PROPOSAL PACKAGE

STEAM TO HOT WATER BUILDING CONVERSION

PHASE 3, GROUP E

Bid # 21-0456

City of Duluth, Minnesota
411 West 1st Street
Duluth, MN 55802

Opening Date: June 22, 2021

Time: 2:00 PM

TO SUBMIT YOUR BID ELECTRONICALLY, GO TO
WWW.BIDEXPRESS.COM

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PROPOSAL PACKAGE
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Purchasing Division
Finance Department

Room 120
411 West First Street
Duluth, Minnesota 55802

218-730-5340
purchasing@duluthmn.gov

INVITATION TO BID
STEAM TO HOT WATER BUILDING CONVERSION
PHASE 3, GROUP E (BELLA GRACE BLDG)

BID NUMBER: **21-0456** **BID OPENING: TUESDAY, JUNE 22, 2021 AT 2:00 PM**

PROJECT DESCRIPTION: The objective of this project is to convert the Bella Grace Building (106 W. Superior St.) from steam to the new District Hot Water System. Current building uses steam for an air handling unit and supplies a steam-to-hot water converter for a hydronic system.

PRE-BID CONFERENCE: There will not be a formal prebid for this project. Bidders interested in a site visit/walk through should contact Mike Smith at 218-723-3601 (o), 218-409-5529 (c) or mike.smith@ever-greenenergy.com

QUESTIONS: Please submit any questions regarding this project via e-mail to purchasing@duluthmn.gov. Responses will be issued as an addendum to this solicitation.

The selected contractor will be issued a construction contract and, if applicable, a project labor agreement (draft included in the Standard City Contracting Forms in the BidExpress solicitation). Notice to Proceed will be issued once the agreement is fully executed.

Specifications may be viewed and downloaded at no cost at www.bidexpress.com. Bidders must create a free account with Bid Express®; and login to search for city projects (search by "City of Duluth" or bid number). Bid Express® does charge a nominal fee for bid submission. More information can be found at https://www.bidexpress.com/vendor_resources.

Proposal forms, contract documents, plans and specifications may also be on file at the following offices: Minnesota Builder's Exchange, Builder's Exchange of Wisconsin, and Blue Book Building and Construction Network.

INSTRUCTIONS TO BIDDERS

Bidders are strongly encouraged to submit their bid electronically through Bid Express® at www.bidexpress.com. Any exceptions must be requested at least 5 days in advance of the bid opening to allow for hard copy bid forms to be created and issued.

Bid surety in the form of a satisfactory bid bond executed by the bidder and acceptable surety, or a certified check or bank draft, payable to the order of the City of Duluth, in an amount equal to five per cent (5%) of the total bid must be submitted by the bid deadline. Bid bonds may be submitted electronically through the BidExpress solicitation, or copies of bid bonds may be emailed to purchasing@duluthmn.gov but must be sent and received prior to the bid opening date and time. The bid bond should not in any way disclose the amount of the bid, and must be verifiable with the surety company. Certified checks or bank drafts may be mailed or dropped off in a sealed envelope to the purchasing office. Bids may be withdrawn without forfeiture of surety if the request is submitted by the

Bidder and received at the Purchasing Office in writing or by e-mail prior to the scheduled bid opening.

The City Purchasing Agent or her designee will conduct a virtual public bid opening immediately after the deadline for receiving bids. Bidders may view the opening by going to the Purchasing web page (https://www.duluthmn.gov/purchasing/bids-request-for-proposals/) and selecting the appropriate link.

No alternatives to the specifications will be considered unless specifically requested. No special conditions shall be made or included in the bid by the bidder.

The City of Duluth reserves the right to split the award where there is a substantial savings to the City, to waive informalities and to reject any and all bids. Price may not be the only consideration for bid award. Bids must be firm for a minimum of 90 days.

Please note that the following requirements also apply to this project, and any additional required documents must be submitted prior to award/contract execution.

1. **Insurance** – Contractor must provide proof of Public Liability and Automobile Liability Insurance with limits not less than $1,500,000 Single Limit prior to the commencement of work. The City of Duluth must be named as an additional insured. Please refer to the draft Contract, Section 8.

2. **Performance & Payment Bonds** – The awarded contractor will be required to submit performance and payments bonds in the full amount of the project cost prior to award.

3. **Project Labor Agreement (PLA)** - A PLA will be required for any bid that is over or could virtually go over $150,000. A copy of the City standard PLA is included in this package.

4. **Community Benefits Provisions** - A Community Benefits Best Efforts Plan will be required for any project that includes a PLA. The required form is included in the bid package, along with a link to additional community benefits information, including the program specifications and a process flowchart.

5. **Out of State Contractor** - Unless a State of Minnesota Certificate of Exemption is provided, any out-of-state bidder receiving a bid award will have 8% retained from invoice payments on any contracts over $50,000. Submit a signed copy of the signed exemption form when submitting Payment and Performance Bonds. This form may be found at: http://www.revenue.state.mn.us/Forms_and_Instructions/sde.pdf

6. **Prevailing Wage** - Not less than the minimum salaries and prevailing wages as set forth in the contract documents must be paid on this project.

The City of Duluth is an Equal Opportunity Employer. Contractor shall comply with all applicable Equal Employment Opportunity laws and regulations.

CITY OF DULUTH

Amanda Ashbach
Purchasing Agent

SCHEDULE OF BID PRICES

This form is completed in the Electronic Bidding process.
The electronic form will be printed and inserted in this location for the hard copy Proposal.
It will become a part of the Contract.

ATTACHMENT A
PRIME CONTRACTOR RESPONSE

RESPONSIBLE CONTRACTOR VERIFICATION AND CERTIFICATION OF COMPLIANCE

This form is completed in the Electronic Bidding process.
The electronic form will be printed and inserted in this location for the hard copy Proposal.
It will become a part of the Contract.

NOTICE TO BIDDERS
SUSPENSIONS/DEBARMENTS

Do not use suspended or debarred parties as subcontractors or material suppliers on this project.

Both the federal government and the State of Minnesota suspend and debar vendors. Review the lists of suspended and debarred vendors when submitting a bid and when submitting a request to sublet.

State Suspensions and Debarments.

To review the list of parties suspended and debarred by the State of Minnesota, go to this website: http://www.mmd.admin.state.mn.us/debarredreport.asp . This list includes parties suspended and debarred by the Minnesota Department of Transportation and the Minnesota Department of Administration.

Federal Suspensions and Debarments.

The federal government maintains a website listing suspended and debarred parties. You do not need a username or password to use the search functions on the website. You can either search for specific entity names, or see a list of parties suspended and debarred by the Federal Highway Administration.

To search the status of a particular vendor, follow this process:

First, go to the System for Awards Management (SAM) website: https://www.sam.gov (requires Internet Explorer version 11 or higher, or another supported browser such as Chrome).

Next, click on the "Search Records" icon.

Next, enter the potential subcontractor or supplier's name in the "Quick Search" box and click the "search" button.

To view a list of all entities suspended or debarred by the Federal Highway Administration, follow this process:

First, go to the System for Awards Management (SAM) website: https://www.sam.gov (requires Internet Explorer version 11 or higher, or another supported browser such as Chrome).

Next, click on the "Search Records" icon.

Next, click on the "Advance Search – Exclusion" tab.

Next, click on the "single search" icon and a search form will pop up.

Next, go to the "Agency" field on the search page and select "Federal Highway Administration" from the drop-down list.

Next, click the "search" button, and the list of suspended and debarred parties will appear.

July 26, 2018

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MINNESOTA DEPARTMENT OF LABOR AND INDUSTRY PREVAILING WAGES FOR STATE FUNDED CONSTRUCTION PROJECTS

THIS NOTICE MUST BE POSTED ON THE JOBSITE IN A CONSPICUOUS PLACE

Construction Type: Commercial

County Number: 69

County Name: ST. LOUIS

Effective: 2020-11-16 Revised: 2020-12-28

This project is covered by Minnesota prevailing wage statutes. Wage rates listed below are the minimum hourly rates to be paid on this project.

All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at a rate of one and one half (1 1/2) times the basic hourly rate. *Note: Overtime pay after eight (8) hours on the project must be paid even if the worker does not exceed forty (40) hours in the work week.*

Violations should be reported to:

Department of Labor and Industry
Prevailing Wage Section
443 Lafayette Road N
St Paul, MN 55155
(651) 284-5091
DLI.PrevWage@state.mn.us

* Indicates that adjacent county rates were used for the labor class listed.

County: ST. LOUIS (69)

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
LABORERS (101 - 112) (SPECIAL CRAFTS 701 - 730)					
101	LABORER, COMMON (GENERAL LABOR WORK)	2020-11-16	27.52	20.19	47.71
		2021-05-01	28.72	20.94	49.66
102	LABORER, SKILLED (ASSISTING SKILLED CRAFT JOURNEYMAN)	2020-11-16	27.52	20.19	47.71
		2021-05-01	28.72	20.94	49.66
103	LABORER, LANDSCAPING (GARDENER, SOD LAYER AND NURSERY OPERATOR)	2020-11-16	25.00	17.46	42.46
		2021-05-01	25.75	18.70	44.45
104	FLAG PERSON	2020-11-16	27.52	20.19	47.71
		2021-05-01	28.72	20.94	49.66

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
105	WATCH PERSON	2020-11-16	25.17	20.19	45.36
		2021-05-01	26.37	20.94	47.31
106	BLASTER	2020-11-16	27.22	19.29	46.51
107	PIPELAYER (WATER, SEWER AND GAS)	2020-11-16	35.83	21.27	57.10
		2021-05-01	37.63	22.02	59.65
108	TUNNEL MINER	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			
109	UNDERGROUND AND OPEN DITCH LABORER (EIGHT FEET BELOW STARTING GRADE LEVEL)	2020-11-16	32.48	20.27	52.75
110	SURVEY FIELD TECHNICIAN (OPERATE TOTAL STATION, GPS RECEIVER, LEVEL, ROD OR RANGE POLES, STEEL TAPE MEASUREMENT; MARK AND DRIVE STAKES; HAND OR POWER DIGGING FOR AND IDENTIFICATION OF MARKERS OR MONUMENTS; PERFORM AND CHECK CALCULATIONS; REVIEW AND UNDERSTAND CONSTRUCTION PLANS AND LAND SURVEY MATERIALS). THIS CLASSIFICATION DOES NOT APPLY TO THE WORK PERFORMED ON A PREVAILING WAGE PROJECT BY A LAND SURVEYOR WHO IS LICENSED PURSUANT TO MINNESOTA STATUTES, SECTIONS 326.02 TO 326.15.	2020-11-16	27.52	20.19	47.71
		2021-05-01	28.72	20.94	49.66
111*	TRAFFIC CONTROL PERSON (TEMPORARY SIGNAGE)	2020-11-16	27.52	20.19	47.71
		2021-05-01	28.72	20.94	49.66
SPECIAL EQUIPMENT (201 - 204)					
201	ARTICULATED HAULER	2020-11-16	40.93	21.70	62.63
		2021-05-03	41.73	22.85	64.58
202	BOOM TRUCK	2020-11-16	40.93	21.70	62.63
		2021-05-03	41.73	22.85	64.58

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
203*	LANDSCAPING EQUIPMENT, INCLUDES HYDRO SEEDER OR MULCHER, SOD ROLLER, FARM TRACTOR WITH ATTACHMENT SPECIFICALLY SEEDING, SODDING, OR PLANT, AND TWO-FRAMED FORKLIFT (EXCLUDING FRONT, POSIT-TRACK, AND SKID STEER LOADERS), NO EARTHWORK OR GRADING FOR ELEVATIONS	2020-11-16	24.00	16.96	40.96
204	OFF-ROAD TRUCK	2020-11-16	33.65	19.95	53.60
205	PAVEMENT MARKING OR MARKING REMOVAL EQUIPMENT (ONE OR TWO PERSON OPERATORS); SELF-PROPELLED TRUCK OR TRAILER MOUNTED UNITS.	2020-11-16	26.91	19.87	46.78
HIGHWAY/HEAVY POWER EQUIPMENT OPERATOR					
GROUP 2		2020-11-16	38.64	20.50	59.14
306	GRADER OR MOTOR PATROL				
308	TUGBOAT 100 H.P. AND OVER WHEN LICENSE REQUIRED (HIGHWAY AND HEAVY ONLY)				
GROUP 3		2020-11-16	39.19	21.55	60.74
		2021-05-03	40.34	22.55	62.89
309	ASPHALT BITUMINOUS STABILIZER PLANT				
310	CABLEWAY				
312	DERRICK (GUY OR STIFFLEG)(POWER)(SKIDS OR STATIONARY) (HIGHWAY AND HEAVY ONLY)				
314	DREDGE OR ENGINEERS, DREDGE (POWER) AND ENGINEER				
316	LOCOMOTIVE CRANE OPERATOR				
320	TANDEM SCRAPER				
322	TUGBOAT 100 H.P AND OVER (HIGHWAY AND HEAVY ONLY)				
GROUP 4		2020-11-16	38.89	21.55	60.44
		2021-05-03	40.04	22.55	62.59
323	AIR TRACK ROCK DRILL				
324	AUTOMATIC ROAD MACHINE (CMI OR SIMILAR) (HIGHWAY AND HEAVY ONLY)				
325	BACKFILLER OPERATOR				
327	BITUMINOUS ROLLERS, RUBBER TIRED OR STEEL DRUMMED (EIGHT TONS AND OVER)				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
328	BITUMINOUS SPREADER AND FINISHING MACHINES (POWER), INCLUDING PAVERS, MACRO SURFACING AND MICRO SURFACING, OR SIMILAR TYPES (OPERATOR AND SCREED PERSON)				
329	BROKK OR R.T.C. REMOTE CONTROL OR SIMILAR TYPE WITH ALL ATTACHMENTS				
330	CAT CHALLENGER TRACTORS OR SIMILAR TYPES PULLING ROCK WAGONS, BULLDOZERS AND SCRAPERS				
331	CHIP HARVESTER AND TREE CUTTER				
332	CONCRETE DISTRIBUTOR AND SPREADER FINISHING MACHINE, LONGITUDINAL FLOAT, JOINT MACHINE, AND SPRAY MACHINE				
334	CONCRETE MOBIL (HIGHWAY AND HEAVY ONLY)				
335	CRUSHING PLANT (GRAVEL AND STONE) OR GRAVEL WASHING, CRUSHING AND SCREENING PLANT				
336	CURB MACHINE				
337	DIRECTIONAL BORING MACHINE				
338	DOPE MACHINE (PIPELINE)				
340	DUAL TRACTOR				
341	ELEVATING GRADER				
345	GPS REMOTE OPERATING OF EQUIPMENT				
347	HYDRAULIC TREE PLANTER				
348	LAUNCHER PERSON (TANKER PERSON OR PILOT LICENSE)				
349	LOCOMOTIVE (HIGHWAY AND HEAVY ONLY)				
350	MILLING, GRINDING, PLANNING, FINE GRADE, OR TRIMMER MACHINE				
352	PAVEMENT BREAKER OR TAMPING MACHINE (POWER DRIVEN) MIGHTY MITE OR SIMILAR TYPE				
354	PIPELINE WRAPPING, CLEANING OR BENDING MACHINE				
356	POWER ACTUATED HORIZONTAL BORING MACHINE, OVER SIX INCHES				
357	PUGMILL				
359	RUBBER-TIRED FARM TRACTOR WITH BACKHOE INCLUDING ATTACHMENTS (HIGHWAY AND HEAVY ONLY)				
360	SCRAPER				
361	SELF-PROPELLED SOIL STABILIZER				
362	SLIP FORM (POWER DRIVEN) (PAVING)				
363	TIE TAMPER AND BALLAST MACHINE				
365	TRACTOR, WHEEL TYPE, OVER 50 H.P. WITH PTO UNRELATED TO LANDSCAPING (HIGHWAY AND HEAVY ONLY)				
367	TUB GRINDER, MORBARK, OR SIMILAR TYPE				
GROUP 5		2020-11-16	34.75	20.50	55.25
370	BITUMINOUS ROLLER (UNDER EIGHT TONS)				
371	CONCRETE SAW (MULTIPLE BLADE) (POWER OPERATED)				
372	FORM TRENCH DIGGER (POWER)				
375	HYDRAULIC LOG SPLITTER				
376	LOADER (BARBER GREENE OR SIMILAR TYPE)				
377	POST HOLE DRIVING MACHINE/POST HOLE AUGER				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
379	POWER ACTUATED JACK				
381	SELF-PROPELLED CHIP SPREADER (FLAHERTY OR SIMILAR)				
382	SHEEP FOOT COMPACTOR WITH BLADE . 200 H.P. AND OVER				
383	SHOULDERING MACHINE (POWER) APSCO OR SIMILAR TYPE INCLUDING SELF-PROPELLED SAND AND CHIP SPREADER				
384	STUMP CHIPPER AND TREE CHIPPER				
385	TREE FARMER (MACHINE)				
GROUP 6		2020-11-16	34.64	21.55	56.19
		2021-05-03	35.79	22.55	58.34
387	CAT, CHALLENGER, OR SIMILAR TYPE OF TRACTORS, WHEN PULLING DISK OR ROLLER				
389	DREDGE DECK HAND				
391	GRAVEL SCREENING PLANT (PORTABLE NOT CRUSHING OR WASHING)				
393	LEVER PERSON				
395	POWER SWEEPER				
396	SHEEP FOOT ROLLER AND ROLLERS ON GRAVEL COMPACTION, INCLUDING VIBRATING ROLLERS				
397	TRACTOR, WHEEL TYPE, OVER 50 H.P., UNRELATED TO LANDSCAPING				
COMMERCIAL POWER EQUIPMENT OPERATOR					
GROUP 1		2020-11-16	44.44	21.70	66.14
		2021-05-03	45.24	22.85	68.09
501	HELICOPTER PILOT (COMMERCIAL CONSTRUCTION ONLY)				
502	TOWER CRANE 250 FEET AND OVER (COMMERCIAL CONSTRUCTION ONLY)				
503	TRUCK CRAWLER CRANE WITH 200 FEET OF BOOM AND OVER, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 2		2020-11-16	44.10	21.70	65.80
		2021-05-03	44.90	22.85	67.75
504	CONCRETE PUMP WITH 50 METERS/164 FEET OF BOOM AND OVER (COMMERCIAL CONSTRUCTION ONLY)				
505	PILE DRIVING WHEN THREE DRUMS IN USE (COMMERCIAL CONSTRUCTION ONLY)				
506	TOWER CRANE 200 FEET AND OVER (COMMERCIAL CONSTRUCTION ONLY)				
507	TRUCK OR CRAWLER CRANE WITH 150 FEET OF BOOM UP TO AND NOT INCLUDING 200 FEET, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 3		2020-11-16	42.69	21.70	64.39
		2021-05-03	43.49	22.85	66.34
508	ALL-TERRAIN VEHICLE CRANES (COMMERCIAL CONSTRUCTION ONLY)				
509	CONCRETE PUMP 32-49 METERS/102-164 FEET (COMMERCIAL CONSTRUCTION ONLY)				
510	DERRICK (GUY & STIFFLEG) (COMMERCIAL CONSTRUCTION ONLY)				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
511	STATIONARY TOWER CRANE UP TO 200 FEET				
512	SELF-ERECTING TOWER CRANE 100 FEET AND OVER MEASURED FROM BOOM FOOT PIN (COMMERCIAL CONSTRUCTION ONLY)				
513	TRAVELING TOWER CRANE (COMMERCIAL CONSTRUCTION ONLY)				
514	TRUCK OR CRAWLER CRANE UP TO AND NOT INCLUDING 150 FEET OF BOOM, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 4		2020-11-16	42.35	21.70	64.05
		2021-05-03	43.15	22.85	66.00
515	CRAWLER BACKHOE INCLUDING ATTACHMENTS (COMMERCIAL CONSTRUCTION ONLY)				
516	FIREPERSON, CHIEF BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)				
517	HOIST ENGINEER (THREE DRUMS OR MORE) (COMMERCIAL CONSTRUCTION ONLY)				
518	LOCOMOTIVE (COMMERCIAL CONSTRUCTION ONLY)				
519	OVERHEAD CRANE (INSIDE BUILDING PERIMETER) (COMMERCIAL CONSTRUCTION ONLY)				
520	TRACTOR . BOOM TYPE (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 5		2020-11-16	40.93	21.70	62.63
		2021-05-03	41.73	22.85	64.58
521	AIR COMPRESSOR 450 CFM OR OVER (TWO OR MORE MACHINES) (COMMERCIAL CONSTRUCTION ONLY)				
522	CONCRETE MIXER (COMMERCIAL CONSTRUCTION ONLY)				
523	CONCRETE PUMP UP TO 31 METERS/101 FEET OF BOOM				
524	DRILL RIGS, HEAVY ROTARY OR CHURN OR CABLE DRILL WHEN USED FOR CAISSON FOR ELEVATOR OR BUILDING CONSTRUCTION (COMMERCIAL CONSTRUCTION ONLY)				
525	FORKLIFT (COMMERCIAL CONSTRUCTION ONLY)				
526	FRONT END, SKID STEER 1 C YD AND OVER				
527	HOIST ENGINEER (ONE OR TWO DRUMS) (COMMERCIAL CONSTRUCTION ONLY)				
528	MECHANIC-WELDER (ON POWER EQUIPMENT) (COMMERCIAL CONSTRUCTION ONLY)				
529	POWER PLANT (100 KW AND OVER OR MULTIPLES EQUAL TO 100KW AND OVER) (COMMERCIAL CONSTRUCTION ONLY)				
530	PUMP OPERATOR AND/OR CONVEYOR (TWO OR MORE MACHINES) (COMMERCIAL CONSTRUCTION ONLY)				
531	SELF-ERECTING TOWER CRANE UNDER 100 FEET MEASURED FROM BOOM FOOT PIN (COMMERCIAL CONSTRUCTION ONLY)				
532	STRADDLE CARRIER (COMMERCIAL CONSTRUCTION ONLY)				
533	TRACTOR OVER D2 (COMMERCIAL CONSTRUCTION ONLY)				
534	WELL POINT PUMP (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 6		2020-11-16	39.42	21.70	61.12
		2021-05-03	40.22	22.85	63.07
535	CONCRETE BATCH PLANT (COMMERCIAL CONSTRUCTION ONLY)				
536	FIREPERSON, FIRST CLASS BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)				
537	FRONT END, SKID STEER UP TO 1 C YD				

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
538	GUNITE MACHINE (COMMERCIAL CONSTRUCTION ONLY)				
539	TRACTOR OPERATOR D2 OR SIMILAR SIZE (COMMERCIAL CONSTRUCTION ONLY)				
540	TRENCHING MACHINE (SEWER, WATER, GAS) EXCLUDES WALK BEHIND TRENCHER				
GROUP 7		2020-11-16	38.30	21.70	60.00
		2021-05-03	39.10	22.85	61.95
541	AIR COMPRESSOR 600 CFM OR OVER (COMMERCIAL CONSTRUCTION ONLY)				
542	BRAKEPERSON (COMMERCIAL CONSTRUCTION ONLY)				
543	CONCRETE PUMP/PUMPCRETE OR COMPLACO TYPE (COMMERCIAL CONSTRUCTION ONLY)				
544	FIREPERSON, TEMPORARY HEAT SECOND CLASS BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)				
545	OILER (POWER SHOVEL, CRANE, TRUCK CRANE, DRAGLINE, CRUSHERS AND MILLING MACHINES, OR OTHER SIMILAR POWER EQUIPMENT) (COMMERCIAL CONSTRUCTION ONLY)				
546	PICK UP SWEEPER (ONE CUBIC YARD HOPPER CAPACITY) (COMMERCIAL CONSTRUCTION ONLY)				
547	PUMP AND/OR CONVEYOR (COMMERCIAL CONSTRUCTION ONLY)				
GROUP 8		2020-11-16	36.29	21.70	57.99
		2021-05-03	37.09	22.85	59.94
548	ELEVATOR OPERATOR (COMMERCIAL CONSTRUCTION ONLY)				
549	GREASER (COMMERCIAL CONSTRUCTION ONLY)				
550	MECHANICAL SPACE HEATER (TEMPORARY HEAT NO BOILER LICENSE REQUIRED) (COMMERCIAL CONSTRUCTION ONLY)				
TRUCK DRIVERS					
GROUP 1 *		2020-11-16	33.65	19.95	53.60
601	MECHANIC . WELDER				
602	TRACTOR TRAILER DRIVER				
603	TRUCK DRIVER (HAULING MACHINERY INCLUDING OPERATION OF HAND AND POWER OPERATED WINCHES)				
GROUP 2		2020-11-16	29.70	16.60	46.30
604	FOUR OR MORE AXLE UNIT, STRAIGHT BODY TRUCK				
GROUP 3		2020-11-16	33.00	19.95	52.95
605	BITUMINOUS DISTRIBUTOR DRIVER				
606	BITUMINOUS DISTRIBUTOR (ONE PERSON OPERATION)				
607	THREE AXLE UNITS				
GROUP 4 *		2020-11-16	25.10	10.85	35.95

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
608	BITUMINOUS DISTRIBUTOR SPRAY OPERATOR (REAR AND OILER)				
609	DUMP PERSON				
610	GREASER				
611	PILOT CAR DRIVER				
612	RUBBER-TIRED, SELF-PROPELLED PACKER UNDER 8 TONS				
613	TWO AXLE UNIT				
614	SLURRY OPERATOR				
615	TANK TRUCK HELPER (GAS, OIL, ROAD OIL, AND WATER)				
616	TRACTOR OPERATOR, UNDER 50 H.P.				
SPECIAL CRAFTS					
701	HEATING AND FROST INSULATORS	2020-11-16	43.56	20.15	63.71
		2021-06-07	45.56	20.20	65.76
702	BOILERMAKERS	2020-11-16	39.69	28.82	68.51
		2021-01-01	41.39	28.82	70.21
703	BRICKLAYERS	2020-11-16	35.29	28.61	63.90
		2021-05-01	38.29	28.61	66.90
704	CARPENTERS	2020-11-16	31.70	22.03	53.73
		2021-05-03	33.75	22.03	55.78
705	CARPET LAYERS (LINOLEUM)	2020-11-16	34.37	20.32	54.69
		2021-06-01	37.02	20.32	57.34
706	CEMENT MASONS	2020-11-16	34.56	20.13	54.69
		2021-05-01	36.51	20.13	56.64
707	ELECTRICIANS	2020-11-16	39.77	28.11	67.88
		2021-06-02	41.36	28.83	70.19
708	ELEVATOR CONSTRUCTORS	2020-11-16	51.55	40.48	92.03
		2021-01-01	53.28	41.79	95.07
709	GLAZIERS	2020-11-16	32.31	21.98	54.29
710*	LATHERS	2020-11-16	31.44	18.43	49.87

LABOR CODE AND CLASS			EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
712	IRONWORKERS		2020-11-16	33.99	30.70	64.69
			2021-05-01	36.19	30.70	66.89
714	MILLWRIGHT		2020-11-16	39.04	21.72	60.76
			2021-05-01	40.99	21.72	62.71
715	PAINTERS (INCLUDING HAND BRUSHED, HAND SPRAYED, AND THE TAPING OF PAVEMENT MARKINGS)		2020-11-16	32.16	21.17	53.33
716	PILEDRIVER (INCLUDING VIBRATORY DRIVER OR EXTRACTOR FOR PILING AND SHEETING OPERATIONS)		2020-11-16	38.96	25.03	63.99
			2021-05-01	41.01	25.03	66.04
717	PIPEFITTERS . STEAMFITTERS	+$200,000	2020-11-16	44.00	22.90	66.90
			2021-07-01	46.05	22.90	68.95
		-$200,000	2020-11-16	41.30	21.90	63.20
			2021-07-01	43.35	21.90	65.25
718	PLASTERERS		2020-11-16	35.14	20.63	55.77
			2021-05-01	36.74	20.63	57.37
719	PLUMBERS	+$200,000	2020-11-16	44.00	22.90	66.90
			2021-07-01	46.05	22.90	68.95
		-$200,000	2020-11-16	41.30	21.90	63.20
			2021-07-01	43.35	21.90	65.25
720*	ROOFER		2020-11-16	35.10	18.39	53.49
721	SHEET METAL WORKERS		2020-11-16	35.07	27.63	62.70
			2021-05-03	37.17	27.63	64.80
722*	SPRINKLER FITTERS		2020-11-16	40.04	22.60	62.64
723	TERRAZZO WORKERS		2020-11-16	38.91	19.40	58.31
724	TILE SETTERS		2020-11-16	28.18	26.35	54.53
			2021-05-03	31.18	26.35	57.53

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
725	TILE FINISHERS	2020-11-16	20.69	20.74	41.43
		2021-05-03	22.19	20.74	42.93
726	DRYWALL TAPER	2020-11-16	32.91	21.17	54.08
727	WIRING SYSTEM TECHNICIAN	2020-11-16	41.42	18.16	59.58
728	WIRING SYSTEMS INSTALLER	2020-11-16	29.02	15.34	44.36
729	ASBESTOS ABATEMENT WORKER	2020-11-16	32.58	20.15	52.73
730	SIGN ERECTOR	2020-11-16	30.03	16.79	46.82

NON-COLLUSION AFFIDAVIT

This form is completed in the Electronic Bidding process.
The electronic form will be printed and inserted in this location for the hard copy Proposal
It will become a part of the Contract.

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DULUTH ENERGY SYSTEMS

Scope of Work
June 9, 2021

Duluth Energy Systems
Project #DES-21-004
Steam to Hot Water Building Conversion
Phase 3 – Group E Building – Bella Grace

1. Introduction/Background

The City of Duluth is concluding the project to rebuild Superior Street from approximately 7th Avenue West to 4th Avenue East. The project consisted of the full reconstruction of Superior Street including all the existing infrastructure. The current district heating system has been updated to a modern and more efficient hot water heating loop which includes hot water supply and return mains and service laterals. The work remaining includes converting the existing steam customers on the south side of Superior St from steam to hot water heat. Duluth Energy Systems (DES) has informed its customers in this phase of the project that their steam supply will be suspended starting May 1st.

DES hired the engineering firm TKDA to do the design and basic layout work for this building. Drawings are attached to this bid package. Energetx has been awarded the contract to design and fabricate all the Energy Transfer Stations (ETS) as per direction from DES.

2. Objective

The objective of this project is to convert the Bella Grace Building (106 W. Superior St.) from steam to the new District Hot Water System. Current building uses steam for an air handling unit and supplies a steam-to-hot water converter for a hydronic system.

3. Operating Conditions

The water temperature on the district side of the hot water system fluctuates based on outside temperature. The temperature range of the district water supply is 160°F to 215°F. Expected pressures on the system when fully built out could exceed 150 psi. Therefore, all piping on the district side of the ETS shall be installed to withstand this temperature and pressure.

Building side systems will be dependent upon the type of heating system installed in the building. Contractor shall be aware of what type of system and medium used when determining material types to install. Approval from the building owner is required prior to deviating from the engineering standards.

4. Scope of Work

A. The following work is general information:

Mechanical:

1. Demo and removal of items required to install the new system
   a. Prior to discarding any equipment removed from a building the building maintenance manager and DES project manager must grant approval
   b. Contractor is responsible for disposal of any waste generated during the project
2. Asbestos abatement is outside this SOW
   a. DES will schedule and contract this work separately
   b. Mechanical contractor to provide schedule for each building so that this work can be done without interference
   c. Mechanical contractor to designate the amount of abatement required for the tie in of the new system
3. Installation of new hot water supply and return piping on the secondary side of the system:
   a. Shall be in accordance with State code and the DES Hot Water Connection Mechanical Specifications
4. All piping needs to be labeled with color coded labels after insulated with the following:
   a. Flow direction
   b. HHW (heating hot water) Supply/Return
   c. DHW (domestic hot water) Supply/Return

Insulation:

1. All piping to be covered as per DES Hot Water Customer Connection Mechanical Specifications
   a. Primary piping temperature will range from 160°F to 215°F
   b. Secondary piping temperature will range from 120°F to 200°F

Electrical:

1. Electrical work is out of scope and will be contracted separately by DES

B. Outline of Work as defined by the drawing set:

Current Building System: There are currently four (4) different heating systems in this building that will be affected by this project.

1. Michigan St Air Handling Unit - Current unit has a steam coil and provides heat to the entire Michigan St level
2. Penthouse Air Handling Units - Current units have hot water coils and are supplied with hot water from a steam heat exchanger located in the penthouse.

3. Second and Third Floor Radiation - Hot water fin tube around perimeter of both floors along with a fan coil unit located in the Skywalk. System is fed with hot water from the same heat exchanger feeding the Penthouse AHU.
4. A fourth heat source that will need to be accounted for is the amount of radiant load that emanates from the steam lines in the sub-basement.

District Piping:

Supply and return piping (2") from Superior St are already stubbed into the building in the Northeast corner of the Michigan St Level. Supply and return piping (2") will need to be routed from the current isolation valves to the location of the Energy Transfer Station (ETS) in the sub-basement mechanical room located in the Southeast corner of the building. The piping route will need to hug the ceiling on the Michigan St Level and avoid the current sprinkler system and the new elevator shaft that is being erected. Elevation change to the sub-basement can happen in the room where the current air handler is located (Southeast corner above the mechanical room).

Sub-basement Mechanical Room:

1. Energy Transfer Station (ETS) to be installed in this area. Contractor responsible for delivery of ETS from warehouse to final placement.
2. Demolition of current steam system required only for installation of new system(s). Remaining steam equipment can be abandoned in place.
3. New unit heater will be required in this area to make up for the lack of heat provided from the radiation of the current steam piping. Secondary side return piping in this room can remain uninsulated to provide additional heat in this area.
4. Contractor to furnish and install expansion tank, air separator, and air vent as shown in Detail 3 on Drawing M500 on new supply and return piping on the secondary side of the ETS.

Michigan St Air Handling Unit:

Steam coil will need to be replaced in the current air handling unit. New hot water supply and return lines (1-1/2") for this unit will need to be connected to the new hot water supply and return mains running to the 4th floor penthouse. Three-way control valve to be installed as a means of controlling flow through this unit.

4th Floor Penthouse:

1. Supply and return lines will need to be run from ETS in sub-basement to the 4th Floor Penthouse. There is an existing pipe chase located in the Southeast corner of the building where the current steam and condensate lines are located. The current steam line can be reused as the new hot water supply line, but a new 2-1/2" return line will need to be installed. Removal of current condensate line may be required to provide the required

space to install this new return line. Current condensate line potentially has asbestos insulation. DES will contract with an asbestos abatement company for the removal of this line if required.

2. Demolition of current steam-to-hot water heat exchanger, condensate flash tank, steam control valves, and steam and condensate piping will be required prior to the connection of the new supply and return lines.
3. New supply and return lines to be connected to existing hydronic piping connected to current steam-to-hot water heat exchanger (demo). Current heating systems to operate as is and will not require any additional work in this room.

General

1. Scheduling of system cut overs will be the responsibility of the contractors to work with Bella Grace Management to minimize impact to building operations
2. Items listed above are an outline of work required. It is made with an honest attempt to capture the work required, but due to the overall complexity of this project this list may not be complete. Contractors are encouraged to walk through this building to better understand the full scope of these drawings.
3. Contractor responsible for understanding TKDA drawing sets and the intent to which this system is designed to work

5. Project Schedule

The anticipated tentative project schedule is as follows:

A. Bid/Contract

1. SOW released for bid……June 10, 2021
2. **Pre-bid site review……TBD**
3. Bids Due……June 22, 2021
4. Resolution for City Council Agenda Meeting (if needed)……June 25, 2021
5. City Council Approval……July 6, 2021
6. Contractor to Obtain Construction Bonds ……July 8, 2021
7. Contract/PLA issued……July 14, 2021
8. Pre-construction meeting……July 15, 2021
9. Pre-construction submittals complete by ……July 15, 2021
10. Construction work
    a. Installation ……July 19, 2021
    b. Installation Completion ……October 8, 2021
    c. De-mob and building cleanup……October 11, 2021
11. Commissioning
    a. System(s) startup……October 9, 2021
    b. Completion of project ……October 12, 2021

6. Pre-Bid Walkthroughs

A. Pre-Bid Building walkthroughs

1. Contractors will be given the chance to arrange a walkthrough at their convenience if the building maintenance manager is available. Mike Smith will schedule and attend each walkthrough.

7. Contact Information

Below is the contact information for:

A. DES Project Manager – Mike Smith

1. Email – mike.smith@ever-greenenergy.com
2. Office phone number – (218) 723-3601
3. Mobile number - (218) 409-5529

8. Contract Documents

A. The following documents comprise the entire set of contract documents for this Statement of Work:

1. TKDA Drawings:
   a. M001 Title Sheet
   b. MD100 Basement Mechanical Demo
   c. M100 Basement Mechanical Plan
   d. MD101 Lower Level Mechanical Demo
   e. M101 Lower Level Mechanical Plan
   f. M102 Third Floor Mechanical Plan
   g. MD103 Upper Level Mechanical Demo
   h. M103 Upper Level Mechanical Plan
   i. M500 Mechanical Details
   j. M600 Mechanical Schedules
   k. M700 Piping and Instrumentation Diagram

2. Energetx Isometrics
   a. None available at this time - design still pending

3. Specifications:
   Contract work completed for Duluth Energy Systems must meet all the specification requirements of the following document(s) unless specifically superseded by the SOW
   a. DES Heating Hot Water System Installation Package

4. Bidders shall submit bids for all work specified on the form attached to this SOW. **Bids will be due by 2:00 PM on June 22, 2021.** Follow the Bid Express instructions on submitting your bids to Amanda Ashbach at the City of Duluth Purchasing office. Amanda's contact info: (218)730-5003, email: aashbach@DuluthMN.gov

9. Contract Price

Subject to the terms and conditions set forth in the Contract Documents, DES agrees to pay the Contractor for the performance of the Work and the Contractor agrees to accept in full compensation therefore, the sums set forth within the Purchase Order to the Contractor for the Work for the amount accepted in the bid. The Cost of the Work shall be inclusive of all taxes that may be payable by the Contractor.

Materials required for this project:

This is a MN State funded job. **All materials should be of domestic or North American origin**. If any of the material or heating units cannot be found with this designation then the Project Engineer will need to be notified in writing to obtain permission to proceed. No exceptions.

The following submissions are required:

1. **Firm Fixed Price Bid** for scope of work described in this document and its attachments
2. Description of any proposed alternative configuration
3. List of subcontractors and their respective roles in the project
4. Current contractor rate sheet

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY. This Section includes the following:

A. Piping Materials and installation instructions common to most piping systems.

B. Dielectric Fittings.

C. Mechanical Sleeve Seals.

D. Sleeves.

E. Escutcheons.

F. Grout.

G. HVAC Demolition.

H. Equipment installation requirements common to equipment sections.

I. Painting and Finishing.

J. Concrete Bases.

K. Supports and Anchorages.

1.03 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. The Following are industry abbreviations for rubber materials:

1. EPDM. Ethylene-propylene-diene terpolymer rubber.
2. NBR. Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Product Data. For the following:

1. Dielectric fittings.
2. Mechanical sleeve seals.
3. Escutcheons.

B. Welding Certificates.

1.05 QUALITY ASSURANCE

A. Steel Support Welding. Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.07 COORDINATION

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

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

C. Coordinate Requirements for access panels and doors for HVAC items requiring access that is concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 MANUFACTURERS. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements listed in the articles below apply for product selection.

A. Manufacturers. Subject to compliance with requirements, provide products by one of the following in the articles listed below.

2.02 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.

2.03 JOINING MATERIALS

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

B. Pipe-Flange Gasket Materials. Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

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

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

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

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

2.04 DIELECTRIC FITTINGS

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

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

C. Dielectric Unions. Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F, sizes 1/2- to 2-inches.

1. Manufacturers

a. Watts Industries, Inc.; Water Products Div., Series 3001A
b. Zurn Industries, Inc.; Wilkins Div., Model QHWD

D. Dielectric Flanges. Factory-fabricated, companion-flange assembly, for 175-psig maximum working pressure at 180 deg F with a BUNA-N gasket or 50 psig maximum working pressure at 300 deg F with a EPDM gasket, sizes 2-1/2 to 4-inches.

1. Manufacturers

a. Watts Industries, Inc.; Water Products Div., Series 3100

2.05 MECHANICAL SLEEVE SEALS

A. Description. Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers

a. Pipeline Seal and Insulator, Inc. (PSI)/Thunderline/Link Seal Model “C”
b. Calpico, Inc., Model “CSL”
c. Metraflex Co., “MetraSeal”

2. Sealing Elements. Black EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates. Reinforced nylon polymer.
4. Connecting Bolts and Nuts. Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.
5. Sleeve.

2.06 SLEEVES

A. Galvanized-Steel Sheet. 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

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

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

D. Stack Sleeve Fittings. Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp. Clamping ring with set screws.

2.07 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, Cast-Brass Type. With set screw.

1. Finish. Polished chrome-plated.

C. Split-Casting, Cast-Brass Type. With concealed hinge and set screw.

1. Finish. Polished chrome-plated.

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

E. Split-Plate, Stamped-Steel Type. With concealed hinge, set screw or spring clips, and chrome-plated finish.

2.08 GROUT

A. Description. ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics. Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix. 5000-psi, 28-day compressive strength.
3. Packaging. Premixed and factory packaged.

PART 3 - EXECUTION

3.01 HVAC DEMOLITION

A. 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.

B. 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.

3.02 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 at Wall, Ceiling and Foor penetrations in Finished Spaces. One-piece or split-casting, cast-brass type with polished chrome-plated finish.

2. Existing Piping. Use the following:

    a. Piping at Wall, Ceiling and Floor Penetrations in Finished Spaces. One-piece or Split-casting, cast-brass type with chrome-plated finish.

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

N. 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 above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install Sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install Sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves. For pipes smaller than NPS 6.
    b. Stack Sleeve Fittings. For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations. Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install Steel Pipe for sleeves smaller than 6 inches in diameter.
2. Mechanical Sleeve Seal Installation. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall Pipe Penetrations. Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations. Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to

Division 07 Section "Penetration Firestopping" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to Equipment Specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

A. Join Pipe and Fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream Ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove Scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints. Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints. Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads. Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints. Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.04 PIPING CONNECTIONS

A. Make Connections according to the following, unless otherwise indicated:

1. Install Unions in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install Flanges in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric unions on pipe sizes 1/2- to 2-inches or dielectric flanges on pipe sizes 2-1/2- to 4-inches to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install Equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install Equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install Equipment to allow right of way for piping installed at required slope.

3.06 PAINTING

A. Painting of HVAC Systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup. Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 CONCRETE BASES. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

A. Construct Concrete Bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

B. Install Dowel Rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

C. Install Epoxy-coated Anchor Bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

D. Place and Secure Anchorage Devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

E. Install Anchor Bolts to elevations required for proper attachment to supported equipment.

F. Install Anchor Bolts according to anchor-bolt manufacturer's written instructions.

G. Use 4000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, Fit, and Place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding. Comply with AWS D1.1.

3.09 GROUTING

A. Mix and Install Grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean Surfaces that will come into contact with grout.

C. Provide Forms as required for placement of grout.

D. Avoid Air Entrapment during placement of grout.

E. Place Grout, completely filling equipment bases.

F. Place Grout on concrete bases and provide smooth bearing surface for equipment.

G. Place Grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings And General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply With Requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply With NEMA MG 1 unless otherwise indicated.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.

2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer. Motors powered through variable frequency drives shall be inverter duty rated as recognized by NEMA for higher winding insulation withstand voltage rating (NEMA MG1 Part 30 and 31) and improved heat dissipation at reduced speeds. The motor shall be capable of properly operating continuously at minimum system design speed without additional cooling from a PWM variable frequency drive with IGBT technology and without damage to motor insulation for reflected voltages up to 1600v. Provide bearing protection for motor as required to prevent damage due to VFD operation. Motor is to be guaranteed for three years from date of start-up.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.05 SINGLE-PHASE MOTORS

A. Motors Larger Than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 23

GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Iron ball valves.
5. Iron, single-flange butterfly valves.
6. Iron, grooved-end butterfly valves.
7. High-performance butterfly valves.
8. Bronze lift check valves.
9. Bronze swing check valves.
10. Iron swing check valves.
11. Iron swing check valves with closure control.
12. Iron, grooved-end swing-check valves.
13. Bronze gate valves.
14. Iron gate valves.
15. Bronze globe valves.
16. Iron globe valves.

B. Related Sections

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.

1.03 DEFINITIONS

A. CWP. Cold working pressure.

B. EPDM. Ethylene propylene copolymer rubber.

C. NBR. Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS. Nonrising stem.

E. OS&Y. Outside screw and yoke.

F. RS. Rising stem.

G. SWP. Steam working pressure.

1.04 SUBMITTALS

A. Product Data. For each type of valve indicated.

1.05 QUALITY ASSURANCE

A. Source Limitations for Valves. Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare Valves for shipping as follows.

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the Following Precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use Sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings. Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes. Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types

1. Handwheel. For valves other than quarter-turn types.
2. Handlever. For quarter-turn valves NPS 6 and smaller[except plug valves].
3. Wrench. For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
4. Chainwheel. Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping. With 2-inch stem extensions and the following features:

1. Gate Valves. With rising stem.
2. Ball Valves. With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves. With extended neck.

F. Valve-End Connections

1. Flanged. With flanges according to ASME B16.1 for iron valves.
2. Grooved. With grooves according to AWWA C606.
3. Threaded. With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections. MSS SP-45.

2.02 BRONZE ANGLE VALVES

A. Class 150, Bronze Angle Valves with Nonmetallic Disc

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO Inc.

2. Description

a. Standard. MSS SP-80, Type 2.
b. CWP Rating. 300 psig.
c. Body Material. ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends. Threaded.
e. Stem. Bronze.
f. Disc. PTFE or TFE.
g. Packing. Asbestos free.
h. Handwheel. Malleable iron, bronze, or aluminum.

2.03 BRASS BALL VALVES

A. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.
b. Legend Valve..
c. Milwaukee Valve Company.

2. Description

a. Standard. MSS SP-110.
b. SWP Rating. 150 psig.
c. CWP Rating. 600 psig.
d. Body Design. Two piece.
e. Body Material. Forged brass.
f. Ends. Threaded.
g. Seats. PTFE or TFE.
h. Stem. Brass.
i. Ball. Stainless Steel.
j. Port. Regular.

2.04 BRONZE BALL VALVES

A. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.; Apollo Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Milwaukee Valve Company.
    f. NIBCO Inc.

2. Description

    a. Standard. MSS SP-110.
    b. SWP Rating. 150 psig.
    c. CWP Rating. 600 psig.
    d. Body Design. Two piece.
    e. Body Material. Bronze.
    f. Ends. Threaded.
    g. Seats. PTFE or TFE.
    h. Stem. Bronze.
    i. Ball. Stainless Steel.
    j. Port. Regular.

2.05 IRON BALL VALVES

A. Class 150, Iron Ball Valves

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

    a. American Valve, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Kitz Corporation.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description

    a. Standard. MSS SP-72.
    b. CWP Rating. 200 psig.
    c. Body Design. Split body.
    d. Body Material. ASTM A 126, gray iron.
    e. Ends. Flanged.
    f. Seats. PTFE or TFE.
    g. Stem. Stainless steel.
    h. Ball. Stainless steel.
    i. Port. Full.

2.06 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.; Apollo Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. DeZurik Water Controls.

e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO Inc.
h. Spence Strainers International; a division of CIRCOR International.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description

a. Standard. MSS SP-67, Type I.
b. CWP Rating. 200 psig.
c. Body Design. Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material. ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat. EPDM.
f. Stem. One- or two-piece stainless steel.
g. Disc. Aluminum bronze.

2.07 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Tyco Fire Products LP; Grinnell Mechanical Products.
b. Victaulic Company.

2. Description

a. Standard. MSS SP-67, Type I.
b. CWP Rating. 175 psig.
c. Body Material. Coated, ductile iron.
d. Stem. Two-piece stainless steel.
e. Disc. Coated, ductile iron.
f. Seal. EPDM.

2.08 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Flowseal.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. DeZurik Water Controls.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO Inc.
g. Tyco Valves & Controls; a unit of Tyco Flow Control.

2. Description

a. Standard. MSS SP-68.
b. CWP Rating. 285 psig at 100 deg F.
c. Body Design. Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material. Carbon steel, cast iron, ductile iron, or stainless steel.

e. Seat. Reinforced PTFE or metal.
f. Stem. Stainless steel; offset from seat plane.
g. Disc. Carbon steel.
h. Service. Bidirectional.

2.09 BRONZE LIFT CHECK VALVES

A. Class 150, Lift Check Valves with Nonmetallic Disc

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.
b. Milwaukee Valve Company.
c. Mueller Steam Specialty; a division of SPX Corporation.
d. NIBCO Inc.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description

a. Standard. MSS SP-80, Type 2.
b. CWP Rating. 200 psig.
c. Body Design. Vertical flow.
d. Body Material. ASTM B 61 or ASTM B 62, bronze.
e. Ends. Threaded.
f. Disc. NBR, PTFE, or TFE.

2.10 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Nonmetallic Disc

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO Inc.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description

a. Standard. MSS SP-80, Type 4.
b. CWP Rating. 200 psig.
c. Body Design. Horizontal flow.
d. Body Material. ASTM B 62, bronze.
e. Ends. Threaded.
f. Disc. PTFE or TFE.

2.11 IRON SWING CHECK VALVES

A. Class 150, Iron Swing Check Valves with Metal Seats

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO Inc.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description

a. Standard. MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating. 200 psig.
c. NPS 14 to NPS 24, CWP Rating. 150 psig.
d. Body Design. Clear or full waterway.
e. Body Material. ASTM A 126, gray iron with bolted bonnet.
f. Ends. Flanged.
g. Trim. Bronze.
h. Gasket. Asbestos free.

2.12 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Tyco Fire Products LP; Grinnell Mechanical Products.
c. Victaulic Company.

2. Description

a. CWP Rating. 300 psig.
b. Body Material. ASTM A 536, ductile iron.
c. Seal. EPDM.
d. Disc. Spring operated, ductile iron or stainless steel.

2.13 BRONZE GATE VALVES

A. Class 150, RS Bronze Gate Valves

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO Inc.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description

a. Standard. MSS SP-80, Type 2.
b. CWP Rating. 200 psig.
c. Body Material. ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends. Threaded or solder joint.

e. Stem. Bronze.
f. Disc. Solid wedge; bronze.
g. Packing. Asbestos free.
h. Handwheel. Malleable iron, bronze, or aluminum.

2.14 IRON GATE VALVES

A. Class 150, OS&Y, Iron Gate Valves

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO Inc.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description

a. Standard. MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating. 200 psig.
c. NPS 14 to NPS 24, CWP Rating. 150 psig.
d. Body Material. ASTM A 126, gray iron with bolted bonnet.
e. Ends. Flanged.
f. Trim. Bronze.
g. Disc. Solid wedge.

2.15 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. NIBCO Inc.

2. Description

a. Standard. MSS SP-80, Type 2.
b. CWP Rating. 200 psig.
c. Body Material. ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends. Threaded or solder joint.
e. Stem. Bronze.
f. Disc. PTFE or TFE.
g. Packing. Asbestos free.
h. Handwheel. Malleable iron, bronze, or aluminum.

2.16 IRON GLOBE VALVES

A. Class 150, Iron Globe Valves

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO Inc.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description

a. Standard. MSS SP-85, Type I.
b. CWP Rating. 200 psig.
c. Body Material. ASTM A 126, gray iron with bolted bonnet.
d. Ends. Flanged.
e. Trim. Bronze.
f. Packing and Gasket. Asbestos free.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Valve Interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate Valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine Threads on valve and mating pipe for form and cleanliness.

D. Examine Mating Flange Faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do Not Attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install Valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate Valves for easy access and provide separate support where necessary.

C. Install Valves in horizontal piping with stem at or above center of pipe.

D. Install Valves in position to allow full stem movement.

E. Install Check Valves for proper direction of flow and as follows:

1. Swing Check Valves. In horizontal position with hinge pin level.
2. Lift Check Valves. With stem upright and plumb.

3.03 ADJUSTING

A. Adjust or Replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If Valve Applications are not indicated, use the following:

1. Shutoff Service. Ball, butterfly, or gate valves.
2. Butterfly Valve Dead-End Service. Single-flange (lug) type.
3. Throttling Service except Steam. Globe or angle valves.
4. Throttling Service, Steam. Globe or angle valves.
5. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller. Bronze swing check valves with nonmetallic disc.
    b. NPS 2-1/2 and Larger. Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.

B. If Valves with Specified SWP Classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select Valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller. Threaded ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4. Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger. Flanged ends.
4. For Steel Piping, NPS 2 and Smaller. Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4. Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger. Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping. Valve ends may be grooved.

3.05 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller

1. Bronze Angle Valves. Class 150 nonmetallic disc.
2. Ball Valves.Two piece, regular port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves. Class 150 nonmetallic disc.
4. Bronze Gate Valves. Class 150 RS.
5. Bronze Globe Valves. Class 150 nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger

1. Iron Valves, NPS 2-1/2 to NPS 3. May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10. Class 150.
3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12. 200 CWP, EPDM seat, stainless-stee disc.
4. Iron Swing Check Valves. Class 150 Class 250, nonmetallic-to-metal seats.
5. Iron Gate Valves. Class 150 OS&Y.
6. Iron Globe Valves, NPS 2-1/2 to NPS 12. Class 150.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section Includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

1.03 DEFINITIONS

A. MSS. Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology. As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 PERFORMANCE REQUIREMENTS

A. Design Supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design Equipment Supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.05 SUBMITTALS

A. Product Data. For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-Actuated Fastener Systems.

B. Shop Drawings. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

1.06 QUALITY ASSURANCE

A. Welding. Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code. Section IX.

B. Welding. Qualify procedures and personnel according to the following:

1. ASME Boiler and Pressure Vessel Code. Section IX.

PART 2 - PRODUCTS

2.01 STEEL PIPE HANGERS AND SUPPORTS

A. Description. MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings. Pregalvanized or hot dipped.

D. Nonmetallic Coatings. Plastic coating, jacket, or liner.

E. Padded Hangers. Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.02 TRAPEZE PIPE HANGERS

A. Description. MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.03 THERMAL-HANGER SHIELD INSERTS

A. Description. 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Hot Piping. ASTM C 533, Type I calcium silicate

D. For Trapeze or Clamped Systems. Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers. Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length. Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.04 FASTENER SYSTEMS

A. Powder-Actuated Fasteners. Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors. Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.05 PIPE STAND FABRICATION

A. Pipe Stands, General. Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand. One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

C. Low-Type, Single-Pipe Stand. One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. MIRO Industries.

D. High-Type, Single-Pipe Stand. Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Portable Pipe Hangers.

2. Base. Stainless steel.
3. Vertical Members. Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member. Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand. Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

a. Portable Pipe Hangers.

2. Bases. One or more plastic.
3. Vertical Members. Two or more protective-coated-steel channels.
4. Horizontal Member. Protective-coated-steel channel.
5. Pipe Supports. Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands. Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.06 EQUIPMENT SUPPORTS

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

2.07 MISCELLANEOUS MATERIALS

A. Structural Steel. ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout. ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties. Nonstaining, noncorrosive, and nongaseous.
2. Design Mix. 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Specific Hanger and Support Requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use Hangers and Supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use Nonmetallic Coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use Padded Hangers for piping that is subject to scratching.

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

1. Adjustable, Steel Clevis Hangers (MSS Type 1). For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2). For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3). For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4). For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5). For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6). For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7). For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9). For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10). For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11). For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12). For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24). For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26). For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36). For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37). For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38). For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41). For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43). For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44). For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45). For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46). For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

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

1. Extension Pipe or Riser Clamps (MSS Type 8). For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42). For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13). For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14). For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15). For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16). For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17). For 120 to 450 deg F piping installations.

I. Building Attachments. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18). For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19). For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20). For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21). For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22). For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23). For structural shapes.
7. Top-Beam Clamps (MSS Type 25). For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27). For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28). For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29). For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30). For attaching to structural steel.
12. Welded-Steel Brackets. For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31). 750 lb.
    b. Medium (MSS Type 32). 1500 lb.
    c. Heavy (MSS Type 33). 3000 lb.

13. Side-Beam Brackets (MSS Type 34). For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57). For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58). For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39). To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40). Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts. For supporting insulated pipe.

K. Spring Hangers and Supports. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47). Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48). For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49). For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50). To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51). Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52). Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53). Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports. For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54). Mounted horizontally.
b. Vertical (MSS Type 55). Mounted vertically.
c. Trapeze (MSS Type 56). Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use Mechanical-Expansion Anchors instead of building attachments where required in concrete construction.

3.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation. Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation. Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes. Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation. Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation. Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation

1. Pipe Stand Types except Curb-Mounting Type. Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands. Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

G. Install Hangers and Supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation. Fabricate from welded-structural-steel shapes.

I. Install Hangers and Supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install Lateral Bracing with pipe hangers and supports to prevent swaying.

K. Install Building Attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

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

M. Pipe Slopes. Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping. Comply with the following.

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature. Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature. Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option. Thermal-hanger shield inserts may be used. Include steel weight-

distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option. Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe. Not less than the following:

    a. NPS 1/4 to NPS 3-1/2. 12 inches long and 0.048 inch thick.
    b. NPS 4. 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6. 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14. 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24. 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger. Include wood inserts.
6. Insert Material. Length at least as long as protective shield.
7. Thermal-Hanger Shields. Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate Structural-Steel Stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting. Place grout under supports for equipment and make smooth bearing surface.

C. Provide Lateral Bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

A. Cut, Drill, and Fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit Exposed Connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding. Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments. Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim Excess Length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

A. Touch Up. Clean field welds and abraded areas of shop paint. Paint exposed areas

immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces. Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY. Section Includes:

A. Equipment Labels

B. Warning Signs and Labels

C. Pipe Labels

D. Duct Labels

E. Stencils

F. Valve Tags

G. Warning Tags

1.03 SUBMITTALS

A. Product Data. For each type of product indicated.

B. Samples. For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule. Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve Numbering Scheme.

E. Valve Schedules. For each piping system to include in maintenance manuals.

1.04 COORDINATION

A. Coordinate Installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate Installation of identifying devices with locations of access panels and doors.

C. Install Identifying Devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment

1. Material and Thickness. Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch, or anodized aluminum, 0.032-inch 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.
3. Minimum Letter Size. 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners. Stainless-steel rivets or self-tapping screws.
5. Adhesive. Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment

1. Material and Thickness. Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color. Black
3. Background Color. Black.
4. Maximum Temperature. Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size. Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size. 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners. Stainless-steel rivets or self-tapping screws.
8. Adhesive. Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content. Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule. For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Material and Thickness. Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color. Red.

C. Background Color. White

D. Maximum Temperature. Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size. Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size. 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners. Stainless-steel rivets or self-tapping screws.

H. Adhesive. Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content. Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels. Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pre-tensioned Pipe Labels. Pre-coiled, semi-rigid 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 high.

2.04 DUCT LABELS

A. Material and Thickness. Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 thick, and having predrilled holes for attachment hardware.

B. Letter Color. Black.

C. Background Color. Yellow

D. Maximum Temperature. Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size. Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size. 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners. Stainless-steel rivets or self-tapping screws.

H. Adhesive. Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents. Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows. Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size. At least 1-1/2 inches high.

2.05 STENCILS. Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

A. Stencil Material. Fiberboard or metal.

B. Stencil Paint. Exterior, gloss, black unless otherwise indicated. Paint may be in pressurized

spray-can form.

C. Identification Paint. Exterior, in colors according to ASME A13.1 unless otherwise indicated.

2.06 VALVE TAGS

A. Valve Tags. Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material. Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch, or, anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners. Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules. For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.07 WARNING TAGS. Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

A. Size. 3 by 5-1/4 inches minimum

B. Fasteners. Brass grommet and wire.

C. Nomenclature. Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

D. Color. Yellow background with black lettering.

PART 3 - EXECUTION

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

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or Permanently Fasten labels on each major item of mechanical equipment.

B. Locate Equipment Labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option. Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.

1. Identification Paint. Use for contrasting background.
2. Stencil Paint. Use for pipe marking.

B. Locate Pipe Labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule

1. Heating Water Piping:

   a. Background Color. Yellow
   b. Letter Color. Black

2. Low-Pressure Steam Piping:

   a. Background Color. Yellow
   b. Letter Color. Black

3. High-Pressure Steam Piping:

   a. Background Color. Yellow
   b. Letter Color. Black

4. Steam Condensate Piping:

   a. Background Color. Yellow
   b. Letter Color. Black

3.04 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. Hot Water. 1-1/2 inches, round.
   b. Low-Pressure Steam. 1-1/2 inches, round.
   c. High-Pressure Steam. 1-1/2 inches, round.
   d. Steam Condensate. 1-1/2 inches, round.

2. Valve-Tag Color:

   a. Hot Water. Natural
   b. Low-Pressure Steam. Natural
   c. High-Pressure Steam. Natural
   d. Steam Condensate. Natural

3. Letter Color:

a. Hot Water. Black
b. Low-Pressure Steam. Black
c. High-Pressure Steam. Black
d. Steam Condensate. Black

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

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY. This Section includes TAB to produce design objectives for the following:

A. Hydronic Piping Systems

1. Constant-flow systems.
2. Variable-flow systems.
3. Primary-secondary systems.

B. Verifying that automatic control devices are functioning properly.

C. Reporting Results of activities and procedures specified in this Section.

1.03 DEFINITIONS

A. Adjust. To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance. To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary. Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft. A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. Procedure. An approach to and execution of a sequence of work operations to yield repeatable results.

F. Report Forms. Test data sheets for recording test data in logical order.

G. Static Head. The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

H. Suction Head. The height of fluid surface above the centerline of the pump on the suction side.

I. System Effect. A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

J. System Effect Factors. Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

K. TAB. Testing, adjusting, and balancing.

L. Terminal. A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

M. Test. A procedure to determine quantitative performance of systems or equipment.

N. Testing, Adjusting, and Balancing (TAB) Firm. The entity responsible for performing and reporting TAB procedures.

1.04 QUALITY ASSURANCE

A. TAB Firm Qualifications. Engage a TAB firm certified by either AABC or NEBB.

B. TAB Report Forms. Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."

C. Instrumentation Type, Quantity, and Accuracy. As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."

D. Instrumentation Calibration. Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.05 PROJECT CONDITIONS

A. Full Owner Occupancy. Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.06 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice. Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - Not used

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for

efficient system and equipment operation.

B. Examine Approved Submittal Data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

D. Examine Design Data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine Equipment Performance Data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine System and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine System and equipment test reports.

H. Examine HVAC System and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine Systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC Equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine Terminal Units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine Strainers for clean screens and proper perforations.

M. Examine Three-Way Valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine System Pumps to ensure absence of entrained air in the suction piping.

O. Examine Equipment for installation and for properly operating safety interlocks and controls.

P. Examine Automatic Temperature System components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multi-zone units, mixing

boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

Q. Report Deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB Plan that includes strategies and step-by-step procedures.

B. Complete System readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform Testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning 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.

3.04 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare Test Reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare Schematic Diagrams of systems' "as-built" piping layouts.

C. Prepare Hydronic Systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gauge for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.05 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure Water Flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gauge heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set Calibrated balancing valves, if installed, at calculated pre-settings.

C. Measure Flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure Flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust Balancing Stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

F. Measure Pump Flow Rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the Differential-Pressure control valve settings existing at the conclusions of balancing.

3.06 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS. Balance systems with

automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.07 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS. Balance the primary system crossover flow first, then balance the secondary system.

3.08 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger. Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers. Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.09 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a Preconstruction Inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before Performing Testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform Testing and Balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow and water flow rates by more than 5

percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.

4. Air balance each air outlet.

3.10 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 non-grounded power supply.

K. Note Operation of electric actuators using spring return for proper fail-safe operations.

3.11 TOLERANCES. Set HVAC system airflow and water flow rates within the following tolerances:

A. Supply, Return, and Exhaust Fans and Equipment with Fans. Plus 5 to plus 10 percent.

B. Air Outlets and Inlets. 0 to minus 10 percent.

C. Heating-Water Flow Rate. 0 to minus 10 percent.

D. Cooling-Water Flow Rate. 0 to minus 5 percent.

3.12 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.

3.13 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. Final Report Contents. In addition to certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

C. General Report Data. In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams. Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling Unit Test Reports. For air-handling units with coils, include the following:

1. Unit Data. Include the following:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.

2. Motor Data

    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values)

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat coil static-pressure differential in inches wg.
    g. Cooling coil static-pressure differential in inches wg.
    h. Heating coil static-pressure differential in inches wg.
    i. Outside airflow in cfm.
    j. Return airflow in cfm.
    k. Outside-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

F. Apparatus-Coil Test Reports

1. Coil Data

    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch o.c.
    f. Make and model number.
    g. Face area in sq. ft.
    h. Tube size in NPS.
    i. Tube and fin materials.
    j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values)

    a. Airflow rate in cfm.
    b. Average face velocity in fpm.
    c. Air pressure drop in inches wg.
    d. Outside-air, wet- and dry-bulb temperatures in deg F.
    e. Return-air, wet- and dry-bulb temperatures in deg F.
    f. Entering-air, wet- and dry-bulb temperatures in deg F.
    g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    h. Water flow rate in gpm.
    i. Water pressure differential in feet of head or psig.
    j. Entering-water temperature in deg F.
    k. Leaving-water temperature in deg F.
    l. Refrigerant expansion valve and refrigerant types.
    m. Refrigerant suction pressure in psig.
    n. Refrigerant suction temperature in deg F.
    o. Inlet steam pressure in psig.

3. Motor Data

    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    g. Number of belts, make, and size.

4. Test Data (Indicated and Actual Values)

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Suction static pressure in inches wg.

G. Air-Terminal-Device Reports

1. Unit Data

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Test apparatus used.
    d. Area served.
    e. Air-terminal-device make.
    f. Air-terminal-device number from system diagram.
    g. Air-terminal-device type and model number.
    h. Air-terminal-device size.
    i. Air-terminal-device effective area in square feet.

2. Test Data (Indicated and Actual Values)

    a. Airflow rate in cfm.
    b. Air velocity in fpm.
    c. Preliminary airflow rate as needed in cfm.
    d. Preliminary velocity as needed in fpm.
    e. Final airflow rate in cfm.
    f. Final velocity in fpm.

g. Space temperature in deg F.

H. System-Coil Reports. For reheat coils and water coils of terminal units, include the following:

1. Unit Data

a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values)

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

I. Pump Test Reports. Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model and serial numbers.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values)

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

J. Instrument Calibration Reports

1. Report Data

    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.14 INSPECTIONS

A. Initial Inspection

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure water flow of at least 5 percent of terminals.
    c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    d. Measure sound levels at two locations.
    e. Measure space pressure of at least 10 percent of locations.
    f. Verify that balancing devices are marked with final balance position.
    g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.15 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.

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Related Sections include the following:

1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.

1.03 DEFINITIONS

A. DDC. Direct digital control.

B. I/O. Input/output.

C. MS/TP. Master slave/token passing.

D. PC. Personal computer.

E. PID. Proportional plus integral plus derivative.

F. RTD. Resistance temperature detector.

1.04 SYSTEM PERFORMANCE. Comply with the following performance requirements:

A. Graphic Display. Display graphic with minimum 20 dynamic points with current data within 10 seconds.

B. Graphic Refresh. Update graphic with minimum 20 dynamic points with current data within 8 seconds.

C. Object Command. Reaction time of less than two seconds between operator command of a binary object and device reaction.

D. Object Scan. Transmit change of state and change of analog values to control units or workstation within six seconds.

E. Alarm Response Time. Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.

F. Program Execution Frequency. Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.

G. Performance. Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.

H. Reporting Accuracy and Stability of Control. Report values and maintain measured variables within tolerances as follows:

1. Water Temperature. Plus or minus 1 deg F.
2. Water Flow. Plus or minus 5 percent of full scale.
3. Water Pressure. Plus or minus 2 percent of full scale.
4. Space Temperature. Plus or minus 1 deg F.
5. Ducted Air Temperature. Plus or minus 1 deg F.
6. Outside Air Temperature. Plus or minus 2 deg F.
7. Dew Point Temperature. Plus or minus 3 deg F.
8. Temperature Differential. Plus or minus 0.25 deg F.
9. Relative Humidity. Plus or minus 5 percent.
10. Airflow (Pressurized Spaces). Plus or minus 3 percent of full scale.
11. Airflow (Measuring Stations). Plus or minus 5 percent of full scale.
12. Airflow (Terminal). Plus or minus 10 percent of full scale.
13. Air Pressure (Space). Plus or minus 0.01-inch wg.
14. Air Pressure (Ducts). Plus or minus 0.1-inch wg.
15. Carbon Monoxide. Plus or minus 5 percent of reading.
16. Carbon Dioxide. Plus or minus 50 ppm.
17. Electrical. Plus or minus 5 percent of reading.

1.05 SUBMITTALS

A. Product Data. Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware. Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Control System Software. Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems. Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams. Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software. List of color graphics indicating monitored systems, data

(connected and calculated) point addresses, output schedule, and operator notations.

10. Controlled Systems

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Data Communications Protocol Certificates. Certify that each proposed DDC system component complies with ASHRAE 135.

D. Operation and Maintenance Data. For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ASHRAE 135 for DDC system components.

1.07 DELIVERY, STORAGE, AND HANDLING

A. System Software. Update to latest version of software at Project completion.

1.08 COORDINATION

A. Coordinate Location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate Supply of conditioned electrical branch circuits for control units and operator workstation.

C. Coordinate Equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

D. Coordinate Equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

E. Coordinate Equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

F. Coordinate Size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.01 MANUFACTURERS. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection.

A. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

2.02 CONTROL SYSTEM

A. Available Manufacturers

1. American Auto-Matrix.
2. Andover Controls Corporation.
3. Honeywell International Inc.; Home & Building Control.
4. Invensys Building Systems.
5. Johnson Controls, Inc.; Controls Group.
6. KMC Controls/Kreuter Manufacturing Company.
7. Siemens Building Technologies, Inc.
8. Trane; Worldwide Applied Systems Group

B. Control System shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

C. Control System shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.03 UNITARY CONTROLLERS. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

A. Configuration. Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.

B. Operating System. Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.

C. ASHRAE 135 Compliance. Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.

D. Enclosure. Dustproof rated for operation at 32 to 120 deg F.

2.04 ANALOG CONTROLLERS

A. Step Controllers. A 6- or 10-stage type with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers. Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.

C. Electronic Controllers. Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers. Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.05 TIME CLOCKS

A. Available Manufacturers

1. ATC-Diversified Electronics.
2. Grasslin Controls Corporation.
3. Paragon Electric Co., Inc.
4. Precision Multiple Controls, Inc.
5. SSAC Inc.; ABB USA.
6. TCS/Basys Controls.
7. Theben AG - Lumilite Control Technology, Inc.
8. Time Mark Corporation.

B. Solid-state, Programmable Time Control with four separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.06 ELECTRONIC SENSORS

A. Description. Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters

1. Available Manufacturers

a. BEC Controls Corporation.
b. Ebtron, Inc.
c. Heat-Timer Corporation.
d. I.T.M. Instruments Inc.
e. MAMAC Systems, Inc.
f. RDF Corporation.

2. Accuracy. Plus or minus 0.5 deg F at calibration point.
3. Wire. Twisted, shielded-pair cable.
4. Insertion Elements in Ducts. Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
5. Averaging Elements in Ducts. 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
6. Insertion Elements for Liquids. Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction. Manufacturer's standard locking covers.

a. Set-Point Adjustment. Exposed.
b. Set-Point Indication. Exposed.
c. Thermometer. Exposed.

8. Outside-Air Sensors. Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors. Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters

1. Available Manufacturers

a. BEC Controls Corporation.
b. MAMAC Systems, Inc.
c. RDF Corporation.

2. Accuracy. Plus or minus 0.2 percent at calibration point.
3. Wire. Twisted, shielded-pair cable.
4. Insertion Elements in Ducts. Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
5. Averaging Elements in Ducts. 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
6. Insertion Elements for Liquids. Brass socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction. Manufacturer's standard locking covers.

a. Set-Point Adjustment. Exposed.
b. Set-Point Indication. Exposed.
c. Thermometer. Exposed.

8. Outside-Air Sensors. Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors. Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors. Bulk polymer sensor element.

1. Available Manufacturers

a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.

2. Accuracy. 5 percent full range with linear output.
3. Room Sensor Range. 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction. Manufacturer's standard locking covers.

a. Set-Point Adjustment. Exposed.

b. Set-Point Indication. Exposed.

c. Thermometer. Exposed.

5. Duct Sensor. 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor. 20 to 80 percent relative humidity range with mounting enclosure,

suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.

7. Duct and Sensors. With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers

1. Available Manufacturers

a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.

2. Static-Pressure Transmitter. Nondirectional sensor with suitable range for expected input, and temperature compensated.

a. Accuracy. 2 percent of full scale with repeatability of 0.5 percent.
b. Output. 4 to 20 mA.
c. Building Static-Pressure Range. 0- to 0.25-inch wg.
d. Duct Static-Pressure Range. 0- to 5-inch wg.

3. Water Pressure Transducers. Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers. Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water). Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters. Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction. Manufacturer's standard locking covers.

a. Set-Point Adjustment. Exposed.

b. Set-Point Indication. Exposed.

c. Thermometer. Exposed.

2.07 STATUS SENSORS

A. Status Inputs for Fans. Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps. Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors. Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac). Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor. 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with

maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches. Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator. Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches. Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

1. Available Manufacturers

a. BEC Controls Corporation.
b. I.T.M. Instruments Inc.

2.08 THERMOSTATS

A. Available Manufacturers

1. Erie Controls.
2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
3. Heat-Timer Corporation.
4. Sauter Controls Corporation.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.

B. Combination Thermostat and Fan Switches. Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches "FAN HIGH-LOW-OFF".
2. Mount on single electric switch box.

C. Electric, Solid-State, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

a. Time of day.
b. Actual room temperature.
c. Programmed temperature.
d. Programmed time.
e. Duration of timed override.
f. Day of week.
g. System mode indications include "heating," "off," "fan auto," and "fan on."

D. Low-Voltage, On-Off Thermostats. NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

E. Line-Voltage, On-Off Thermostats. Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

1. Electric Heating Thermostats. Equip with off position on dial wired to break ungrounded conductors.
2. Selector Switch. Integral, manual on-off-auto.

F. Remote-Bulb Thermostats. On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements. Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat. With precision snap switches and with electrical ratings required by application.
6. Modulating Thermostats. Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

G. Fire-Protection Thermostats. Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:

1. Reset. Manual.
2. Reset. Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.

H. Immersion Thermostat. Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

I. Airstream Thermostats. Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

J. Electric, Low-Limit Duct Thermostat. Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length. Minimum 20 feet.
2. Quantity. One thermostat for every 20 sq. ft. of coil surface.

K. Electric, High-Limit Duct Thermostat. Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length. Minimum 20 feet.
2. Quantity. One thermostat for every 20 sq. ft. of coil surface.

L. Heating/Cooling Valve-Top Thermostats. Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

2.09 HUMIDISTATS

A. Available Manufacturers

1. MAMAC Systems, Inc.
2. ROTRONIC Instrument Corp.

B. Duct-Mounting Humidistats. Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.10 ACTUATORS

A. Electric Motors. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type. Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2. Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2. Size for running and breakaway torque of 150 in. x lbf.
5. Nonspring-Return Motors for Dampers Larger Than 25 sq. ft.. Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
6. Spring-Return Motors for Dampers Larger Than 25 sq. ft.. Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Available Manufacturers

a. Belimo Aircontrols (USA), Inc.

2. Valves. Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers. Size for running torque calculated as follows:

a. Parallel-Blade Damper with Edge Seals. 7 inch-lb/sq. ft. of damper.
b. Opposed-Blade Damper with Edge Seals. 5 inch-lb/sq. ft. of damper.
c. Parallel-Blade Damper without Edge Seals. 4 inch-lb/sq. ft of damper.
d. Opposed-Blade Damper without Edge Seals. 3 inch-lb/sq. ft. of damper.
e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm. Increase running torque by 1.5.
f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm. Increase running torque by 2.0.

4. Coupling. V-bolt and V-shaped, toothed cradle.
5. Overload Protection. Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation. Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return). 24-V ac.
8. Power Requirements (Modulating). Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal. 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating. Minus 22 to plus 122 deg F.
11. Temperature Rating (Smoke Dampers). Minus 22 to plus 250 deg F.

12. Run Time. 12 seconds open, 5 seconds closed.

2.11 CONTROL VALVES

A. Available Manufacturers

1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
2. Erie Controls.
3. Hayward Industrial Products, Inc.
4. Magnatrol Valve Corporation.
5. Neles-Jamesbury.
6. Parker Hannifin Corporation; Skinner Valve Division.
7. Pneuline Controls.
8. Sauter Controls Corporation.

B. Control Valves. Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Hydronic System Globe Valves shall have the following characteristics:

1. NPS 2 and Smaller. Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 and Larger. Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction. Replaceable plugs and stainless-steel or brass seats.

    a. Single-Seated Valves. Cage trim provides seating and guiding surfaces for plug on top and bottom.
    b. Double-Seated Valves. Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.

4. Sizing. 5-psig maximum pressure drop at design flow rate or the following:

    a. Two Position. Line size.
    b. Two-Way Modulating. Either the value specified above or twice the load pressure drop, whichever is more.
    c. Three-Way Modulating. Twice the load pressure drop, but not more than value specified above.

5. Flow Characteristics. Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating. Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

D. Terminal Unit Control Valves. Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating. Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Sizing. 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics. Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

E. Self-Contained Control Valves. Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating. Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Thermostatic Operator. Wax-filled integral sensor with integral adjustable dial.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install Software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify Location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install Automatic Dampers according to Division 23 Section "Air Duct Accessories."

E. Install Damper Motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

F. Install Labels and Nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

G. Install Hydronic Instrument Wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

H. Install Steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."

I. Install Refrigerant Instrument Wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."

J. Install Duct Volume-control Dampers according to Division 23 Sections specifying air ducts.

K. Install Electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.02 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install Raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install Building Wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Connect Manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

D. Connect Hand-off-auto Selector Switches to override automatic interlock controls when switch is in hand position.

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports

1. Operational Test. After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.

3.04 ADJUSTING

A. Calibrating and Adjusting

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure

    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature

    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

3.05 DEMONSTRATION. Train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.

1.03 DEFINITIONS

A. PTFE. Polytetrafluoroethylene.

1.04 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping. 150 psig at 230 deg F.

1.05 SUBMITTALS

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

1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air control devices.
3. Hydronic specialties.

B. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints. Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding. Processes and operators shall be qualified according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding. Processes and operators shall be qualified according to ASME Boiler and Pressure Vessel Code. Section IX.

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. Shall comply with 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 air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code. Section VIII, Division 01.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing. **ASTM B 88, Type L**.

B. Annealed-Temper Copper Tubing. ASTM B 88, Type K.

C. Wrought-Copper Fittings. ASME B16.22.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

   a. Anvil International, Inc.
   b. S. P. Fittings; a division of Star Pipe Products.
   c. Victaulic Company of America.

2. Grooved-End Copper Fittings. Shall be ASTM B 75, copper tube or ASTM B 584, bronze casting.
3. Grooved-End-Tube Couplings. Shall be rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

D. Copper or Bronze Pressure-Seal Fittings.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

   a. Stadler-Viega.

2. Housing. Copper.
3. O-Rings and Pipe Stops. EPDM.
4. Tools. Manufacturer's special tools.
5. Minimum 200-psig working-pressure rating at 250 deg F.

E. Copper, Mechanically Formed Tee Option. For forming T-branch on copper water tube.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

   a. T-DRILL Industries Inc.

F. Wrought-Copper Unions. ASME B16.22.

2.02 STEEL PIPE AND FITTINGS

A. Steel Pipe. Shall be ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings. Shall be ASME B16.4; Classes 150 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings. Shall be ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions. Shall be ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings. Shall be ASME B16.1, Classes 25, 150, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings. Shall be ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings. Shall be ASME 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.

2.03 JOINING MATERIALS

A. Pipe-Flange Gasket Materials. Shall be suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type. For flat-face, Class 150, cast-iron and cast-bronze flanges.

B. Flange Bolts and Nuts. Shall be ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals. Shall be ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals. Shall be AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals. Shall comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Fiberglass Pipe Adhesive. As furnished or recommended by pipe manufacturer.

G. Gasket Material. Shall be a thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.04 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. Shall be 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 Regulator Co.; a division of Watts Water Technologies, Inc.
    e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.

2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

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 Regulator Co.; a division of Watts Water Technologies, Inc.

2. Factory-fabricated companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits.

1. Manufacturers. Subject to compliance with requirements, provide products by one on 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. Shall 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 minimum working pressure where required to suit system pressures.

F. Dielectric Couplings.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

    a. Calpico, Inc.
    b. Lochinvar Corporation.

2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Victaulic Company of America.

2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.05 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves. Shall comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors. Shall comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

a. Armstrong Pumps, Inc.
b. Bell & Gossett Domestic Pump; a division of ITT Industries.
c. Flow Design Inc.
d. Gerand Engineering Co.
e. Griswold Controls.
f. Taco.

2. Body. Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball. Brass or stainless steel.
4. Plug. Resin.
5. Seat. PTFE.
6. End Connections. Threaded or socket.
7. Pressure Gage Connections. Integral seals for portable differential pressure meter.
8. Handle Style. Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 150 psig.
10. Maximum Operating Temperature. 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

a. Armstrong Pumps, Inc.
b. Bell & Gossett Domestic Pump; a division of ITT Industries.
c. Flow Design Inc.
d. Gerand Engineering Co.
e. Griswold Controls.
f. Taco.
g. Tour & Andersson; available through Victaulic Company of America.

2. Body. Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball. Brass or stainless steel.
4. Stem Seals. EPDM O-rings.
5. Disc. Glass and carbon-filled PTFE.
6. Seat. PTFE.
7. End Connections. Flanged or grooved.

8. Pressure Gage Connections. Integral seals for portable differential pressure meter.
9. Handle Style. Lever, with memory stop to retain set position.
10. CWP Rating. Minimum 150 psig.
11. Maximum Operating Temperature. 250 deg F.

E. Automatic Flow-Control Valves.

1. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

    a. Flow Design Inc.
    b. Griswold Controls.

2. Body. Brass or ferrous metal.
3. Piston and Spring Assembly. Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies. Include bonze or brass-alloy ball valve.
5. Identification Tag. Marked with zone identification, valve number, and flow rate.
6. Size. Same as pipe in which installed.
7. Performance. Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating. 175 psig.
9. Maximum Operating Temperature. 200 deg F.

2.06 AIR CONTROL DEVICES

A. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

B. Manual Air Vents.

1. Body. Bronze.
2. Internal Parts. Nonferrous.
3. Operator. Screwdriver or thumbscrew.
4. Inlet Connection. NPS 1/2.
5. Discharge Connection. NPS 1/8.
6. CWP Rating. 150 psig.
7. Maximum Operating Temperature. 225 deg F.

C. Automatic Air Vents.

1. Body. Bronze or cast iron.
2. Internal Parts. Nonferrous.
3. Operator. Noncorrosive metal float.
4. Inlet Connection. NPS 1/2.
5. Discharge Connection. NPS 1/4.
6. CWP Rating. 150 psig.
7. Maximum Operating Temperature. 240 deg F.

D. Expansion Tanks.

1. Tank. Shall be welded steel, rated for 150-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in

end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code. Section VIII, Division 1 if indicated in equipment schedule.

2. Air-Control Tank Fitting. Shall be cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal unit only; sized for compression-tank diameter. Provide tank fittings for 150-psig working pressure and 250 deg F maximum operating temperature.
3. Tank Drain Fitting. Shall have brass body, nonferrous internal parts; 150-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gage Glass. Shall be Full height with dual manual shutoff valves, 3/4-inch-diameter gage glass, and slotted-metal glass guard.

E. In-Line Air Separators.

1. Tank. Shall be one-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure. Up to 175 psig.
3. Maximum Operating Temperature. Up to 300 deg F.

2.07 CHEMICAL TREATMENT

A. Ethylene and Propylene Glycol. Shall be industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.08 HYDRONIC PIPING SPECIALTIES

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 NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen. 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating. 150 psig.

B. Stainless-Steel Bellow, Flexible Connectors.

1. Body. Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections. Threaded or flanged to match equipment connected.
3. Performance. Capable of 3/4-inch misalignment.
4. CWP Rating. 150 psig.
5. Maximum Operating Temperature. 250 deg F.

C. Spherical, Rubber, Flexible Connectors.

1. Body. Fiber-reinforced rubber body.
2. End Connections. Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance. Capable of misalignment.
4. CWP Rating. 150 psig.
5. Maximum Operating Temperature. 250 deg F.

D. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. District side - Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:

1. Schedule 40 steel pipe; Class 150, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. District side - Hot-water heating piping, aboveground, NPS 2-1/2 shall be any of the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Building Side - Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; Class 150, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Building Side - Hot-water heating piping, aboveground, NPS 2-1/2 shall be any of the following:

1. Type **L**, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

E. Hot-water heating piping installed belowground and within slabs shall be the following:

1. Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

3.02 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.03 PIPING INSTALLATIONS

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

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

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

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

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

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

I. Install piping to allow application of insulation.

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

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.04 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments.

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.

3. Pipe Roller. MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4. Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1. Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2. Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2. Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2. Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3. Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4. Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6. Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8. Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10. Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. NPS 12. Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. NPS 14. Maximum span, 25 feet; minimum rod size, 1 inch.
13. NPS 16. Maximum span, 27 feet; minimum rod size, 1 inch.
14. NPS 18. Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20. Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4. Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1. Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2. Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2. Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2. Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3. Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Plastic Piping Hanger Spacing. Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.05 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. Soldered Joints. Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints. Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads. Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

J. Pressure-Sealed Joints. Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.06 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

D. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3.07 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install 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 ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.08 CHEMICAL TREATMENT

A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:

1. pH.9.0 to 10.5
2. "P" Alkalinity. 100 to 500 ppm
3. Boron. 100 to 200 ppm
4. Chemical Oxygen Demand. Maximum 100 ppm. Modify this value if closed system contains glycol.
5. Corrosion Inhibitor:

    a. Sodium Nitrate. 1000 to 1500 ppm

6. Soluble Copper. Maximum 0.20 ppm.
7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor. Minimum 10 ppm.
8. Total Suspended Solids. Maximum 10 ppm
9. Ammonia. Maximum 20 ppm
10. Free Caustic Alkalinity. Maximum 20 ppm
11. Microbiological Limits:

    a. Total Aerobic Plate Count. Maximum 1000 organisms/ml.
    b. Total Anaerobic Plate Count. Maximum 100 organisms/ml.
    c. Nitrate Reducers. 100 organisms/ml.
    d. Sulfate Reducers. Maximum 0 organisms/ml.
    e. Iron Bacteria. Maximum 0 organisms/ml.

B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

C. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

D. Fill Systems indicated to have antifreeze or glycol solutions with the following concentrations:

1. Hot-Water Heating Piping. Test fluid and confirm with Owner before matching ethylene and propylene glycol percentages.

END OF SECTION

SECTION 23 82 16

AIR COILS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following types of air coils that are not an integral part of air-handling units.

1. Hot-water.

B. Related Sections include the following.

1. Division 23 Sections for air coils that are integral to air-handling units.

1.03 SUBMITTALS

A. Product Data. For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.

B. Coordination Drawings. Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

C. Field Quality-Control Test Reports.

D. Operation and Maintenance Data. For air coils to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 PROJECT CONDITIONS

A. Altitude above Mean Sea Level. 900

PART 2 - PRODUCTS

2.01 WATER COILS

A. Manufacturers. Subject to compliance with requirements, provide products by one of the following.

1. Aerofin Corporation.
2. Carrier Corporation.
3. Coil Company, LLC.
4. Dunham-Bush, Inc.
5. Heatcraft Refrigeration Products LLC; Heat Transfer Division.
6. Super Radiator Coils.
7. Trane.

8. USA Coil & Air.

B. Performance Ratings. Tested and rated according to ARI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings. 200 psig, 325 deg F.

D. Source Quality Control. Factory tested to 300 psig.

E. Tubes. ASTM B 743 copper, minimum 0.020 inch thick.

F. Fins. Aluminum or Copper, minimum 0.010 inch thick.

G. Headers. Seamless copper tube with brazed joints, prime coated

H. Hot-Water Coil and Steam Coil, Face-and-Bypass Dampers. Alternating arrangement of coil segments and dampers.

1. Coil Configuration. Horizontal tubes.
2. Dampers. Extruded-aluminum blades with edge and end seals; full-length drive rod and mount for actuator outside the airstream.EXECUTION

2.02 EXAMINATION

A. Examine Ducts, Plenums, and Casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine Roughing-In for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with Installation only after unsatisfactory conditions have been corrected.

2.03 INSTALLATION

A. Install Coils level and plumb.

B. Install Coils in Metal Ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Straighten Bent Fins on air coils.

D. Clean Coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

2.04 CONNECTIONS

A. Piping Installation Requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install Piping adjacent to coils to allow service and maintenance.

C. Connect Water Piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 Section "Instrumentation and Control for HVAC," and other piping specialties are specified in Division 23 Section "Hydronic Piping."

END OF SECTION

SECTION 23 82 36

FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes **hydronic**, **finned-tube** radiation heaters.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details and dimensions of custom-fabricated enclosures.
4. Indicate location and size of each field connection.
5. Indicate location and arrangement of piping valves and specialties.
6. Indicate location and arrangement of integral controls.
7. Include enclosure joints, corner pieces, access doors, and other accessories.
8. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members, including wall construction, to which finned-tube radiation heaters will be attached.
2. Method of attaching finned-tube radiation heaters to building structure.
3. Penetrations of fire-rated wall and floor assemblies.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.01 **HOT-WATER** BASEBOARD RADIATION HEATERS

A. Performance Ratings: Rate baseboard radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Baseboard Radiation."

B. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on polypropylene element glides. One end of tube shall be

belled.

1. Tube Diameter: See Drawing Schedule
2. Fin Size: See Drawing Schedule
3. Fin Spacing: See Drawing Schedule
4. Number of Tiers: See Drawing Schedule
5. Heat Output: See Drawing Schedule
6. Entering-Air Temperature: **65 deg F**
7. Average Water Temperature: **180 deg F**

C. Enclosures: Minimum **0.0329-inch** thick steel, removable front cover.

1. Full-height back.
2. Full-length damper.
3. End panel.
4. End caps.
5. Inside and outside corners.
6. Valve access door.
7. Joiner pieces to snap together.
8. Finish: Baked-enamel finish in manufacturer's **standard** color as selected by Architect.
9. Element Brackets: Primed and painted steel to support front panel and element.

2.02 **HOT-WATER** FINNED-TUBE RADIATION HEATERS

A. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

B. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.

1. Tube Diameter: See Drawing Schedule

2. Fin Size: See Drawing Schedule

3. Fin Spacing: See Drawing Schedule

4. Number of Tiers: See Drawing Schedule

5. Heat Output: See Drawing Schedule

6. Entering-Air Temperature: **65 deg F**

7. Average Water Temperature: **180 deg F**

C. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.

D. Floor-Mounted Pedestals: Conceal insulated piping at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel. Provide stainless-steel escutcheon for floor openings at pedestals.

E. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.

F. Finish: Baked **enamel** finish in manufacturer's **standard** color as selected by Architect.

G. Damper: Knob-operated internal damper at enclosure outlet.

H. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum

size 6 by 7 inches, integral with enclosure.

I. Enclosure Style: **Sloped** top.

1. Front Inlet Grille: Punched louver; painted to match enclosure.
2. Front Inlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.

    a. Mill-finish aluminum.
    b. Anodized finish, color as selected by Architect from manufacturer's **standard** colors.
    c. Painted to match enclosure.

3. **Front** Outlet Grille: Punched louver; painted to match enclosure.
4. **Front** Outlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.

    a. Mill-finish aluminum.
    b. Anodized finish, color as selected by Architect from manufacturer's **standard** colors.
    c. Painted to match enclosure.

J. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for **hydronic-piping** connections to verify actual locations before installation of finned-tube radiation heaters.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 BASEBOARD RADIATION HEATER INSTALLATION

A. Install units level and plumb.

B. Install enclosure continuously around corners, using outside and inside corner fittings.

C. Join sections with splice plates and filler pieces to provide continuous enclosure.

D. Install access doors for access to valves.

E. Install enclosure continuously from wall to wall.

F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

G. Install valves within reach of access door provided in enclosure.

H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

I. Install piping within pedestals for freestanding units.

3.03 FINNED-TUBE RADIATION HEATER INSTALLATION

A. Install units level and plumb.

B. Install enclosure continuously around corners, using outside and inside corner fittings.

C. Join sections with splice plates and filler pieces to provide continuous enclosure.

D. Install access doors for access to valves.

E. Install enclosure continuously from wall to wall.

F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

G. Install valves within reach of access door provided in enclosure.

H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

I. Install piping within pedestals for freestanding units.

3.04 CONNECTIONS

A. Piping installation requirements are specified in [Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."] [Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties."] Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot-water finned-tube radiation heaters and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."

1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

C. Connect steam finned-tube radiation heaters and components to piping according to Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties."

1. Install shutoff valve on inlet; install strainer, steam trap, and shutoff valve on outlet.

D. Install control valves as required by Section 230923.11 "Control Valves."

E. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.

F. Ground electric finned-tube radiation heaters according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.05 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm

proper operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 23 82 39

UNIT HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY. Section Includes:

A. Propeller Unit Heaters with hot-water coils.

1.03 DEFINITIONS

A. BAS. Building automation system.

B. CWP. Cold working pressure.

C. PTFE. Polytetrafluoroethylene plastic.

D. TFE. Tetrafluoroethylene plastic.

1.04 SUBMITTALS

A. Product Data. Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Operation and Maintenance Data. For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE. Electrical Components, Devices, and Accessories. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.06 EXTRA MATERIALS. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

A. Cabinet Unit Heater Filters. Furnish one spare filter for each filter installed.

PART 2 - PRODUCTS

2.01 PROPELLER UNIT HEATERS

A. Manufacturers. Subject to compliance with requirements, provide products by one of the following:

1. Airtherm; a Mestek Company.
2. Engineered Air Ltd.
3. McQuay International.
4. Rosemex Products.
5. Ruffneck Heaters; a division of Lexa Corporation.
6. Trane.
7. Sterling
8. Vulcan
9. Modine

B. Description. An assembly including casing, coil, fan, and motor in discharge configuration with adjustable discharge louvers.

C. Cabinet shall have removable panels for maintenance access to controls.

D. Discharge Louver. Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

E. General Coil Requirements. Test and rate hot-water propeller unit heater coils according to ASHRAE 33.

F. Hot-Water Coil shall be copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1-inch and shall be rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

G. Fan shall be propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

H. Fan Motors shall comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Type shall be permanently lubricated,

I. Control Devices

1. Wall-mounting fan-speed switch.
2. Wall-mounting thermostat.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine Roughing-In for piping and electrical connections to verify actual locations before unit heater installation.

C. Proceed with Installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install Propeller Unit Heaters level and plumb.

B. Suspend Propeller Unit Heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install Wall-Mounting Thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Install New Filters in each fan-coil unit within two weeks of Substantial Completion.

3.03 CONNECTIONS

A. Piping Installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install Piping adjacent to machine to allow service and maintenance.

C. Connect Piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Unless Otherwise Indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."

E. Ground Equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect Wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Perform the Following Field Tests and inspections and prepare test reports:

1. Operational Test. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and Replace malfunctioning units and retest as specified above.

END OF SECTION

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BELLA GRACE BUILDING

DRAWING INDEX	
M001	TITLE SHEET
MD100	BASEMENT MECHANICAL DEMO PLAN
M100	BASEMENT MECHANICAL PLAN
MD101	LOWER LEVEL MECHANICAL DEMO PLAN
M101	LOWER LEVEL MECHANICAL PLAN
MD102	THIRD FLOOR MECHANICAL DEMO PLAN
M102	THIRD FLOOR MECHANICAL PLAN
MD103	UPPER LEVEL MECHANICAL DEMO PLAN
M103	UPPER LEVEL MECHANICAL PLAN
M600	MECHANICAL SCHEDULES
M700	PIPING AND INSTRUMENTATION DIAGRAM
M800	MECHANICAL SPECIFICATIONS

SITE LOCATION MAP

PROJECT LOCATION

106 W. SUPERIOR ST
DULUTH MN 55802

CONTACT INFORMATION

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TKDA REPRESENTATIVES

LUKE J. ZUPAN PROJECT ENGINEER TKDA	11 E. SUPERIOR ST SUITE 420 DULUTH, MN PHONE: (218) 340-3156 E-MAIL: luke.zupan@tkda.com

PIPING SYMBOLS

- NEW PIPING
- DEMO PIPING
- 90° ELBOW UP
- 90° ELBOW DN
- TEE UP
- TEE DN
- DEMOLISHED PIPING/EQUIPMENT
- CONNECT TO EXISTING
- FLOW DIRECTION
- CONCENTRIC REDUCER
- UNION
- CAP
- GATE VALVE - OPEN
- BALL VALVE - OPEN
- BALL VALVE - NORMALLY CLOSED
- CHECK VALVE
- PRESSURE REDUCING VALVE
- PRESSURE REGULATOR VALVE
- PRESSURE RELIEF VALVE
- THREE-WAY VALVE
- Y TYPE STRAINER
- CIRCULATION PUMP
- DIAPHRAGM OPERATOR
- ELECTRIC MOTOR OPERATOR (M)
- PRESSURE GAUGE (PG)
- TEMPERATURE SENSOR (T)
- THERMOSTAT (T)
- THERMOWELL
- BALANCE VALVE

ABBREVIATIONS

AFF	ABOVE FINISHED FLOOR	FTR	FINNED TUBE RADIATION
AHU	AIR HANDLING UNIT	FP	FIRE PROTECTION
AP	ACCESS PANEL	GA	GAUGE
AS	AIR SEPARATOR	HP	HEAT PUMP
BAS	BUILDING AUTOMATION SYSTEM	HPC	HIGH PRESSURE CONDENSATE
BLDG	BUILDING	HPS	HIGH PRESSURE STEAM
CD	CONDENSATE DRAIN	HWS	HEATING WATER SUPPLY
CIRC	CIRCULATION	HWR	HEATING WATER RETURN
CLG	CEILING	HW	HOT WATER
CLR	CLEARANCE	HX	HEAT EXCHANGER
COND	CONDENSATE	IN	INCH
CONN	CONNECTION	LPC	LOW PRESSURE CONDENSATE
CONT	CONTINUATION	LPS	LOW PRESSURE STEAM
CP	CONTROL PANEL	MECH	MECHANICAL
CUH	CABINET UNIT HEATER	MISC	MISCELLANEOUS
CVU	CABINET VENTILATION UNIT	M	MOTORIZED
CW	COLD WATER	NC	NORMALLY CLOSED
DIA	DIAMETER	NO	NORMALLY OPEN
DN	DOWN	P&F	PLATE AND FRAME
EA	EACH	REQ	REQUIRED
ELEC	ELECTRICAL	RM	ROOM
EL/ELEV	ELEVATION	STM	STEAM
EQUIP	EQUIPMENT	SUP	SUPPLY
EX/EXIST	EXISTING	RET	RETURN
ET	EXPANSION TANK	T	THERMOSTAT
ETS	ENERGY TRANSFER SKID	TEMP	TEMPERATURE
F	FAHRENHEIT	TYP	TYPICAL
FCU	FAN COIL UNIT	UH	UNIT HEATER
FLR	FLOOR	VLV	VALVE
FT	FEET		

GENERAL NOTES

1. IT IS THE RESPONSIBILITY OF MECHANICAL CONTRACTORS TO COORDINATE THE WORK OF THEIR TRADE WITH ALL OTHER TRADES PRIOR TO EXECUTING WORK. WORK REQUIRING REMOVAL AND RE-INSTALLATION DUE TO LACK OF COORDINATION SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL NOT BE BILLED TO THE PROJECT.
2. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO FLUSH, FILL AND TEST NEW HYDRONIC SYSTEMS. ANY EXISTING SYSTEM THAT IS TO REMAIN IN SERVICE SHALL BE RETURN TO SYSTEM FILL AND PRESSURE PRIOR TO OPERATION.
3. CONTRACTOR SHALL INSPECT ALL EXISTING CONDITIONS AS WELL AS THE WORK OF OTHER TRADES PRIOR TO PERFORMING INSTALLATIONS.
4. CONTRACTOR SHALL PROTECT EXISTING INFRASTRUCTURE AS WELL AS PREVIOUSLY INSTALLED WORK THAT IS TO REMAIN IN PLACE AFTER PROJECT IS COMPLETE.
5. CONTRACTOR IS REQUIRED TO VERIFY ALL EXISTING CONDITIONS PRIOR TO PERFORMING WORK.
6. CONTRACTOR IS RESPONSIBLE FOR INSTALLING PIPING IN GENERAL LOCATIONS SHOWN ON PLANS. IT IS EXPECTED THAT PIPING AND EQUIPMENT WILL BE INSTALLED IN SUCH A WAY THAT IT IS SERVICEABLE, SAFE TO OPERATE AND EFFICIENTLY LOCATED FOR CONTINUED USED OF THE PHYSICAL SPACES.
7. CONTRACTOR SHALL FOLLOW ALL STATE AND LOCAL BUILDING AND MECHANICAL CODES. ALL PIPING SHALL BE INSTALLED PER ASME B31.9 REQUIREMENTS. THE VERY LIMITED HIGH PRESSURE STEAM ISOLATION WORK MUST COMPLY WITH B31.1.
8. ALL EQUIPMENT SHALL BE INSTALLED TRUE AND LEVEL. ANY DEVIATION FROM SHOWN INSTALL LOCATION MUST BE APPROVED BY OWNER AND ENGINEER.
9. PROTECT EQUIPMENT AND MATERIALS FROM WEATHER AND CONSTRUCTION DUST. LEAVE ALL EQUIPMENT, INSTALLED PIPING, AND CONSTRUCTION AREAS CLEAN.
10. INSTALL ALL MANUALLY ADJUSTABLE CONTROL DEVICES AT A MAXIMUM OF 48" A.F.F. IN ACCORDANCE WITH ADA REQUIREMENTS. INSTALL CONTROL SENSORS AT AN ELEVATION OF 60" A.F.F.

DULUTH ENERGY SYSTEMS

BELLA GRACE BLDG

106 W. SUPERIOR ST.
DULUTH MN 55802

STEAM TO HOT WATER CONVERSIONS

ALL CONTRACTORS AND SUBCONTRACTORS SHALL VERIFY ALL DIMENSIONS BY MEASUREMENT AT THE BUILDING AND/OR SITE

0 1

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS DRAWING ADJUST SCALES ACCORDINGLY.

ISSUED FOR BID

NO.	DATE	ISSUE RECORD
1	6-4-2021	ISSUED FOR BID

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SIGNATURE:
PRINTED NAME: LUKE J. ZUPAN
LIC. NO.: 53597 DATE: 6-4-2021

TKDA
11 E. Superior Street, Suite 420
Duluth, MN 55802
218.724.8578
tkda.com

DESIGNED	DRAWN	CHECKED
LJZ	BMB	LJZ

TITLE SHEET

M001

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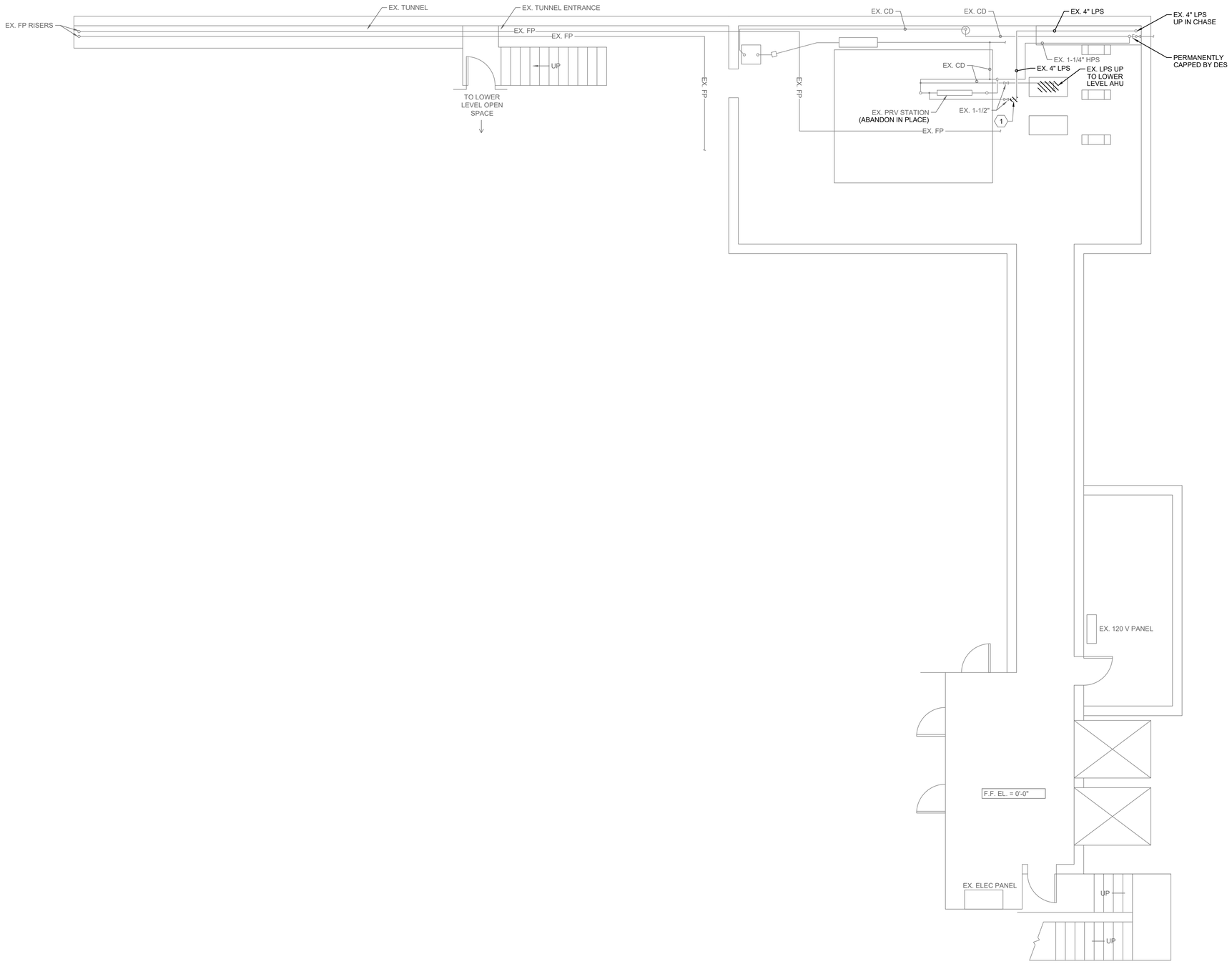

DEMOLITION KEYED NOTES

1 DISCONNECT PIPING AS INDICATED AND PREPARE EXISTING 4" LPS TO BE REUSED AS NEW HWS LINE.

1 MD100 BASEMENT MECHANICAL DEMO PLAN
SCALE: 3/16"=1'-0"

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SCALE IN FEET

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DULUTH ENERGY SYSTEMS

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BASEMENT MECHANICAL DEMO PLAN

MD100

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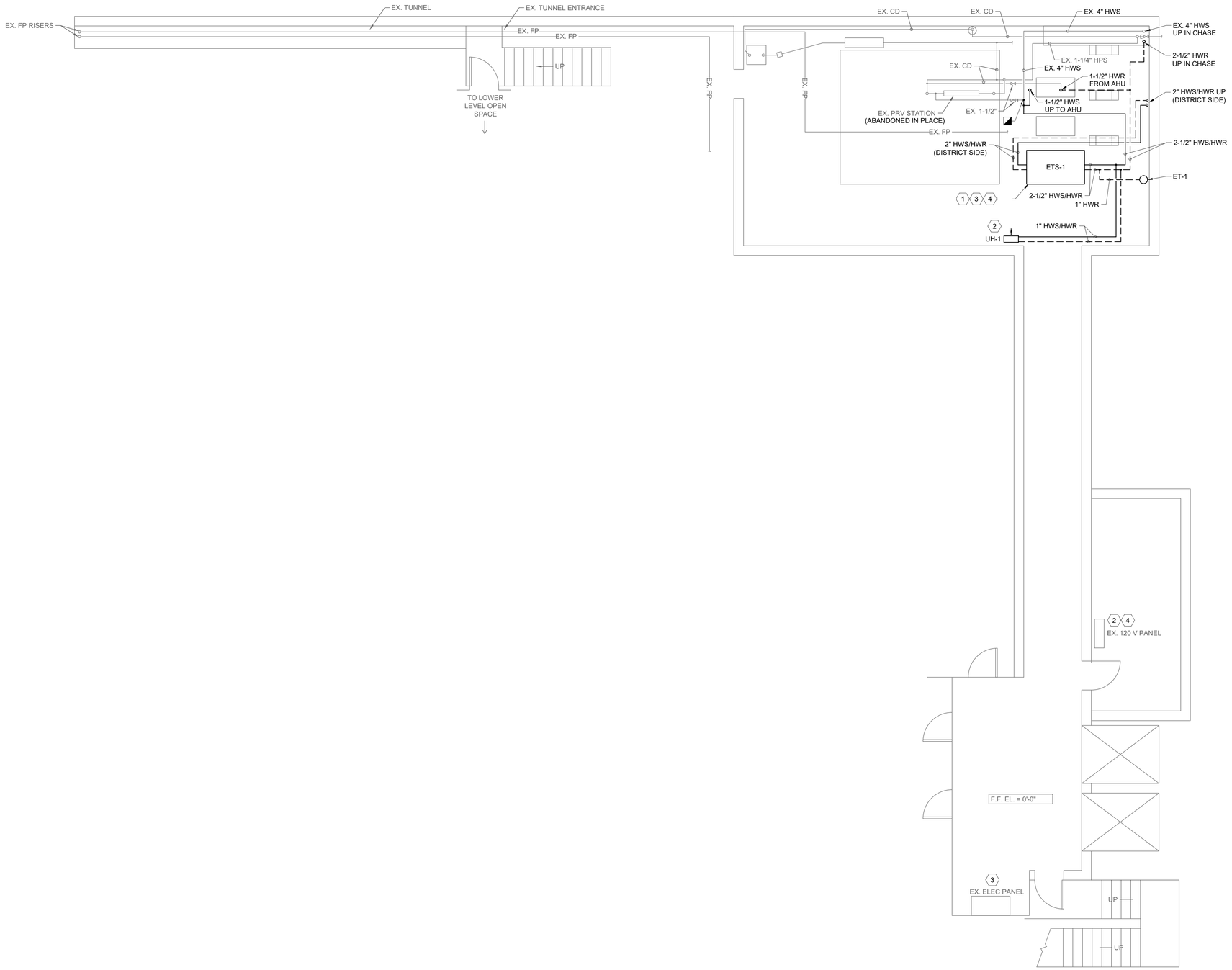

1 M100 BASEMENT MECHANICAL PLAN

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KEYED NOTES

1. INSTALL OWNER FURNISHED ETS AND CONNECT TO DISTRICT AND BUILDING HOT WATER PIPING.
2. PROVIDE NEW 120V SINGLE PHASE 20A SINGLE POLE BREAKER IN EXISTING PANELBOARD FOR UH-1 FAN POWER. PROVIDE CONDUIT AND CABLE TO NEW UH-1.
3. PROVIDE NEW 208V THREE PHASE XXA THREE POLE BREAKER IN EXISTING PANELBOARD FOR ETS-1 SYSTEM POWER. PROVIDE CONDUIT AND CABLE TO NEW ETS-1. SIZE BREAKER PER CONTROL PANEL MANUFACTURER LISTING.
4. PROVIDE NEW 120V SINGLE PHASE 20A SINGLE POLE BREAKER IN EXISITNG PANELBOARD FOR ETS-1 CONTROL POWER. PROVIDE CONDUIT AND CABLE TO NEW ETS-1.

DULUTH ENERGY SYSTEMS

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BASEMENT MECHANICAL PLAN

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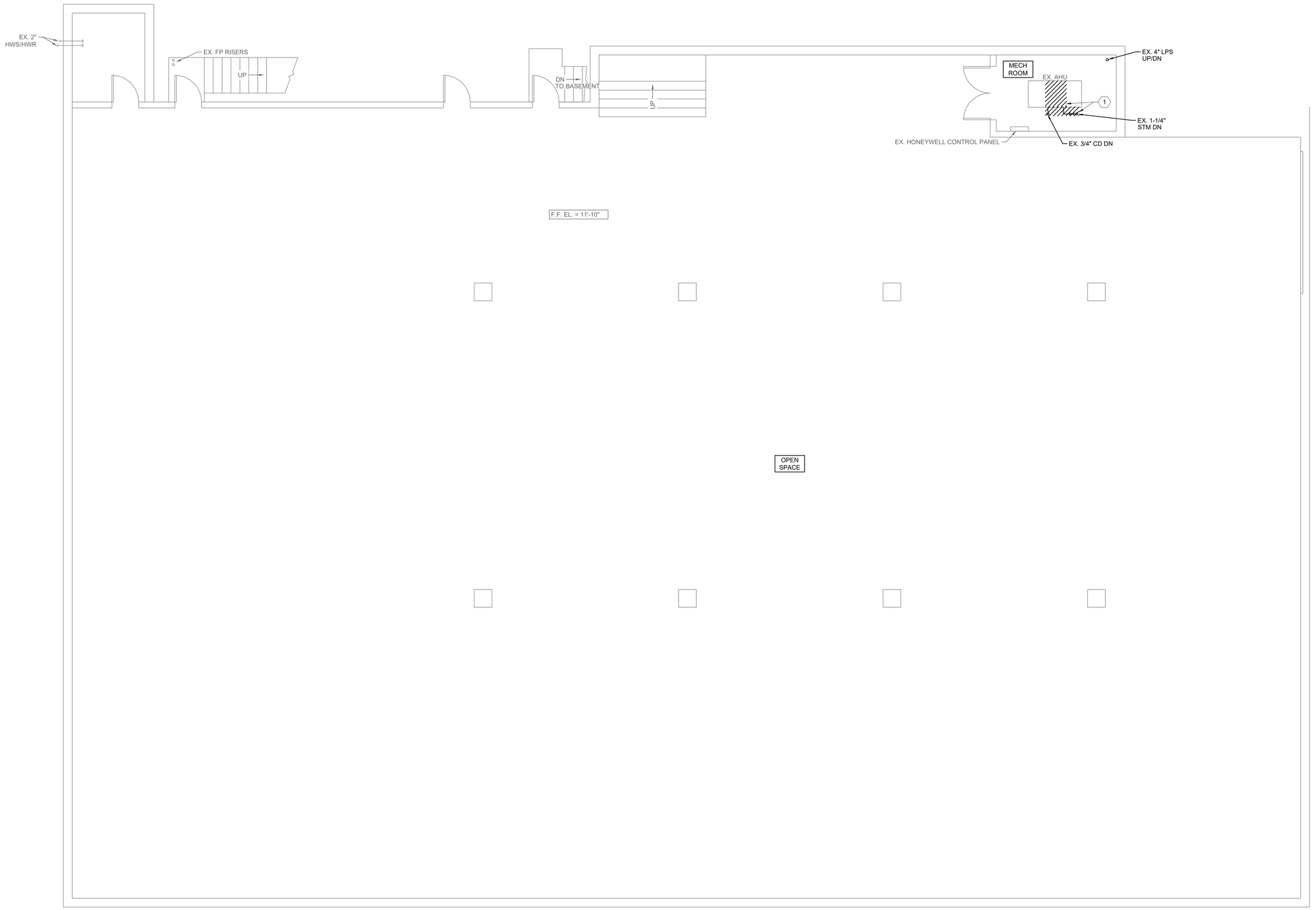
DEMOLITION KEYED NOTES

1 REMOVE EXISTING STEAM HEATING COIL AS WELL AS STEAM AND CONDENSATE LINES SERVING AHU.



1 MD101 LOWER LEVEL MECHANICAL DEMO PLAN

SCALE: 3/16"=1'-0"

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SCALE IN FEET

DULUTH ENERGY SYSTEMS

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STEAM TO HOT WATER CONVERSIONS

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LOWER LEVEL MECHANICAL DEMO PLAN

MD101

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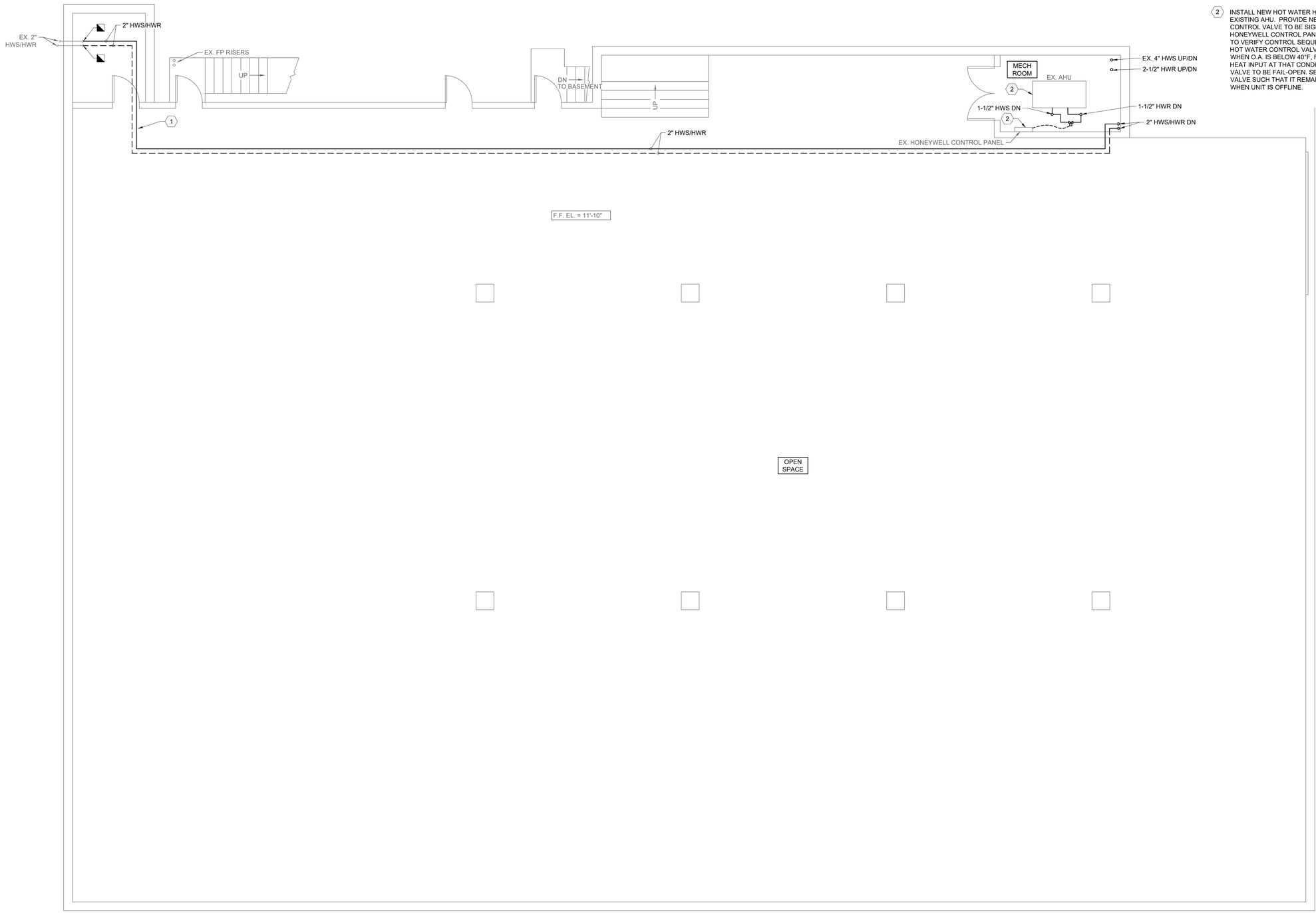

KEYED NOTES

1. RUN DISTRICT HEATING LINES TIGHT TO CEILING. COORDINATE WITH OWNER TO MAINTAIN CLEARANCE AROUND NEW ELEVATOR INSTALLATION IN THIS AREA.
2. INSTALL NEW HOT WATER HEATING COIL IN EXISTING AHU. PROVIDE NEW TWO-WAY CONTROL VALVE TO BE SIGNALED BY EXISTING HONEYWELL CONTROL PANEL. CONTRACTOR TO VERIFY CONTROL SEQUENCE MODULATES HOT WATER CONTROL VALVE TO 100% OPEN WHEN O.A. IS BELOW 40°F. F&B TO CONTROL HEAT INPUT AT THAT CONDITION. CONTROL VALVE TO BE FAIL-OPEN. SEQUENCE CONTROL VALVE SUCH THAT IT REMAINS 100% OPEN WHEN UNIT IS OFFLINE.

1 M101 LOWER LEVEL MECHANICAL PLAN
SCALE: 3/16"=1'-0"

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SCALE IN FEET

DULUTH ENERGY SYSTEMS

BELLA GRACE BLDG

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STEAM TO HOT WATER CONVERSIONS

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LOWER LEVEL MECHANICAL PLAN

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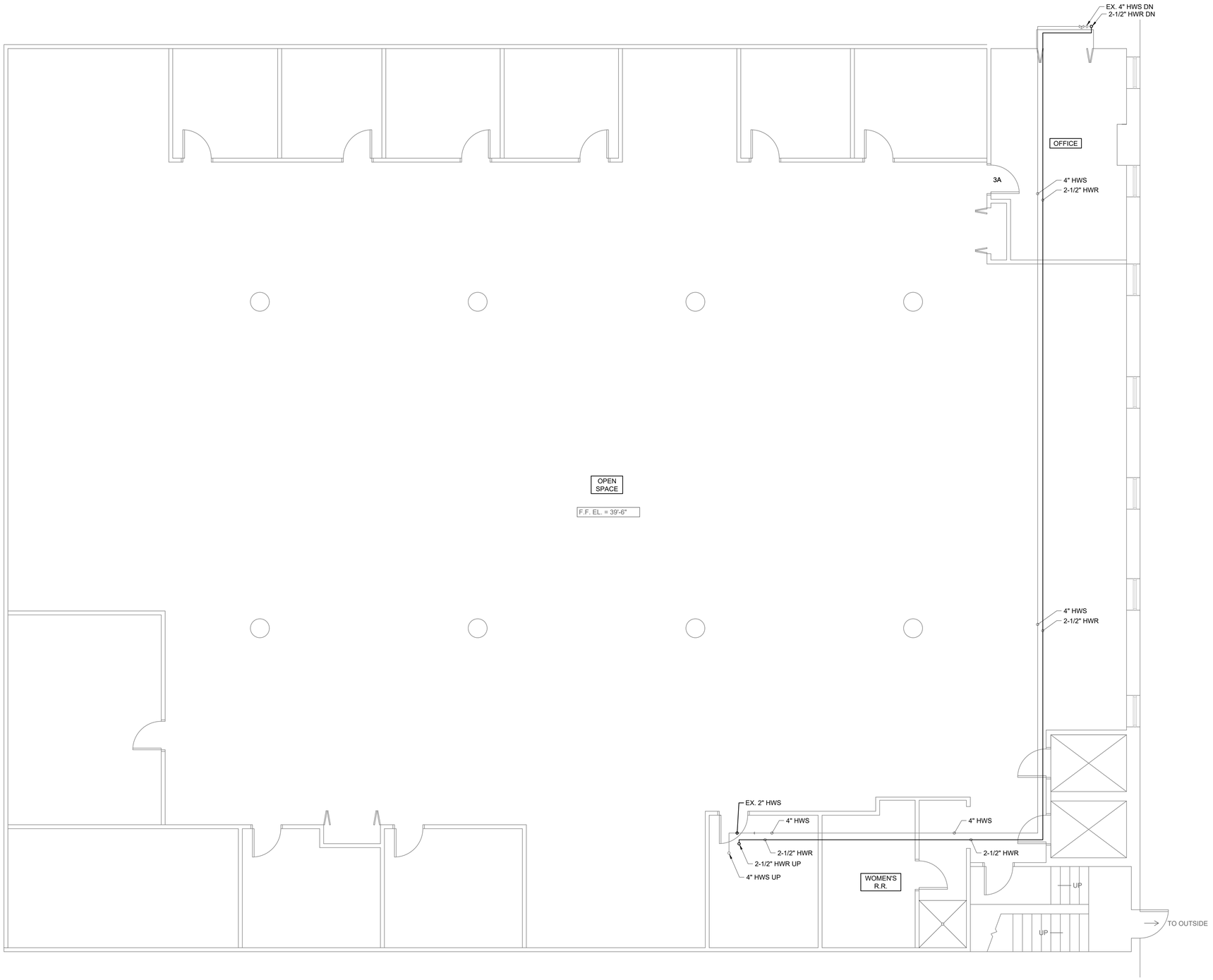

1 M102 THIRD FLOOR MECHANICAL PLAN

SCALE: 3/16"=1'-0"

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SCALE IN FEET

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DULUTH ENERGY SYSTEMS

BELLA GRACE BLDG

106 W. SUPERIOR ST.
DULUTH MN 55802

STEAM TO HOT WATER CONVERSIONS

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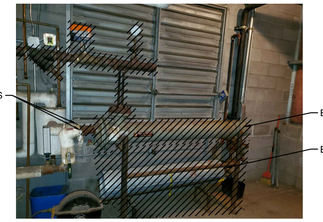
THIRD FLOOR MECHANICAL PLAN

M102

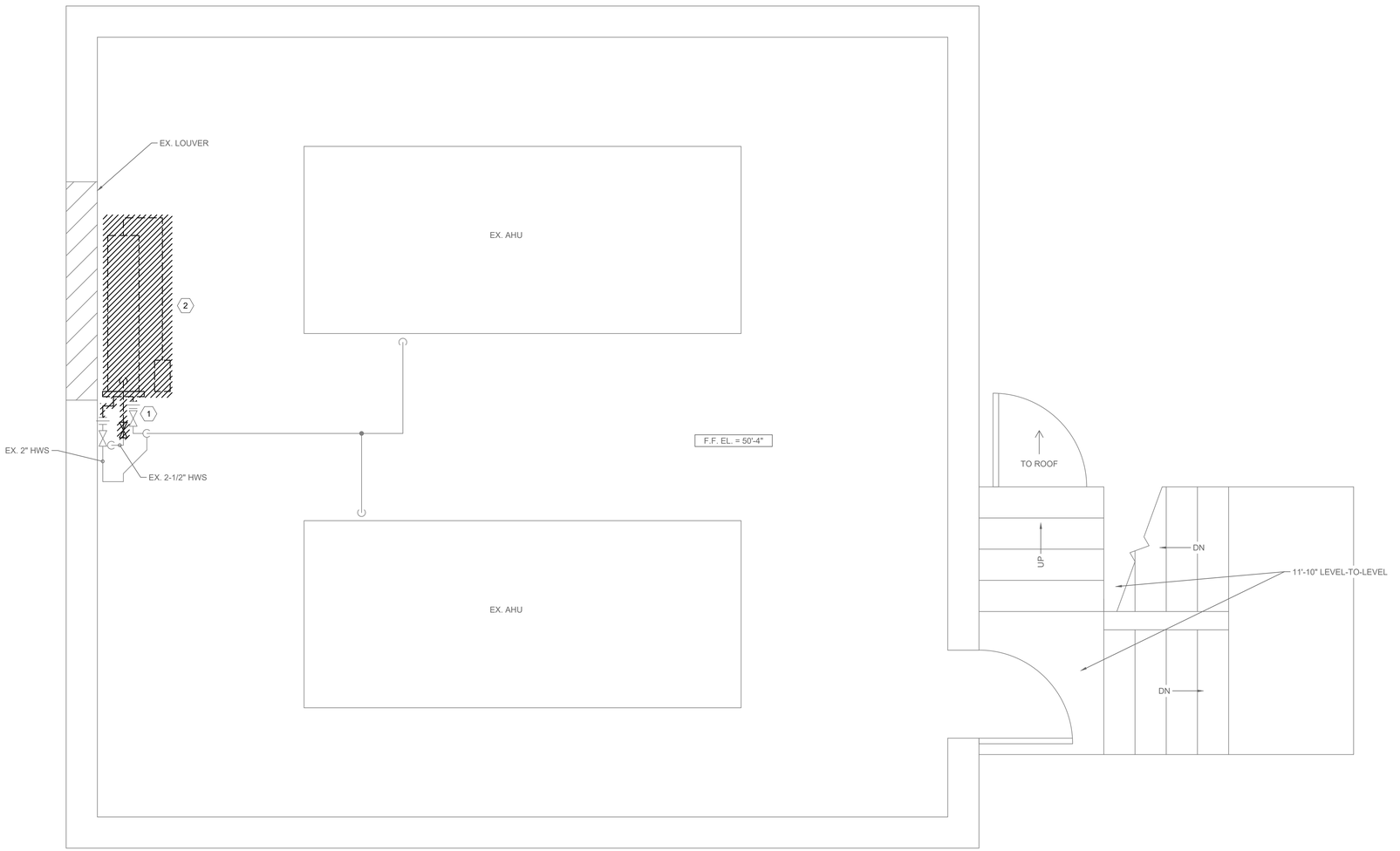
18160.000

DEMOLITION KEYED NOTES

1. REMOVE STEAM LINE AND ISOLATION VALVE. DISCONNECT HOT WATER SUPPLY AND RETURN BACK TO UNIONS.
2. REMOVE HEAT EXCHANGER, CONDENSATE TANK, AND METER, AND RETURN TO DULUTH ENERGY SYSTEMS.



2 MD103 HEAT EXCHANGER DEMOLITION
NOT TO SCALE



1 MD103 UPPER LEVEL MECHANICAL DEMO PLAN
SCALE: 1/2"=1'-0"

0 1 2 4
SCALE IN FEET

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DULUTH ENERGY SYSTEMS

BELLA GRACE BLDG

106 W. SUPERIOR ST.
DULUTH MN 55802

STEAM TO HOT WATER CONVERSIONS

ALL CONTRACTORS AND SUBCONTRACTORS SHALL VERIFY ALL DIMENSIONS BY MEASUREMENT AT THE BUILDING AND/OR SITE

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SIGNATURE:
PRINTED NAME: LUKE J. ZUPAN
LIC. NO.: 53597 DATE: 6-4-2021

TKDA
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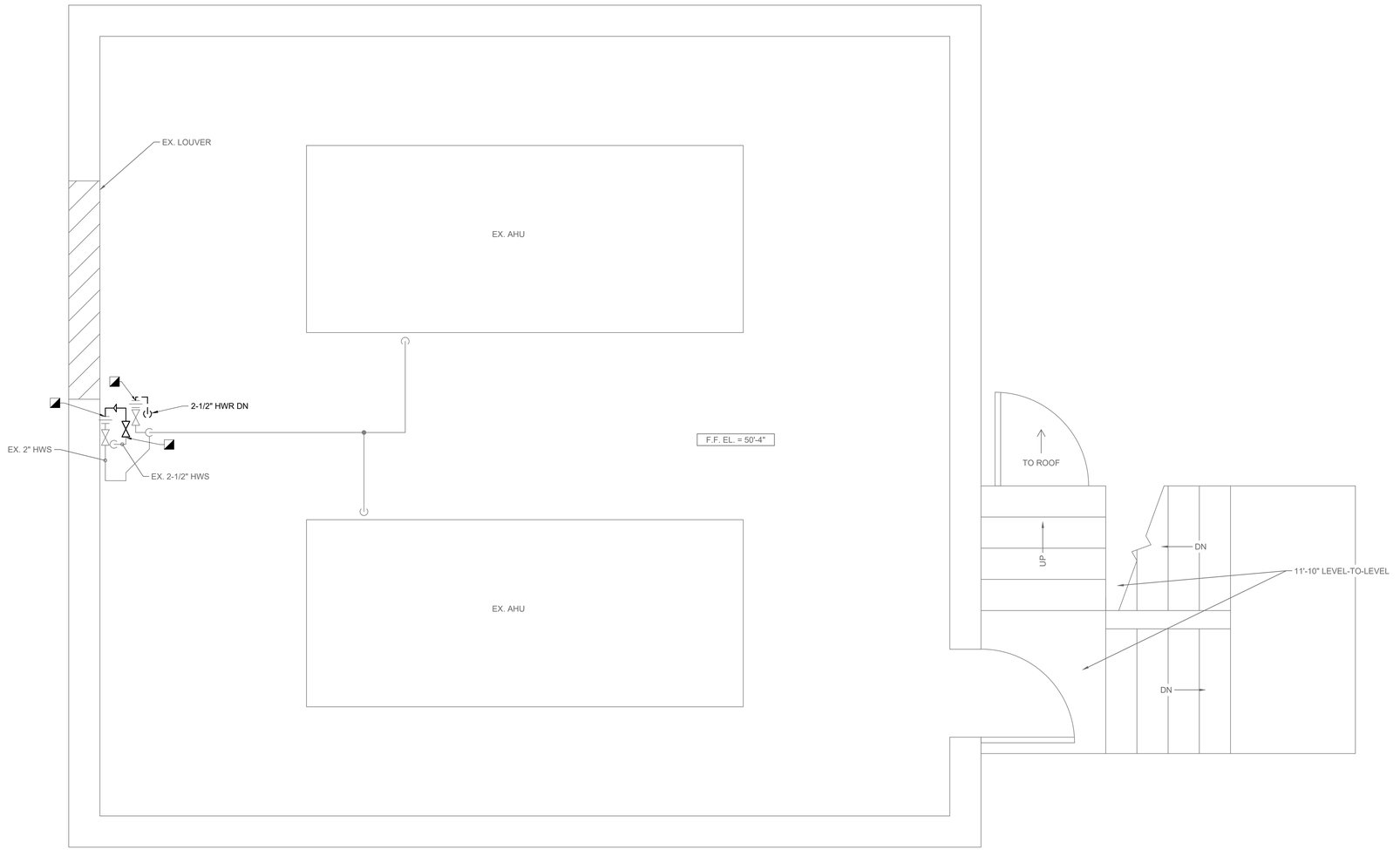
Duluth, MN 55802
218.724.8578
tkda.com

DESIGNED	DRAWN	CHECKED
LJZ	BMB	LJZ

UPPER LEVEL MECHANICAL DEMO PLAN

MD103

18160.000



1 M103 UPPER LEVEL MECHANICAL PLAN

SCALE: 1/2"=1'-0"

0 1 2 4

SCALE IN FEET

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UPPER LEVEL MECHANICAL PLAN

M103

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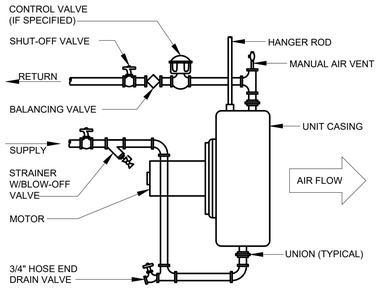
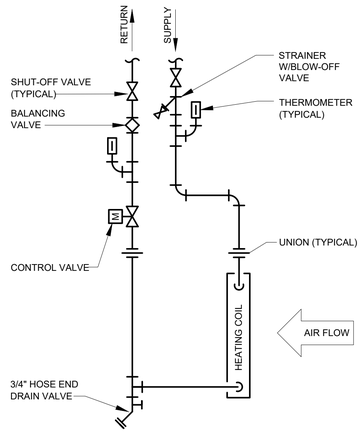


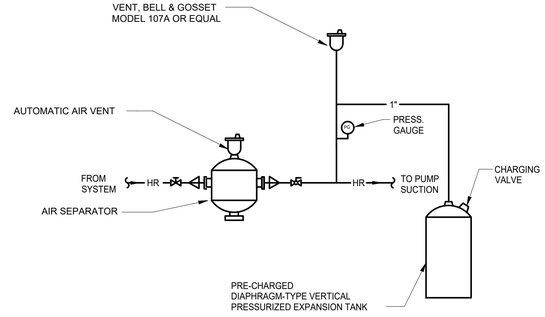
1 M500 TYPICAL HORIZONTAL HOT WATER UNIT HEATER

NOT TO SCALE



2 M500 TYPICAL WATER HEATING COIL W/TWO WAY CONTROL VALVE

NOT TO SCALE



3 M500 TYPICAL AIR SEPARATOR AND EXPANSION TANK

NOT TO SCALE

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DULUTH ENERGY SYSTEMS

BELLA GRACE BLDG

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DULUTH MN 55802

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MECHANICAL DETAILS

M500

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UNIT HEATER SCHEDULE											
BASED ON 200 DEG. F EWT & 60 DEG. F EAT											
UNIT NO.	LOCATION	MANUFACTURER MODEL NO.	MBH	CFM	GPM	WPD	HP	REQUIRED ELECTRICAL VOLTS	REQUIRED ELECTRICAL PH	ARRANGEMENT	REMARKS
UH-1	BASEMENT MECHANICAL AREA	MODINE HSB 108	83.7	2010	8.7	-	1/8	120	1	HORIZONTAL BOTTOM CONNECT	FURNISHED AND INSTALLED BY MC

1. INSTALL (1) 120V SINGLE PHASE 20A SINGLE POLE BREAKER PER UNIT HEATER FOR FAN POWER

EXPANSION TANK SCHEDULE							
UNIT NO.	LOCATION	SERVES	MANUFACTURER MODEL NO.	ACCEPTANCE GALLONS CAPACITY	SIZE LENGTH	SIZE DIAMETER	REMARKS
ET-1	BASEMENT MECHANICAL AREA	BELLA GRACE HEATING SYSTEM	BELL & GOSSETT D40	11.3	29"	16"	BLADDER TANK, ASME RATED, AIR SEPARATOR IS EXISTING IN PENTHOUSE MECH. ROOM

PUMP SCHEDULE												
UNIT NO.	LOCATION	SERVES	MANUFACTURER MODEL NO.	GPM	HD. FT. H20	HP	RPM	REQUIRED ELECTRICAL VOLTS	REQUIRED ELECTRICAL PH	EFF.	IMPELLER SIZE	REMARKS
P-1	BASEMENT MECHANICAL AREA	BELLAGRACE HEATING SYSTEM	BELL & GOSSETT 90 2AAC	100	70	3	2978	208	3	74.6	5"	1 OF 2 DUPLEX PUMPS LOCATED ON ETS-1. PROVIDED BY OWNER.
P-2	BASEMENT MECHANICAL AREA	BELLAGRACE HEATING SYSTEM	BELL & GOSSETT 90 2AAC	100	70	3	2978	208	3	74.6	5"	2 OF 2 DUPLEX PUMPS LOCATED ON ETS-1. PROVIDED BY OWNER.

HEAT EXCHANGER SCHEDULE															
UNIT NO.	LOCATION	SERVES	MANUFACTURER MODEL NO.	HEAT TRANSFER MBH	PRIMARY SIDE GPM	PRIMARY SIDE EWT	PRIMARY SIDE LWT	PRIMARY SIDE WPD	PRIMARY SIDE FLUID	SECONDARY SIDE GPM	SECONDARY SIDE EWT	SECONDARY SIDE LWT	SECONDARY SIDE WPD	SECONDARY SIDE FLUID	REMARKS
ETS-1	BASEMENT MECHANICAL AREA	BELLA GRACE HEATING SYSTEM	BY OWNER	1350	67.5	215	175	5 PSI	100% WATER	93	175	205	5 PSI	100% WATER	HX IS PART OF OWNER FURNISHED ETS-1. CONTRACTOR IS RESPONSIBLE FOR SETTING AND INSTALLING SKID.

1. INSTALL (1) 480V THREE PHASE XXA THREE POLE BREAKER FOR ETS-1 SYSTEM POWER. SIZE BREAKER PER CONTROL PANEL MANUFACTURER LISTING.
2. INSTALL (1) 120V SINGLE PHASE 20A SINGLE POLE BREAKER FOR ETS-1 CONTROL POWER.

REPLACEMENT AHU COIL SCHEDULE (WATER)														
UNIT NO.	LOCATION	MANUFACTURER MODEL NO.	CFM	EAT	LAT	APD	EWT	LWT	GPM	WPD	SIZE (WxL)	ROWS	FLUID	REMARKS
AHU-1	LEVEL 1	DAIKIN	1300	-24	83	0.25	200	180	15.2	2.9	15"X37.6"	2	100% WATER	CONTRACTOR TO VERIFY COIL DIMENSIONS ARE COMPATIBLE WITH EXISTING AHU PRIOR TO ORDER AND INSTALLATION. VERIFY THAT FACE AND BYPASS CONTROLS ARE MAINTAINED IN EXISTING UNIT CONTROLS SUCH THAT HOT WATER CONTROL VALVE IS 100% OPEN WHEN OUTSIDE AIR IS BELOW 40°F.

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BELLA GRACE BLDG

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DULUTH MN 55802

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MECHANICAL SCHEDULES

M600

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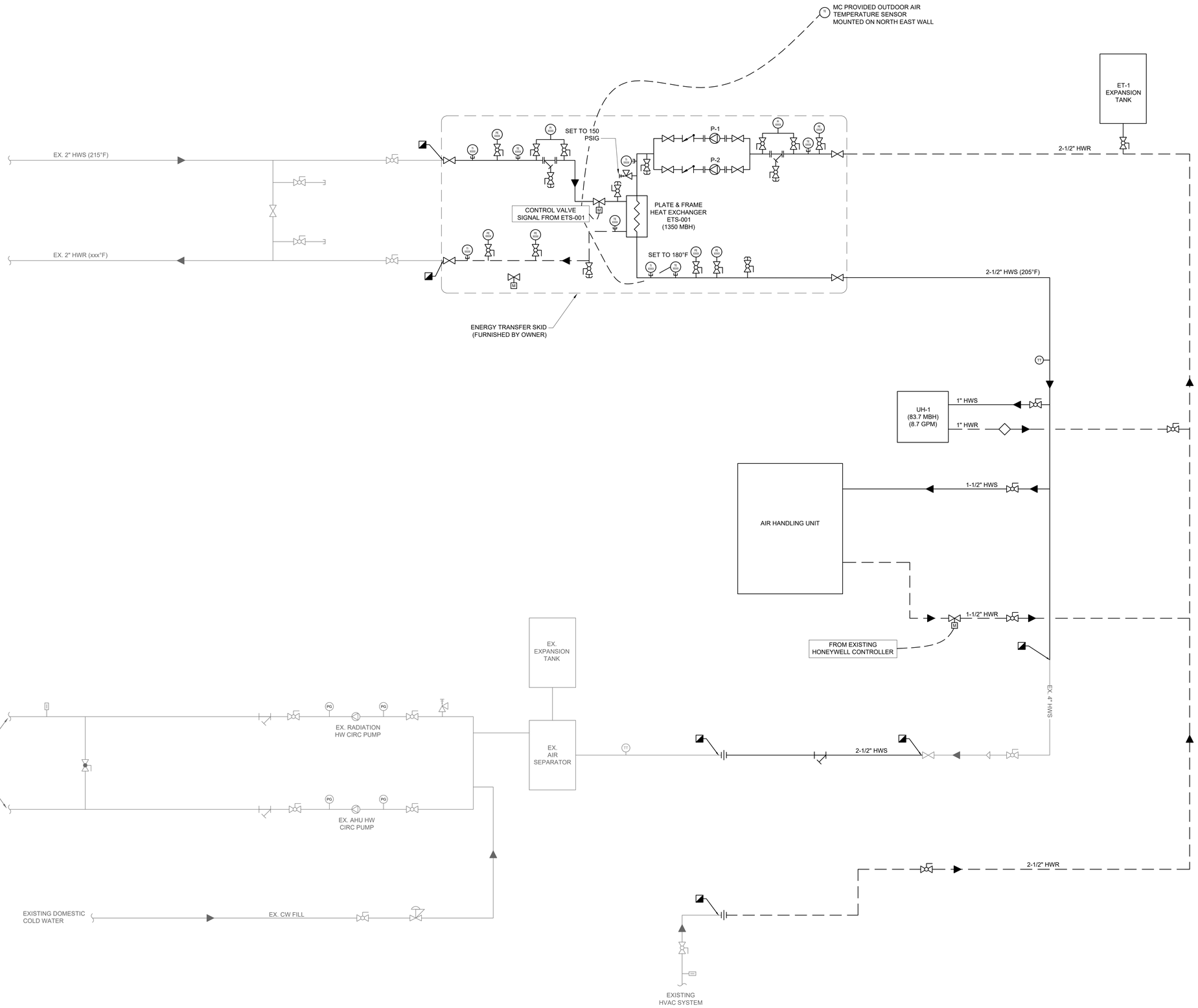

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PIPING AND INSTRUMENTATION DIAGRAM

M700

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