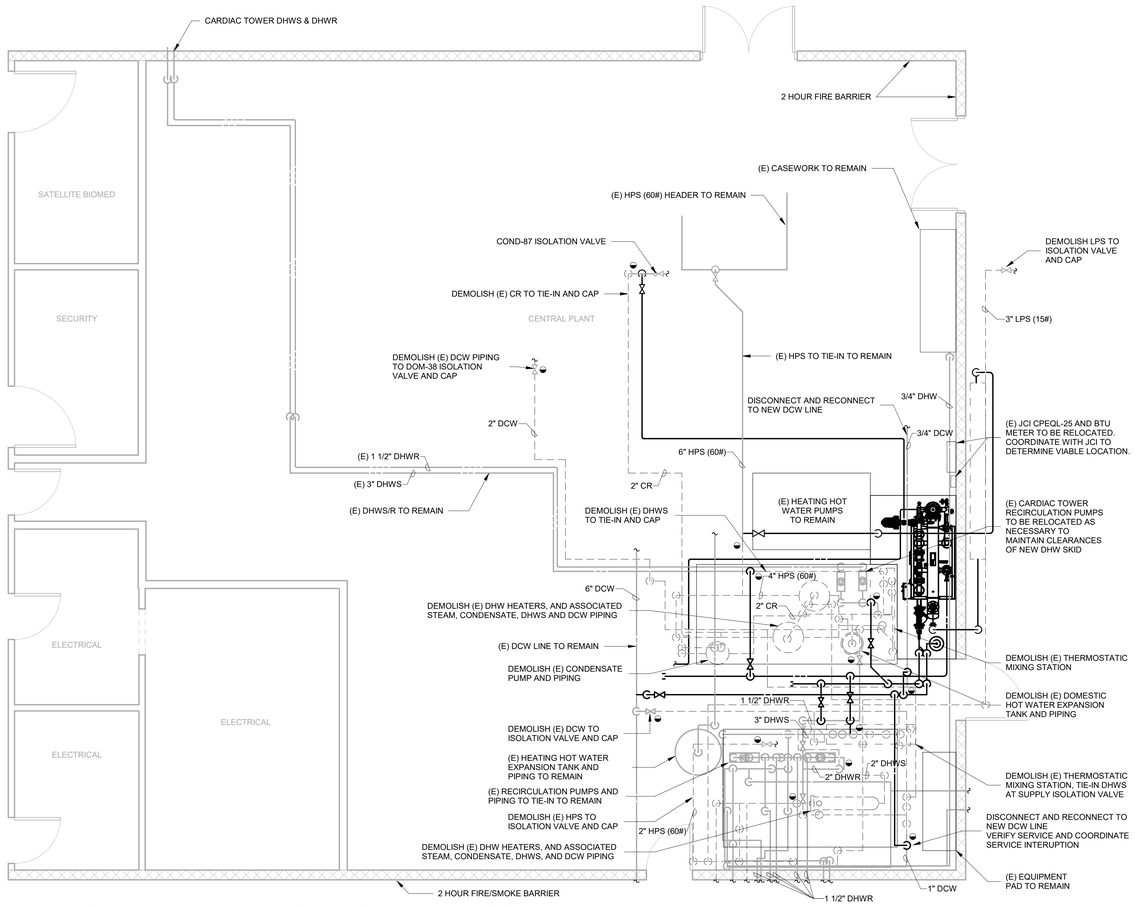
RSN: 1686562
Permit#: 23-2272045-CT

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1 LEVEL 01 CENTRAL PLANT PIPING PLAN

1/4" = 1'-0"



2 LEVEL 01 CENTRAL PLANT DEMOLITION PLAN

1/4" = 1'-0"

SALAS O'BRIEN
expect a difference
MEP/FP Engineering
Salas O'Brien
Denver, CO
(303) 225-6320

Health ONE The Medical Center of Aurora

Seal / Signature

COLORADO LICENSED MICHAEL P THOMPSON 53150 PROFESSIONAL ENGINEER

No.	Date	Description
	9/16/2022	100% CONSTRUCTION DOCUMENTS

Project Name

DOMESTIC HOT WATER SYSTEM UPGRADE

Project Address

THE MEDICAL CENTER OF AURORA
1501 S POTOMAC ST,
AURORA, CO 80012

Salas O'Brien Project Number

2022-02900-00

Consultant Project Number

Sheet Title

CENTRAL PLANT PIPING PLAN

Sheet Number

M100

Scale 1/4" = 1'-0"

RSN: 1686562
Permit#: 23-2272045-CT

9/19/2022 11:46:06 AM

GENERAL ELECTRICAL SYMBOLS

	CONDUIT STUBBED UP
	CONDUIT STUBBED DOWN
	FLEXIBLE CONDUIT
	MULTI-OUTLET ASSEMBLY
	UNDERGROUND DUCTBANK
	UNDERGROUND DIRECT BURIAL CABLE
PB	PULL BOX
J	JUNCTION BOX- EXPOSED OR IN CEILING
J	JUNCTION BOX – WALL MOUNTED
J	JUNCTION BOX WITH FLEXIBLE CONDUIT AND FINAL CONNECTION TO EQUIPMENT.
PDO 13	EQUIPMENT IDENTIFICATION TAG

LIGHTING SYMBOLS

F1 1a	2' X 4' LIGHTING FIXTURE.
1a	2' X 2' LIGHTING FIXTURE.
F1 1a	1' X 4' LIGHTING FIXTURE.
F1 1a	LIGHTING FIXTURE– LENGTH AS INDICATED.
T F1 1a	WALL MOUNTED LIGHTING FIXTURE– LENGTH AS INDICATED.
F1 F1 1a 1a	RECESSED DOWNLIGHT LIGHTING FIXTURE.
F1 F1 1a 1a	WALL MOUNTED LIGHTING FIXTURE
F1 E1	2' X 4' LIGHTING FIXTURE CONNECTED TO EMERGENCY CIRCUIT.
F1 E1	LIGHTING FIXTURE CONNECTED TO EMERGENCY CIRCUIT.
F1 F1 E1 E1	LIGHTING FIXTURE CONNECTED TO EMERGENCY CIRCUIT.
F1 E2	BATTERY PACK, EMERGENCY LIGHTING UNIT
	REMOTE HEAD CONNECTED TO BATTERY PACK.
NEW #3 E3 / #21 E5	"#X" INDICATES INSCRIPTION, ARROWS, AND SINGLE OR DOUBLE FACED, AS SHOWN BELOW. SHADED QUADRANTS INDICATES DIRECTION OF LIGHTED FACES.
NEW #3N E3 / #21N E5	
EXISTING #3E E3 / #21E E5	

"#1" FIRE ESCAPE; "#2" STAIRWAY; "#2A" STAIRS; "#3" EXIT; "#4" FIRE ESCAPE; "#5" STAIRWAY; "#5A" STAIRS; "#6" EXIT; "#7" FIRE ESCAPE; "#8" STAIRWAY; "#8A" STAIRS; "#9" EXIT; "#10" FIRE ESCAPE; "#11" STAIRWAY; "#11A" STAIRS; "#12" EXIT; "#13" EXIT – RECESSED; "#14" TRIANGLE; "#15" ELEVATOR; "#16" FIRE ESCAPE; "#17" STAIRWAY; "#17A" STAIRS; "#18" EXIT; "#19" FIRE ESCAPE; "#20" STAIRWAY; "#20A" STAIRS; "#21" EXIT; "#22" FIRE ESCAPE; "#23" STAIRWAY; "#23A" STAIRS; "#24" EXIT

3W XXa $	LIGHT SWITCH, SINGLE POLE UNLESS NOTED OTHERWISE:

"a" INDICATES LIGHTS CONTROLLED; "D" INDICATES DIMMER SWITCH; "EP" INDICATES EXPLOSION PROOF; "FD" INDICATES FLUORESCENT DIMMER; "ID" INDICATES INCANDESCENT DIMMER; "K" INDICATES KEY OPERATED; "LV" INDICATES LOW VOLTAGE; "MC" INDICATES MOMENTARY CONTACT; "P" INDICATES PILOT LIGHT; "XX" INDICATES CIRCUIT NUMBER; "WP" INDICATES WEATHERPROOF; "2P" INDICATES 2 POLE; "3P" INDICATES THREE POLE; "3W" INDICATES THREE-WAY; "4W" INDICATES FOUR-WAY; "OS" INDICATES COMBINATION WITH OCCUPANCY SENSOR; "V" INDICATES COMBINATION WITH VACANCY SENSOR

LC	LIGHTING CONTACTOR IN ENCLOSURE
LCC	LIGHTING CONTACTOR CABINET
LRC	LIGHTING RELAY CABINET
TC	TIME CLOCK
PC	PHOTOCELL
TS	TIME SWITCH
OS	OCCUPANCY SENSOR

LIGHTING FIXTURES: "F1" INDICATES LIGHTING FIXTURE TYPE. REFER TO LIGHTING FIXTURE SCHEDULE FOR DESCRIPTION AND MOUNTING. "1" INDICATES CIRCUIT NUMBER "a" INDICATES SWITCH CONTROL. SHADING OF LIGHTING FIXTURE OR "E" INDICATES LIGHTING FIXTURE CONNECTED TO EMERGENCY CIRCUIT.

POWER SYMBOLS

WALL	FLOOR	POKE-THROUGH	
			DUPLEX RECEPTACLE
			DOUBLE DUPLEX RECEPTACLE
			DUPLEX RECEPTACLE – SPLIT WIRED
			SINGLE RECEPTACLE
			SPECIAL RECEPTACLE – NEMA TYPE AS INDICATED
			JUNCTION BOX WITH FLEXIBLE CONDUIT AND FINAL EQUIPMENT OR FURNITURE SYSTEM POWER CONNECTION

WP/GFI	WEATHERPROOF, HINGED TOP OUTLET BOX WITH INTEGRAL BASE (MANUFACTURER: PEDOC) WITH (1) GFI DUPLEX RECEPTACLE (BY EC)
USB	DUPLEX RECEPTACLE WITH 2 USB PORTS
USB	OUTLET WITH 2 USB PORTS
WP XX	ADJACENT LETTERS IN THE SYMBOLS ABOVE INDICATE THE FOLLOWING:

"CR" INDICATES CHILD RESISTANT (SAFETY TYPE); "E" INDICATES RECEPTACLE FED BY EMERGENCY CIRCUIT; "EP" INDICATES RECEPTACLE IS EXPLOSION PROOF; "EWC" INDICATES RECEPTACLE SERVES ELECTRIC WATER COOLER; "GFI" INDICATES RECEPTACLE HAS GROUND FAULT CIRCUIT INTERRUPTER; "IG" INDICATES RECEPTACLE HAS ISOLATED GROUND; "TVS" INDICATES RECEPTACLE HAS TRANSIENT VOLTAGE SURGE SUPPRESSION; "WP" INDICATES RECEPTACLE HAS WATERPROOF COVER; "XX" INDICATES RECEPTACLE CIRCUIT NUMBER; "S" INDICATES RECEPTACLE IS SAFETY TYPE

	DUPLEX RECEPTACLE MOUNTED ABOVE COUNTER TOP
	PUSHBUTTON STATION WITH ONE BUTTON
EPO	EMERGENCY POWER OFF MUSHROOM PUSHBUTTON CONTROL STATION
2P XX $	MANUAL MOTOR CONTROL

"M" INDICATES LOCKOUT MOTOR SWITCH; "K" INDICATES KEY OPERATED; "P" INDICATES PILOT LIGHT; "TH" INDICATES THERMAL OVERLOAD PROTECTION; "XX" INDICATES CIRCUIT NUMBER; "2P" INDICATES 2 POLE SWITCH; "3P" INDICATES 3 POLE SWITCH

	SWITCHGEAR, SWITCHBOARD OR MOTOR CONTROL CENTER, DASHED LINES INDICATE FUTURE SECTIONS, ARROW INDICATES FRONT
	SURFACE MOUNTED DISTRIBUTION PANELBOARD
	SURFACE MOUNTED BRANCH CIRCUIT PANELBOARD
	RECESSED MOUNTED BRANCH CIRCUIT PANELBOARD
D	DAMPER MOTOR
	MOTOR – RATED AS INDICATED
A CB	CIRCUIT BREAKER IN ENCLOSURE, "A" INDICATES AMPERE RATING OF BREAKER
AS	NON-FUSED DISCONNECT SWITCH, "AS" INDICATES AMPERE RATING OF SWITCH
AS/AF	FUSED DISCONNECT SWITCH, "AS" INDICATES AMPERE RATING OF SWITCH AND "AF" INDICATES AMPERE RATING OF FUSE
	MAGNETIC MOTOR STARTER – NEMA SIZE AS INDICATED
T	TRANSFORMER

SINGLE LINE DIAGRAM SYMBOLS

	CABLE LUGS
CT	CURRENT TRANSFORMER
	SWITCH
	FUSE
	GROUND FAULT SENSOR
	GROUNDING ELECTRODE CONDUCTOR
	CIRCUIT BREAKER
	PANELBOARD
	TRANSFORMER WITH FLEXIBLE CONDUIT AND PAD
ST	SHUNT TRIP

SIGNAL SYMBOLS

CCTV	CLOSED CIRCUIT TELEVISION CAMERA
S	SPEAKER, WALL OR CEILING MOUNTED
CR	CARD READER
DC	DOOR CONTACT
KP	KEYPAD

WALL	FLOOR	POKE-THROUGH	
			SUBSCRIPT INDICATES THE FOLLOWING FOR BELOW WALL MOUNTED OUTLETS, (U.N.O.): "H" HANDICAP MOUNTED AT 48" A.F.F.; "P" PAY PHONE MOUNTED AT 54" A.F.F.; "W" WALL MOUNTED AT 54" A.F.F.

	COMMUNICATIONS OUTLET – PROVIDE 2-GANG BACKBOX WITH 1-GANG MUDRING AND 1"C STUBBED TO ACCESSIBLE CEILING CAVITY WITH INSULATING BUSHING.
WAP	WIRELESS ACCESS POINT OUTLET
AV1	AUDIOVISUAL OUTLET – PROVIDE 2-GANG BACKBOX WITH 1-GANG MUDRING AND 1"C STUBBED TO ACCESSIBLE CEILING CAVITY WITH INSULATING BUSHING.
AV2	AUDIOVISUAL OUTLET – PROVIDE 2-GANG BACKBOX WITH 2-GANG MUDRING AND 1"C STUBBED TO ACCESSIBLE CEILING CAVITY WITH INSULATING BUSHING.
PM1	PATIENT MONITORING SYSTEM DATA OUTLET – PROVIDE 2-GANG BACKBOX WITH 1-GANG MUDRING AND 1"C STUBBED TO ACCESSIBLE CEILING CAVITY WITH INSULATING BUSHING.
PM2	PATIENT MONITORING SYSTEM VIDEO OUTLET – PROVIDE 4X4 BACKBOX WITH COVER WITH 2" BUSHED OPENING AND 1-1/2"C STUBBED TO ACCESSIBLE CEILING CAVITY WITH INSULATING BUSHING.

FIRE ALARM SYMBOLS

S	FIRE ALARM MANUAL PULL STATION
SD	SMOKE DETECTOR
D	HEAT DETECTOR
DD	DUCT DETECTOR
RA	REMOTE INDICATOR LIGHT FOR SMOKE DETECTOR
S	VOICE SPEAKER
SV	VOICE SPEAKER WITH VISUAL ALARM
V	VISUAL ALARM
T	VOICE COMMUNICATION TELEPHONE
HMD	MAGNETIC DOORHOLDER
WFS	WATER FLOW SWITCH
VSS	VALVE SUPERVISION SWITCH
APS	AIR PRESSURE SWITCH
FACP	FIRE ALARM CONTROL PANEL
FAAP	FIRE ALARM ANNUNCIATOR PANEL
VCP	VOICE COMMUNICATION CONTROL PANEL

ABBREVIATIONS

ABBREV.	DESCRIPTION
AFF	ABOVE FINISHED FLOOR
ACL	ACROSS THE LINE
ALM	ALARM
AC	ALTERNATING CURRENT
A	AMPERE
AMP	AMPERE
AIC	AMPERES INTERRUPTING CAPACITY
AL	ALUMINUM
ANN	ANNUNCIATOR
ATS	AUTOMATIC TRANSFER SWITCH
BAL	BALLAST
BR	BRANCH
BRKR	BREAKER
BGB	BUILDING GROUND BOX
CAB	CABINET
CATV	CABLE TELEVISION
C.B.	CIRCUIT BREAKER
CCT	CIRCUIT
CCTV	CLOSED CIRCUIT TELEVISION
CLO	CLOSET
COAX	COAXIAL
C.I.	COEFFICIENT OF UTILIZATION
COMED	COMMONWEALTH EDISON COMPANY
C	CONDUIT
CONN	CONNECTION
CONV	CONVENIENCE
CU	COPPER
CUH	CABINET UNIT HEATER
CT	CURRENT TRANSFORMER
CTRL	CONTROLLER
HZ	HERTZ (CYCLES/SECOND)
DC	DIRECT CURRENT
DS	DISCONNECT SWITCH
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DO	DRAWOUT
DT	DUSTTIGHT
ELEC	ELECTRIC
EWC	ELECTRIC WATER COOLER
EWH	ELECTRIC WATER HEATER
EM	EMERGENCY
EMT	ELECTRIC METALLIC TUBING (THIN WALL CONDUIT)
EQ	EQUIPMENT
EUH	ELECTRIC UNIT HEATER
EX	EXISTING
EP	EXPLOSION PROOF
FPB	FAN POWERED BOX
FA	FIRE ALARM
FDC	FIRE DEPARTMENT CONNECTION
FB	FLOORBOX
FLUOR	FLUORESCENT
F	FUSE
F.S.	FUSED SWITCH
GEN	GENERATOR
GRD	GROUND
GFI	GROUND FAULT INTERRUPTER
GHW	GALVANIZED HEAVYWALL STEEL CONDUIT
HV	HIGH VOLTAGE
HP	HORSE POWER
INC	INCANDESCENT
IC	INTERRUPTING CAPACITY
IMC	INTERMEDIATE GRADE CONDUIT
JB	JUNCTION BOX
KW	KILOWATT
KWH	KILOWATT-HOUR

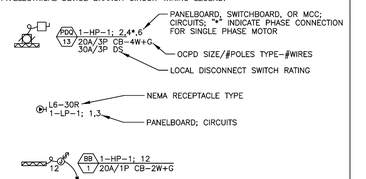
ABBREV.	DESCRIPTION
KVA	KILOVOLT-AMPERE
KO	KNOCKOUT
LTG	LIGHTING
LS	LOUD SPEAKER
LV	LOW VOLTAGE
MH	MANHOLE
MFR	MANUFACTURER
MV	MULTI VAPOR
MERC.	MERCURY VAPOR
MTR	MOTOR
MCC	MOTOR CONTROL CENTER
MTD	MOUNTED
NEC	NATIONAL ELECTRICAL CODE
NEUT	NEUTRAL
NC	NORMALLY CLOSED
NO	NORMALLY OPENED
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
PNL	PANEL
PH	PHASE
PT	POTENTIAL TRANSFORMER
PWR	POWER
PRI	PRIMARY
PROT.	PROTECTION OR PROTECTIVE
PA	PUBLIC ADDRESS
PB	PULL BOX
RT	RAINTIGHT
RECP	RECEPTACLE
RC	REMOTE CONTROL
R	RESISTANCE
REL	RELOCATED
SEC	SECONDARY
SC	SHORT CIRCUIT
SP	SINGLE POLE
SPST	SINGLE POLE SINGLE THROW
SPDT	SINGLE POLE DOUBLE THROW
SPKR	SPEAKER
SPEC	SPECIFICATION
SS	STAINLESS STEEL
STA	STATION
S	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
SYM	SYMMETRICAL
SYS	SYSTEM
TC	TERMINAL CABINET
TEL	TELEPHONE
TEL.CL.	TELEPHONE CLOSET
TTC	TELEPHONE TERMINAL CABINET
TV	TELEVISION
TERM.	TERMINAL
TX	TRANSFORMER
T	TRIP
TL	TWIST LOCK
UL	UNDERWRITER'S LABORATORIES
UNG	UNGROUNDED
UH	UNIT HEATER
UNO	UNLESS NOTED OTHERWISE
VP	VAPORPROOF
VT	VAPORTIGHT
V	VOLT
VA	VOLT-AMPERE
WT	WATERTIGHT
W	WATT
WP	WEATHERPROOF
XR	EXISTING TO BE REMOVED
XRL	EXISTING TO BE RELOCATED
XRW	EXISTING TO BE REWIRED

BRANCH CIRCUIT WIRING SCHEDULE

OCPD	1P & 2P	2P-3W & 3P-3W	3P-4W
15	2#12, 1#12G, 3/4"C	3#12, 1#12G, 3/4"C	4#12, 1#12G, 3/4"C
20	2#12, 1#12G, 3/4"C	3#12, 1#12G, 3/4"C	4#12, 1#12G, 3/4"C
25	2#10, 1#10G, 3/4"C	3#10, 1#10G, 3/4"C	4#10, 1#10G, 3/4"C
30	2#10, 1#10G, 3/4"C	3#10, 1#10G, 3/4"C	4#10, 1#10G, 3/4"C
35	2#8, 1#10G, 3/4"C	3#8, 1#10G, 3/4"C	4#8, 1#10G, 3/4"C
40	2#8, 1#10G, 3/4"C	3#8, 1#10G, 3/4"C	4#8, 1#10G, 3/4"C
45	2#6, 1#10G, 3/4"C	3#6, 1#10G, 3/4"C	4#6, 1#10G, 1"C
50	2#6, 1#10G, 3/4"C	3#6, 1#10G, 3/4"C	4#6, 1#10G, 1"C
60	2#4, 1#10G, 3/4"C	3#4, 1#10G, 1"C	4#4, 1#10G, 1 1/4"C
70	2#4, 1#8G, 3/4"C	3#4, 1#8G, 1"C	4#4, 1#8G, 1 1/4"C
80	2#3, 1#8G, 1"C	3#3, 1#8G, 1"C	4#3, 1#8G, 1 1/4"C
90	2#2, 1#8G, 1"C	3#2, 1#8G, 1 1/4"C	4#2, 1#8G, 1 1/4"C
100	2#1, 1#8G, 1 1/4"C	3#1, 1#8G, 1 1/4"C	4#1, 1#8G, 1 1/2"C

GENERAL NOTES

1. REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATIONS OF LIGHTING AND CONTROLS, RECEPTACLES, COMMUNICATIONS DEVICES, FIRE ALARM DEVICES, AND LIFE SAFETY DEVICES.
2. REFER TO MECHANICAL DRAWINGS FOR EXACT LOCATION OF HVAC, PLUMBING, AND FIRE PROTECTION EQUIPMENT.
3. REFER TO PANEL DIVISION LINES FOR BRANCH CIRCUIT HOMERUN PANELBOARD DEMARCATION LINES, UNLESS NOTED OTHERWISE.
4. BRANCH CIRCUIT WIRING FOR 120 VOLT 20 AMP CIRCUITS WIRED TO 208Y/120V SYSTEMS SHALL BE AS FOLLOWS:
   A. GENERAL RECEPTACLES AND LIGHTING LOADS:
      UP TO 100 FEET IN LENGTH: 3#12, 1#12N, 1#12G –3/4"C.
      OVER 100 FEET IN LENGTH: 3#10, 1#10N, 1#10G –3/4"C.
5. BRANCH CIRCUIT WIRING FOR 277 VOLT 20 AMP CIRCUITS WIRED TO 480Y/277V SYSTEMS SHALL BE AS FOLLOWS:
   A. LIGHTING LOADS:
      UP TO 150 FEET IN LENGTH: 3#12, 1#10N, 1#12G –3/4"C.
      OVER 150 FEET IN LENGTH: 3#10, 1#8N, 1#10G –3/4"C.
6. DISTANCES FOR BRANCH CIRCUIT WIRING, AS INDICATED IN NOTES 4 & 5 ABOVE, SHALL BE MEASURED FROM THE FINAL OCPD TO THE CENTER OF THE BRANCH CIRCUIT LOAD. SIZES ARE A MINIMUM AND CONTRACTOR MAY BE REQUIRED TO UP-SIZE TO ACCOUNT FOR VOLTAGE DROP.
7. COMPUTER EQUIPMENT OUTLETS, OUTLETS WITHIN WORKSTATIONS, OFFICES, FURNITURE SYSTEMS, AND THE LIKE SHALL BE CONSIDERED NON-LINEAR LOADS.
8. BRANCH CIRCUIT CONDUCTORS SIZED AS INDICATED IN NOTES 4 & 5 ABOVE AND/OR ON PLAN SHALL BE ROUTED TO EACH ELECTRIC DEVICE CONNECTED TO THE INDICATED BRANCH CIRCUIT. PROVIDE WIRENUTS AND PIGTAILS SIZED TO MATCH THE CORRESPONDING OCPD LISTED IN THE BRANCH CIRCUIT WIRING SCHEDULE FOR ELECTRICAL DEVICE TERMINATIONS WHERE THE ELECTRICAL DEVICE LUGS CANNOT ACCOMMODATE THE INCREASED CONDUCTOR SIZE INDICATED ABOVE, U.N.O.
9. REFER TO THE BRANCH CIRCUIT WIRING SCHEDULE FOR MINIMUM INSTALLATION CRITERIA. BRANCH CIRCUIT WIRING SPECIFIED IN NOTES AND/OR ON PLAN OR OTHER SCHEDULES SHALL TAKE PRECEDENCE OVER THE INFORMATION PROVIDED IN THE SCHEDULE.
10. PROVIDE AN EQUIPMENT GROUNDING SCREW WITHIN THE RECEPTACLE OUTLET BOX FOR RECEPTACLES WITHOUT A SIDE-MOUNTED GROUNDING SCREW FOR TERMINATION OF THE BRANCH CIRCUIT EQUIPMENT GROUNDING CONDUCTOR.
11. ELECTRICAL DEVICE BRANCH CIRCUIT WIRING LEGEND:



12. MOUNTING HEIGHTS OF ELECTRICAL ITEMS SHALL BE AS LISTED BELOW ABOVE FINISHED FLOOR TO CENTERLINE, UNLESS NOTED OTHERWISE ON ARCHITECTURAL DRAWINGS OR AS REQUIRED BY CODE:

A. GENERAL RECEPTACLES	18" TO BOTTOM
B. PATIENT RECEPTACLES	18" TO BOTTOM
D. GENERAL TELE AND DATA OUTLETS	18" TO BOTTOM
E. PATIENT TELE AND DATA OUTLETS	18"
F. GENERAL TOGGLE SWITCHES	48"
G. FIRE ALARM PULL STATIONS	48"
H. SECURITY CALL STATIONS	48"
I. CLOCK AND PAGING SPEAKER OUTLETS	84"
J. FIRE ALARM AUDIO VISUAL DEVICES	80"
K. GENERAL WALL MOUNTED LIGHTS	90"
L. CORRIDOR WALL SCONCES (>4" DEEP)	66"
M. EXIT SIGNS	90"
N. INDIVIDUAL DISCONNECTS AND STARTERS	60"
O. GROUPED DISCONNECTS AND STARTERS	> 12"
	< 72"
P. PANELBOARD OVERCURRENT DEVICES	> 12"
	< 72"

13. PROVIDE NEW FIRE ALARM DEVICES AS INDICATED IN THE DOCUMENTS OR AS OTHERWISE REQUIRED BY LOCAL CODES. NEW DEVICES SHALL BE PRODUCTS OF THE EXISTING FIRE ALARM MANUFACTURER, JCI/SIMPLEX. CONTACT DAN RAAP – DANIEL.RAAP@JCI.COM.
14. PROVIDE MODIFICATIONS TO THE OVERHEAD AND INTERDEPARTMENTAL PAGING SYSTEM UTILIZING THE HOSPITAL PAGING SYSTEM MAINTENANCE CONTRACTOR, BEACON COMMUNICATIONS. CONTACT ANDREAS KACZANOWSKI – 303-750-6500.

ELECTRICAL CODE REFERENCE

CITY OF AURORA, COLORADO MUNICIPAL CODE
2018 INTERNATIONAL BUILDING CODE
2018 INTERNATIONAL FIRE CODE
2020 NATIONAL ELECTRICAL CODE
2019 CITY OF AURORA AMENDMENTS
2018 INTERNATIONAL ENERGY CONSERVATION CODE

ELECTRICAL DRAWING LIST

E000	ELECTRICAL LEGENDS, NOTES, AND ABBREVIATIONS	NO SCALE
E001	ELECTRICAL SPECIFICATIONS	NO SCALE
E100	LEVEL 01 ELECTRICAL POWER PLAN	1/4"=1'-0"

SALASO'BRIEN
expect a difference
MEP/FP Engineering
Salas O'Brien
Denver, CO
(303) 225-6320

HealthONE The Medical Center of Aurora

Seal / Signature

COLORADO LICENSED MICHAEL P. THOMPSON 55150 PROFESSIONAL ENGINEER

No.	Date	Description

Project Name
DOMESTIC HOT WATER SYSTEM UPGRADE

Project Address
THE MEDICAL CENTER OF AURORA
1501 S POTOMAC ST,
AURORA, CO 80012

Salas O'Brien Project Number
2022-02900-00

Consultant Project Number

Sheet Title
ELECTRICAL SYMBOLS , ABBREVIATIONS & NOTES

Sheet Number
E000

Scale 12" = 1'-0"

RSN: 1686562
Permit#: 23-2272046-CT

9/16/2022 4:33:30 PM

DIVISION 16000 – ELECTRICAL

1. GENERAL

A. Requirements:

1) Products and execution shall be provided for a complete and fully operational electrical system throughout the extent of the project, in conformance with applicable codes, laws, ordinances and agency standards of governing bodies having jurisdiction, and in strict accordance with the contract documents, and building standards.

2) Products, including equipment, devices, fixtures, and materials shall be new unless noted otherwise, UL listed, and bear appropriate label.

3) Execution, including preparation, installation, starting, and testing shall be performed by skilled trades personnel, in compliance with the associated manufacturers recommendations, and coordinated with the other construction trades.

B. Applicable Codes:

1) National Electrical Code	NEC
2) International Building Code	IBC

C. Applicable Laws and Agency Standards:

1) American National Standards Institute	ANSI
2) American Society for Testing and Materials	ASTM
3) Americans with Disabilities Act	ADA
4) Electrical Testing Laboratories	ETL
5) Electronic/Telecommunications Industries Association	EIA/TIA
6) Illuminating Engineering Society of North America	IESNA
7) Institute of Electrical and Electronics Engineers	IEEE
8) Insulated Cable Engineers Association	ICEA
9) National Electrical Manufacturers Association	NEMA
10) National Fire Protection Association	NFPA
11) Underwriters' Laboratories	UL

D. Approvals:

1) Emergency and Exit Lighting Documents shall be prepared and submitted to the Local Fire Department for their approval of system layout, circuiting, and fixture type. Approved drawings shall be submitted for review prior to construction.

2) Fire Alarm and Life Safety Documents shall be prepared and submitted to the Local Fire Department for their approval of system expansion, layout, circuiting, equipment and device type. The base building fire alarm and life safety system manufacturer/installer shall be retained to produce or update the building fire alarm and life safety documents, and to make final connections and alterations to the existing system. Approved drawings shall be submitted for review prior to construction.

3) Other systems requiring specific approval.

E. Submittals:

1) Product Data shall be prepared and submitted for review prior to construction for the following products: cabinets, access panels, supports, raceway components, floor boxes, fire proof fittings, wire, fuses, circuit breakers, receptacles, toggle switches, slide dimmers, disconnect switches, motor starters, contactors, lighting fixtures, ballasts, lamps, controls, fire alarm devices, life safety devices, and electric heating equipment.

2) Shop Drawings shall be prepared and submitted for review prior to construction for the following products: metering equipment, distribution panelboards, branch panelboards, transformers, cable tray, dimming equipment, fire alarm equipment, and life safety equipment.

3) Test Results shall be prepared and submitted prior to project completion for cable insulation, grounding system, emergency system, fire alarm system, and life safety systems in accordance with authorities having jurisdiction, and applicable codes and agency standards.

4) Manufacturers Instructions shall be prepared and submitted prior to construction including installation manuals with application conditions and limitations for electrical apparatus use, storage, handling, protection, examination, preparation, installation, and starting.

5) Project Record Documents shall be prepared using AutoCAD or equivalent CAD package. Project Record Documents shall be submitted on reproducible media prior to project completion for electrical systems. Record actual location of equipment, devices, fixtures, etc. Record actual routing of overhead feeders. Record actual routing of feeders below slab and branch circuits within or below slab.

6) Maintenance Data shall be prepared and submitted prior to project completion for electrical apparatus including operation manuals and maintenance manuals.

F. Coordination:

1) Electrical Engineer: Notify the Engineer of any conflicting design information or any design intentions which are not readily interpreted from the contract documents prior to any product selection or execution of work. Notify the Engineer of any products which are damaged, unsuitable, incompatible, or non–compliant with any applicable codes or ordinances of any governing bodies having lawful jurisdiction.

2) Architect: Coordinate construction of the electrical system with the Architect. Final locations and mounting heights of electrical equipment, fire alarm equipment, receptacles, switches, communications devices, fire alarm devices, lighting fixtures, etc. shall be as directed by the Architect.

3) Construction Trades: Coordinate work with other construction trades.

4) Building Management: Meet on site with the building engineer to become familiar with building standards. Normal building working hours shall be recognized. After–hours work or temporary services shall be with prior written approval from building management. Enclose construction area from other areas to prevent transmission of dust, dirt and noise into other existing tenant areas. Product and waste transfer shall be coordinated with building management for scheduling of the elevators, deliveries, and waste removal.

5) Existing Building Systems: Review building standards with the building engineer. Perform a site visit to verify the existing site conditions. Costs associated with unforeseen conditions as result of not performing a site visit shall not be an entitlement for an increase to the contract. Construction shall be performed without interruption to the building power, communications, security, fire alarm and life safety systems, or interference to common areas, corridors, exits or existing tenants. Where any construction would interfere with the daily operations of the building or other tenants, after–hours work or temporary services shall be provided at no increase to the contract.

G. Warrantee and Guarantee

1) Provide warrantee and manufacturers certificate for each product, minimum of one year or longer as specified, from the date of occupancy. Repair and/or replace any equipment, devices, fixtures, materials, etc. with defect as required at no increase to the contract.

2) Provide guarantee of installation for a period of one year from the date of occupancy. Repair and/or reinstall any work with defect as required at no increase to the contract. Provide guarantee of rework for a period of one year from the completion of repair or reinstallation.

3) Damage caused to finishes, surfaces, ceiling tiles, equipment, etc. shall be repaired and/or replaced to match the pre–existing condition at no increase to the contract.

H. Pay fees and other charges incidental to the electrical work and obtain and pay for required liability and casualty insurance, permits, licenses, inspections, taxes, etc.

I. Construction shall be done during regular working hours and days, unless otherwise specified. Work required to be performed during overtime hours or days shall be as indicated.

J. Substitutions are not acceptable.

2. PRODUCTS

A. Cabinets, enclosures and access panels shall be code gage steel with baked enamel finish and flangeless hinges and fasteners. Equipment bases shall be 3 inch high concrete, steel braced and reinforced with 1/4 inch chamfer, and shall extend a minimum of 2 inches around base of equipment. Vibration isolation shall be spring elements in suspended rods and isolation pads below equipment, electrical connections shall be flexible conduit.

B. Conduits shall be hot–dipped galvanized or electro–galvanized steel, minimum size shall be 3/4 inch, except power branch circuits may be 1/2 inch (unless noted otherwise) and flexible connections to recessed lighting fixtures which may be 3/8 inch. Flexible steel conduit shall be galvanized steel, with UL listed liquid tight jacket as required, for final connections to motors, recessed lighting fixtures, and life safety devices. Supports, including channels, angles, rods, and fasteners shall be hot–dipped galvanized steel. Manufacturer shall be AFC, Allied, Anamet, Electri–Flex, O–Z/Gedney, Republic, or Wheatland.

C. Conduit fittings shall be steel; die cast fittings of pot metal are not acceptable. Electrical metallic tubing (EMT) fittings shall be compression type with insulated throats; set screw fittings are not acceptable. Intermediate metal conduit (IMC) and heavy wall conduit (HWG) fittings shall be of threaded joints; set screw and compression fittings are not acceptable. Manufacturer shall be Appleton, Crouse Hinds, OZ/GGedney, Raco, Steel City, or T&B.

D. Outlet boxes for all toggle switches, receptacles, communications devices, fire alarm devices, and life safety devices shall include plaster rings, device plates, and cover plates where required. Provide boxes suitable for plenum, wet, or hazardous locations as required. Device cover plates shall be plastic or stainless steel as selected by the Architect. Multi–gang outlet boxes shall include suitable one–piece device cover plate. Outlets located on opposite sides of a partition shall be staggered by 12 inches, minimum. Manufacturer shall be Appleton, Raco, or Steel City.

E. Wire shall be 600 Volt insulated copper, minimum size shall be No.12 AWG, wire sizes No.8 AWG and larger shall be stranded. Manufacturer shall be Cerro, Encore Wire, General Cable, Okonite, or SouthWire.

F. Cable supports shall be appropriate for the size of conduit and type of wire and cables. Cable lubricant shall be less than six percent solid residue after drying and shall not contain any waxes, greases, silicones, or glycol oils.

G. Local disconnect switches for electrically operated equipment shall be heavy duty within enclosure suitable for the location. Fusible disconnect switches 800 Amps and larger shall be bolted pressure, load–break type. Fusible and non–fusible disconnect switches 600 Amps and smaller shall be quick–make, quick–break type. Manufacturer shall be Eaton, General Electric, Siemens, or Square D.

H. Overcurrent and short circuit protection within fusible switches shall be Class L current limiting time delay fuses for switches rated 800 Amps and larger, and Class RK–1 current limiting time delay fuses for switches rated 600 Amps and smaller. Manufacturer shall be Bussmann, Mersen, or Littelfuse.

I. Grounding system, including service and equipment grounding and bonding, shall be in accordance with code and shall connect all electrically operated equipment. Provide a separate green ground wire for each branch circuit and feeder.

J. Receptacles shall be duplex NEMA 5–20R, back and side wired, specification grade, unless noted otherwise. Special receptacle configurations, duplex isolated ground receptacles, duplex ground fault interrupter receptacles, and tamper resistant receptacles shall be as required or as indicated on the contract documents. General receptacle color shall be white and IG receptacle color shall be orange unless specified otherwise, verify color with Architect. Manufacturer shall be Bryant, Hubbell, Leviton, or Legrand.

K. Toggle switches shall be single pole 20 Amp, 120–277 Volt, back and side wired, specification grade, unless noted otherwise. Special switches, including 3–way, pilot light and momentary contact, shall be as required or as indicated on the contract documents. Color shall be white unless specified otherwise, verify color with Architect. Manufacturer shall be Bryant, Hubbell, Leviton, or Legrand.

3. EXECUTION

A. Penetrations and channels in floors and walls shall be via cutting and coring as required for the size of product, only in accordance with the Architect and Engineer recommendations, and as scheduled with the building management. Patch and fill sleeves, inserts, penetrations, and channels with appropriate code approved fire safing or filling to match or restore the original fire rating of the construction.

B. Install 3 inch concrete pad below floor mounted equipment including distribution panelboards, transformers, etc.

C. Make final connections to vibrating equipment, fixtures, and devices with flexible metal conduit or liquid tight flexible metal conduit as required. Extend ground wire through flexible connections.

D. Install conduit, fittings, supports, etc. in accordance with codes, standards, and manufacturers recommendations. The voltages identified in the following schedules are line–to–line or line–to–neutral. Interior concealed locations are those locations which are above ceilings, within walls, within floor slabs, and within dedicated electrical rooms. Conduit installation shall be as follows unless noted otherwise:

Voltage Location	0V thru 50V	Above 50V thru 250V	Above 250V thru 600V	Above 600V
Interior Concealed	EMT	EMT	≤ 2"EMT ≥ 2 1/2"IMC	HWG
Interior Exposed	EMT	≤ 2"EMT ≥ 2 1/2"IMC	IMC	HWG
Exterior and Hazardous Locations	EMT	IMC	HWG	HWG

E. Installations within air handling spaces, including plenum ceilings and built up air handling systems shall be approved for plenum installation and shall be in strict accordance with all applicable codes.

F. Installations within hazardous locations shall be listed for the Classification and Division of hazard. Install wiring and conduit complete with seals and explosion proof fittings in strict accordance with all applicable codes.

G. Install pull boxes, junction boxes, and outlet boxes in accordance with codes, standards, and manufacturers recommendations. Boxes shall include accessible covers, shall be fabricated of heavy gage galvanized steel, and shall be sized with code to adequately facilitate pulling and connecting the quantity of wires, cables, and feeders contained. Conduit terminations shall be made with bushings and locknuts. Supports for conduits and boxes shall be suspended directly to the building structural components and in no case shall they be attached to suspended ceiling grid, ductwork, or piping components.

H. Install feeders and branch circuit wiring in accordance with codes, standards, and manufacturers recommendations. Provide neutral sized at 200% or (2) neutral conductors where serving panels with 200% rated neutral bus, coordinate installation with panel manufacturers lug provisions. Install normal power, emergency power, fire alarm, and life safety systems within continuous metal raceways. Install concealed security and communications wiring within continuous metal raceways. Separate each system into independent raceways. Provide cable supports as required. Terminate cables per code and manufacturers recommendations. Provide (2) hole lugs for cables 250 kcmil and larger. Power wiring insulation shall be as follows unless noted otherwise:

Wire Location	300 kcmil and smaller	350 kcmil and larger	Environmental Conditions
Interior Locations	THHN/THWN	XHHW	dry
Exterior Locations	THHN/THWN	XHHW XHHW–2	damp wet

I. Install electrical distribution equipment and devices, including metering, distribution panelboards, branch panelboards, motor starters, local disconnect switches, overcurrent protection, transformers, main contactors, receptacles, etc. in accordance with codes, standards, and manufacturers recommendations.

J. Install grounding systems in accordance with codes, standards, and manufacturers recommendations. Communications system shall include ground lug and AWG No. 6 which shall connect to the electrical service equipment ground bus. Grounding conductor between computer room raised floor pedestals, computer room structural steel, and computer room equipment shall be AWG No. 6. Grounding loop around computer room perimeter pedestals shall be AWG No. 2 which shall connect to the electrical service equipment ground bus. Grounding conductors shall be secured to computer room raised floor pedestals via Burndy GP series clamps.

K. Install lighting and associated controls, including fixtures, ballasts, lamps, toggle switches, slide dimmers, dimming equipment, lighting contactors, etc in accordance with codes, standards, and manufacturers recommendations.

L. Install single and multiple device cover plates as required. Extend existing devices to finished surface as required.

M. Install fire alarm and other life safety systems in accordance with codes, standards, and manufacturers recommendations.

N. Install inscription plates and identification markings for products and wiring including the same inscriptions where indicated on the contract documents. Install plastic laminate nameplates on enclosures for each device within metering equipment, distribution panelboards, branch panelboards, motor starters, disconnect switches, transformers, and contactors. Nameplates shall be white with black core, 1–1/4 inches by 3 inches minimum, with 3/16 inch lettering, secured to equipment with two machine screws. Prepare and install type–written panel directory within each branch panel. Device plates shall be engraved for toggle switches and other devices whose function is not readily apparent. Markers shall be self–sticking for each wire and cable at terminations and at each accessible point in equipment and raceway.

O. Clean electrical apparatus prior to completion of construction. Keep work areas clean at all times.

P. Alterations and Demolition of existing systems shall be as follows:

1) Provide all alterations and demolition of the existing electrical installation as required, including any incidental materials to execute all removal, rerouting, relocation, and any other modifications for proper accommodation of all new construction as indicated on the contract documents. All alterations and demolition shall be as indicated on the contract documents or as required, including any modifications not specifically identified on any contract documents but required to complete all new construction.

2) Provide all modifications to existing equipment as required or as indicated on the contract documents in strict accordance with the existing product manufacturers recommendations.

3) Existing raceway, wire and cable extending through the construction area but serving areas outside the contract shall be rerouted and reconnected as required. All modifications shall be without any interruption to the building power, communications, security, fire alarm and life safety systems, or interference to other areas or tenants. Where any modifications would interfere with the daily operations of the building or other tenants, after–hours work or temporary services shall be provided with prior written approval from the building.

4) Existing conduit, wire, cable, supports, hangers, and other electrical installation which is removed, shall be completely removed, back to the first device or that equipment which is unaffected by the modifications. Conduit which is buried in concrete or otherwise inaccessible may be abandoned and capped at each end. All wire and cable shall be removed from any abandoned conduit.

5) Existing electrical materials and equipment, including lighting fixtures, switches, receptacles, speakers, conduit, outlet boxes, fittings, wire, cable, and other equipment and devices which are removed shall remain the property of the Owner and shall be stored or discarded as directed.

6) Reuse existing electrical products as indicated on the contract documents only as is found practical. Examine the condition of all such products, determine suitability for re–use, and periodically notify the Architect/Engineer of findings for final acceptance of re–use. Wire and cable for new construction or extension of an existing installation shall be new, in no case shall existing wire and cable be reused.

7) Refer to architectural demolition drawings for full extent and scope of partition and ceiling modifications.

a. Existing ceilings to remain shall not be altered except where removal and replacement of surfaces is required to modify systems within ceiling space.
b. Existing ceilings to be removed shall included demolition of all fixtures equipment, speakers, raceway, and wire, including any obsolete or previously abandoned products. Remaining areas shall only be altered as required and in accordance with the contract documents.
c. Existing partitions to remain shall not be altered except where removal and replacement of surfaces is required to modify systems within partitions.
d. Existing partitions to be removed shall include demolition of all devices, raceway and wire including any obsolete or previously abandoned products. Raceway and wiring systems serving other remaining areas shall only be altered as required and in accordance with the contract documents.
e. Existing floor mounted devices shall be demolished. Provide abandoning plates and fire proofing as required.

8) Refer to mechanical and plumbing demolition drawings for full extent and scope of electrically operated equipment modifications.

a. Demolition of existing mechanical equipment shall include associated disconnects, raceway, wire and controls.

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MEP/FP Engineering
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Denver, CO
(303) 225-6320

Health ONE The Medical Center of Aurora

Seal / Signature

COLORADO LICENSED
MICHAEL T. THOMPSON
55150
PROFESSIONAL ENGINEER

No.	Date	Description

Project Name

DOMESTIC HOT WATER SYSTEM UPGRADE

Project Address

THE MEDICAL CENTER OF AURORA
1501 S POTOMAC ST,
AURORA, CO 80012

Salas O'Brien Project Number

2022-02900-00

Consultant Project Number

Sheet Title

ELECTRICAL SPECIFICATIONS

Sheet Number

E001

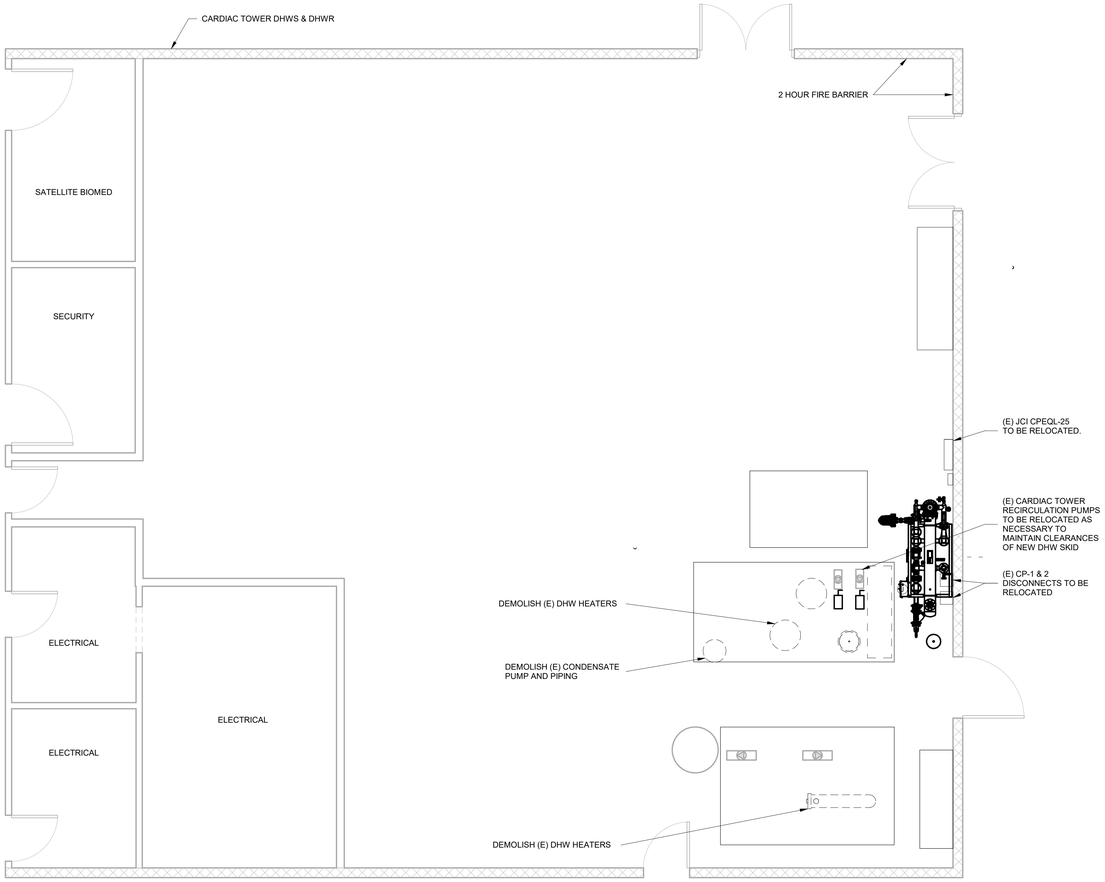
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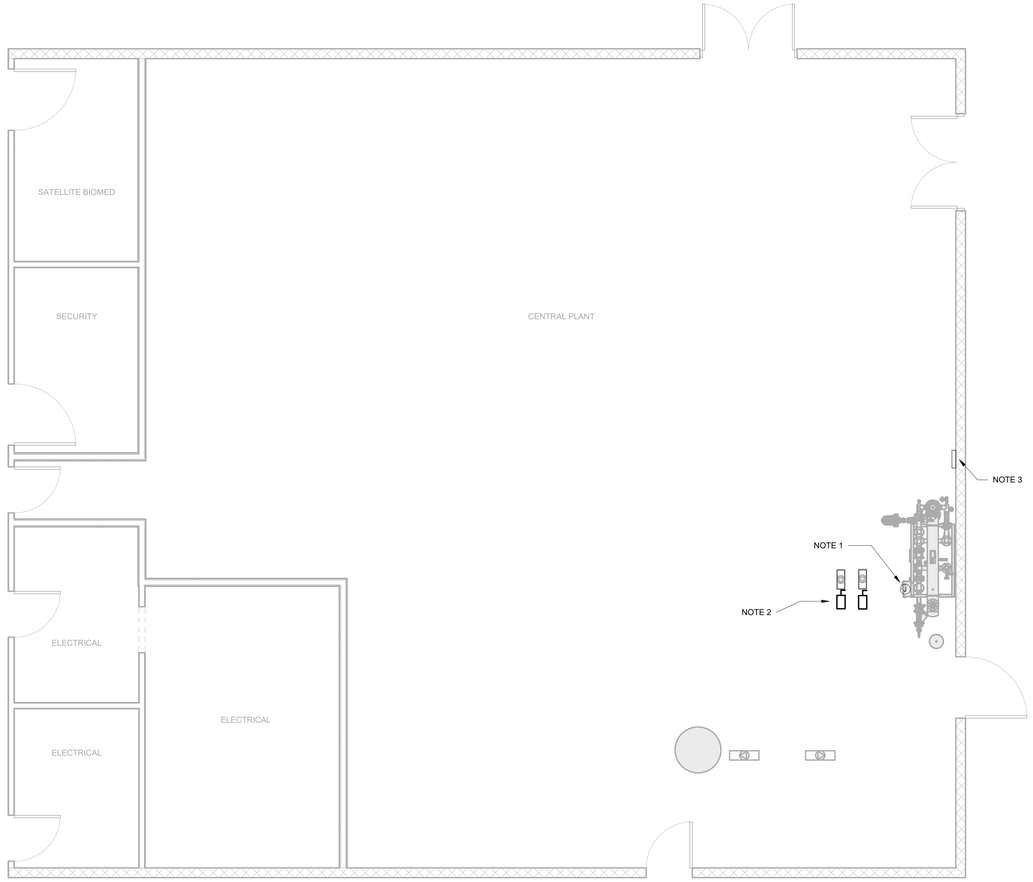
NOTES:

1. PROVIDE 120V 20A DEDICATED CIRCUIT CONNECTION TO NEW DOMESTIC HOT WATER SKID CONTROL PANEL FROM EXISTING 120/208V EQUIPMENT BRANCH CIRCUIT PANEL SERVING THE AREA.
2. EXTEND AND RECONNECT EXISTING ELECTRICAL CIRCUITS SERVING RELOCATED CARDIAC TOWER RECIRCULATION PUMPS. PROVIDE LOCAL DISCONNECT SWITCH, EXTEND AND RECONNECT EXISTING CONTROLS, AND RELOCATE EXISTING VFDS AS REQUIRED.
3. EXTEND AND RECONNECT EXISTING 120V CIRCUIT SERVING RELOCATED BAS CONTROL PANEL AS REQUIRED.



2 CENTRAL PLANT ELECTRICAL DEMOLITION POWER PLAN

1/4" = 1'-0"



1 CENTRAL PLANT ELECTRICAL POWER FLOOR PLAN

1/4" = 1'-0"

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MEP/FP Engineering
Salas O'Brien
Denver, CO
(303) 225-6320

Health ONE The Medical Center of Aurora

Seal / Signature

COLORADO LICENSED MICHAEL F THOMPSON 53150 PROFESSIONAL ENGINEER

No.	Date	Description

Project Name

DOMESTIC HOT WATER SYSTEM UPGRADE

Project Address

THE MEDICAL CENTER OF AURORA
1501 S POTOMAC ST,
AURORA, CO 80012

Salas O'Brien Project Number

2022-02900-00

Consultant Project Number

Sheet Title

LEVEL 01 ELECTRICAL POWER PLAN

Sheet Number

E100

Scale 1/4" = 1'-0"

RSN: 1686562
Permit#: 23-2272045-CT

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