23 09 23 – Thermal Utility Metering

1. Introduction

   A. This Design Guideline covers utility metering and utility building entrance requirements for chilled water, heating water, condenser water and steam system entrances.

   B. Designers should coordinate with Duke FMD on installation requirements where needed.

2. References

   A. Refer to the following Design & Construction Standard sections for reference, as needed:

      a. 23 21 13 Building Mechanical Piping
      b. 23 61 00 Chilled Water and Heating Hot Water Systems
      c. 23 22 13 Building Steam & Condensate Piping Systems
      d. 23 07 16 – HVAC Piping and Equipment Insulation.
      e. A33 63 00 Steam Energy Distribution
      f. Division 23 Appendix Duke-Siemens Graphics Standard

3. General Requirements:

   A. Duke FMD operates district energy and water systems to provide power, heating, and cooling utilities to University & Health System campus facilities. The metering applications listed below, and the resultant data are critical to the successful operation, maintenance, and sustainability goals of the campus, and as such, are critical to building design.

   B. The district energy utility metering equipment listed in this guideline are the only devices currently approved by Duke FMD for use in existing and new construction. **Any variance in design, hardware, or equipment, other than those provided in this guideline must be approved by Duke FMD.**

   C. For all applications, designers should take care not to oversize hardware based on extreme operating conditions or unnecessarily conservative load calculations; rather, selecting metering hardware that meets the normal minimum and maximum loads anticipated by the facility through a normal operating year. Under no circumstances will Duke FMD accept “line-sizing” as a justification for meter / sensor hardware selection.

   D. For all applications, designers shall follow manufacturer instructions for installation, grounding, termination, access, and maintenance.

   E. Insulation shall be installed in a method where the insulation can be removed to access and service the devices and meters for maintenance.

   F. For all device / sensor applications as part of the utilities metering package, designers shall coordinate with Duke FMD on developing the list of point names, alarms,

notification groups and classes, return-to-normal, conditional pre-requisites, and escalation requirements.

G. For metering and valve elements of the utilities package, designers shall include instrumentation tagging, asset name and detail reporting, and designation of the parent asset to the owner project team.

H. All utility metering hardware, valves, and isolation devices should be installed in locations and orientations that allow personnel access to calibrate, maintain, and replace these devices.

I. In critical locations where sensors, meters, or valves are installed above leak protection pans or hardening for an area. The protection design must accommodate for future access to sensors, meters, or valves for calibration, maintenance, or replacement.

J. Designer shall coordinate with Owner Project Manager to define “new” and “demo” devices so the applicable Computerized Maintenance Management System (CMMS) spreadsheets can be filled out and equipment uploaded to the Owners CMMS.

K. Identification of piping. Color-coding of piping shall be in accordance with Duke Construction Guideline 23 07 16 – HVAC Piping and Equipment Insulation.

L. Projects installing a thermal utility metering package shall include a dedicated BAS DUES controller for the monitoring of thermal utility distribution pressure, flow, temperature, and feedback points, to contain calculations for differential and totalization parameters, and control or valves.

M. For all applications where utilities metering and valve equipment has power greater than 48V supplied, Designer will designate install of a manual switched disconnect mounted near the device, the rocker switch will have a weather resistant cover.

N. Graphics

a. Refer to the Duke-Siemens Graphics Standard document in the Division 23 Appendix for engineering units, placement, colors, text and line sizes, and table examples. This is to provide easier service of thermal utility entrance devices and separation of building or plant controls.

b. Graphics will be visible in both Utilities and Application views on both Desigo CC ClickOnce and FlexClient interfaces.

4. Meter Applications

A. District Chilled Water (CHW) and Heating Hot Water (HHW)

a. Design & Installation

i. Main supply and return main piping connections should be provided with flow, pressure, and temperature transmitters for accurate utility metering.
ii. In certain applications, to be discussed with Duke FMD staff, district thermal piping supplied to process equipment should be provided with flow, pressure, and temperature transmitters for submetering of loads.
iii. All energy calculations and conversion should be done in the building automation system software, derived from the below specified hardware for flow, pressure,

and temperature measurement. No standalone “flow computer” hardware should be specified.

iv. All flowmeter electronics with integrated displays must be installed in locations that can be regularly accessed from floor level, without the aid of a ladder or lift. Any variation must be approved by Duke FMD.

v. All temperature and pressure sensors, valves, and flowmeter transducers must be installed in locations and orientations that can be regularly accessed from floor level, or with the aid of a ladder or lift. Any variation must be approved by Duke FMD.

b. Hardware

i. Flow:

a) Base of Design: Katronic Ultrasonic flowmeter
b) Katronic KatFlow Ultrasonic flowmeter model #:

i) KatFlow KF100, provided with transducer set appropriate to pipe size, material, and temperature. 4-20mA passive output for flow range measured in gpm (supply & return) that are powered by the automation system.
ii) KatFlow 150 may be selected for larger pipes and higher temperature range capability as recommended by manufacturer.
iii) Project shall include factory authorized start-up and programming of the meter.
iv) Transducers shall be strapped directly to the pipe. Coupling pads and grease shall be installed per the manufacturer’s instructions.
v) Conditions where expansion and contraction of pipe diameter occurs requires a 1/8” EPDM gasket material only under the flowmeter strap. Strap shall include a stainless-steel spring-loaded clasp to be installed.
vi) Insulation is not required over transducers on heating hot water piping.
vii) Any installation and setup variance other than those provided in this guideline must be approved by Duke FMD.

ii. Temperature:

a) Chilled Water, Condenser Water and Heating Hot Water Base of Design: Reotemp

i) Reotemp 100-ohm Resistive Temperature Device Temperature Sensor (RTD) and transmitter assembly
ii) 4-20mA passive output for the measured temperature range (see below) as a matched pair to be installed on the supply & return headers that are powered by the automation system.
iii) Temperature Ranges and equipment models for each system are as follows:

(a) Chilled Water: 30-90°F, model #RX8TPE1QX-CW
(b) Condenser Water: 30-110°F, model #RX8TPE1QX-CT
(c) Heating Hot Water: 90-220°F, model #RX8TPE1QX-HW

iii. Valves:

a) Basis of Design: Bray International
b) Automated Isolation Valving: Bray Model S70, Modulating valve with a 4-20mA analog input for position command and analog output for position feedback (supply & return).

c) Valve actuator shall use 120V power with a manual switched disconnect mounted near the device, the rocker switch will have a weather resistant cover.
d) Valve control module shall be configured to **fail-open** upon loss of control command signal.
e) Valve body for chilled water, condenser water and heating hot water applications:

i) **3" and smaller:** Ball valve
ii) **4" and larger:** Butterfly valve

iv. Pressure:

a) Basis of Design: Setra
b) Setra model # C206, pressure sensor, 4-20mA passive output for the 0-200 psi pressure range (supply & return) that are powered by the automation system.

c. Data Acquisition and BAS Integration

i. District Chilled Water and/or Heating Hot Water meters and associated transmitter hardware are to be connected to the Siemens building automation system. Designers, contractors, and integrators should discuss instantaneous and totalized data capture intervals, specific BAS programming coding requirements, and long-term data storage requirements with Duke FMD.
ii. Gauge pressure sensors for Supply and Return CHW and HHW will be used to calculate a differential pressure value for each package.
iii. All thermal utility CHW, CW, and HHW points will be set to trend.
iv. Device instance number, BACnet name, and panel IP address for each thermal utility package point will be submitted to the Duke Automation Team.

B. District Steam and Condensate

a. Design & Installation

i. Main district steam (STM) supply piping connections to campus buildings shall be metered.
ii. In certain but atypical applications, to be discussed with Duke FMD staff, district steam utility should be metered.
iii. In certain applications, to be discussed with Duke FMD staff, district steam supplied to process equipment should be provided with flow, pressure, and temperature transmitters for submetering of loads.
iv. All energy calculations and conversion should be done in the building automation system, derived from the below specified hardware for flow, pressure, and temperature measurement. No standalone "flow computer" hardware should be specified.
v. Manufacturer recommended diameter and length of reference lines, valve and fill assemblies, and blowdown lines shall be installed to maintain accuracy of the flow body and pressure measurement device. Designer shall provide the procedure to blowdown the assembly for maintenance.
vi. All flowmeter or pressure electronics with integrated displays must be installed in locations that can be regularly accessed from floor level, without the aid of a ladder or lift. Any variation must be approved by Duke FMD.
vii. All temperature and pressure sensors, valves, isolation devices, and flowmeter components must be installed in locations and orientations that can be regularly

accessed from floor level, or with the aid of a ladder or lift. Any variation must be approved by Duke FMD.

b. Hardware

i. Steam Flow:

a) Base of Design: Armstrong
b) Veris Accelabar differential pressure flowmeter, single transmitter option. Apply to piping 2” NPS and larger:

i) For horizontal installation arrangements, provide with integral transmitter port valves and direct mount transmitter.
ii) For vertical (upward flow) installation arrangements, provide with integral port valves and remote mount transmitter kit.

c) For all material and installation requirements for steam systems, refer to Duke Construction Guideline Sections *23 21 13 Building Mechanical Piping* and *23 22 13 Building Steam & Condensate Piping Systems.*

c. Data Acquisition and BAS Integration

i. District steam meters and associated transmitter hardware are to be connected to the Siemens building automation system. Designers, contractors, and integrators should discuss instantaneous and totalized data capture intervals, specific BAS programming coding requirements, calculations, and long-term data storage requirements with Duke FMD.
ii. All thermal utility steam points will be set to trend.
iii. Device instance number, BACnet name, and panel IP address for each thermal utility package point will be submitted to the Duke Automation Team.

C. Instrument Identification – Field Mounted Instrumentation Tags

a. Tags for Instruments (inclusive but not limited to control valves, meters, and sensors:

i. Tags shall be stainless steel, AISI 300 or 400 series. These shall have nominal minimum size of 1.75 x 2.75 inch and be of 26 ga minimum thickness (This is the minimum size needed for vendor to install owner-provided CMMS sticker on reverse side of tag.). Size may be adjusted in accordance with the size of the device to be tagged. Initial size to be 3/16” with final size to be coordinated with Duke FMD. 5/64" mounting holes shall be punched 1/4" from each end for mounting.
ii. Critical instrument tags (control valves and sensors used to control) shall be red. Utilize silver/metal color for monitoring only sensors.

iii. See example tag below:

b. Identify control valves, meter, and instrumentation sensors with rectangular stainless (SS) tags bearing system identification number and panel that controls the device in 3/8” to 1/2" black characters on one side of tag only. Attach tag to instrument with SS jack chain, SS ring, or SS braided wires with swag sleeves and "S" hook. Non-metallic fasteners are not allowed. Unless otherwise noted, device numbering shall match the Schedule and / or Points List on the Drawings.

c. Owner will provide the naming and asset template tracking spreadsheet to the designer.

d. Owner will furnish CMMS (EAM) sticker, and the vendor will install stickers on the back side of the metal tag.

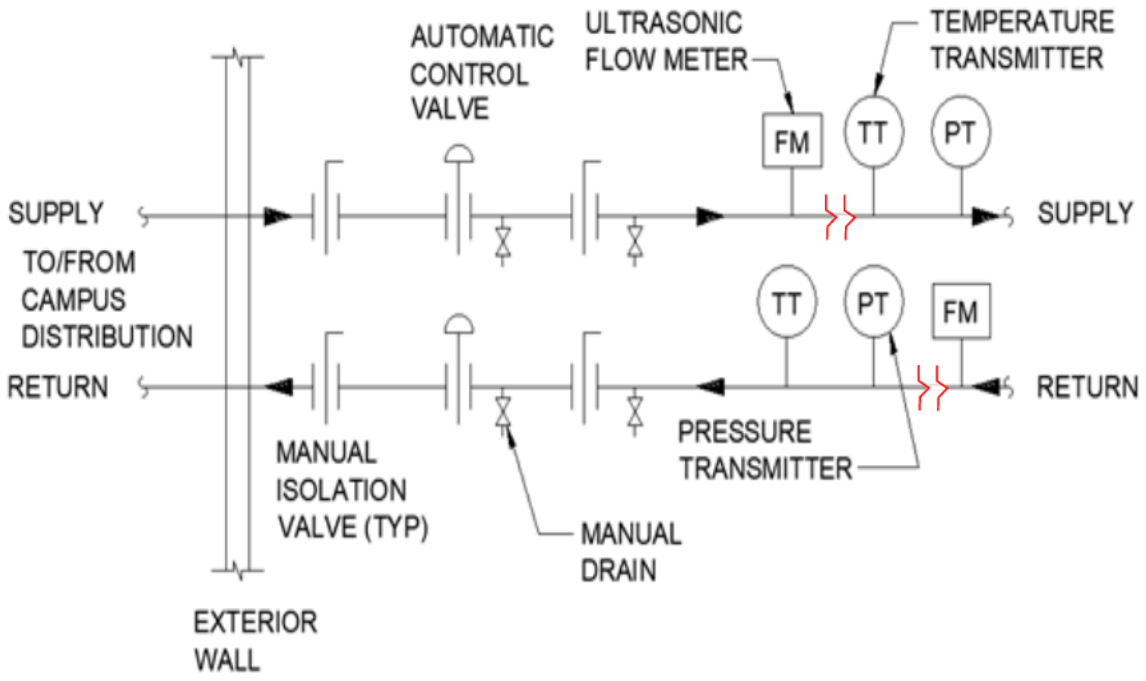
e. Label all new utility metering, monitoring, and control devices.

f. Affix tag to permanent part or body of instrument, not to removable part such as lid, or as directed by Owner.

g. Do not mark on instruments with permanent markers, i.e.: felt pens or paint sticks.

5. Meter and Device Installation Details

A. Campus Chilled Water and Heating Hot Water



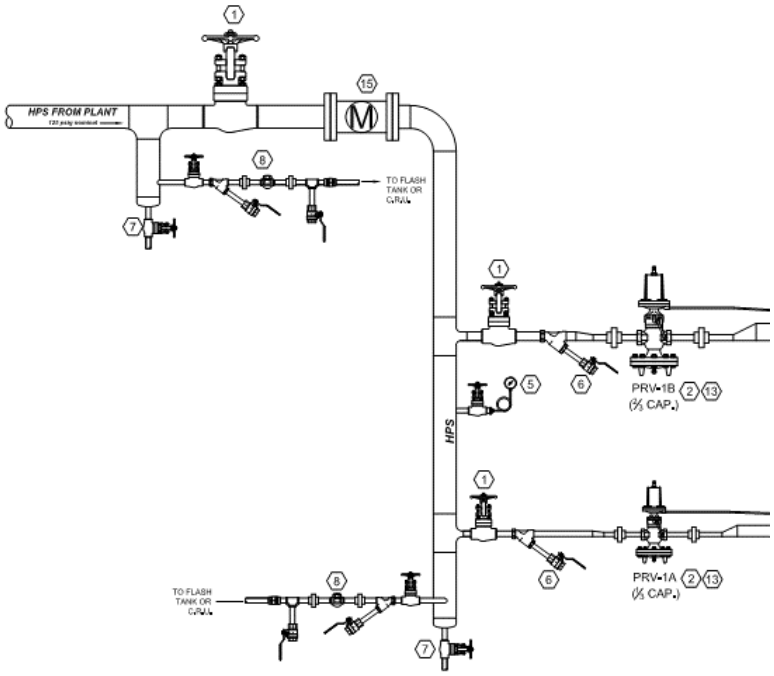
CHILLED & HEATING WATER BUILDING CONNECTION DETAIL

NOT TO SCALE

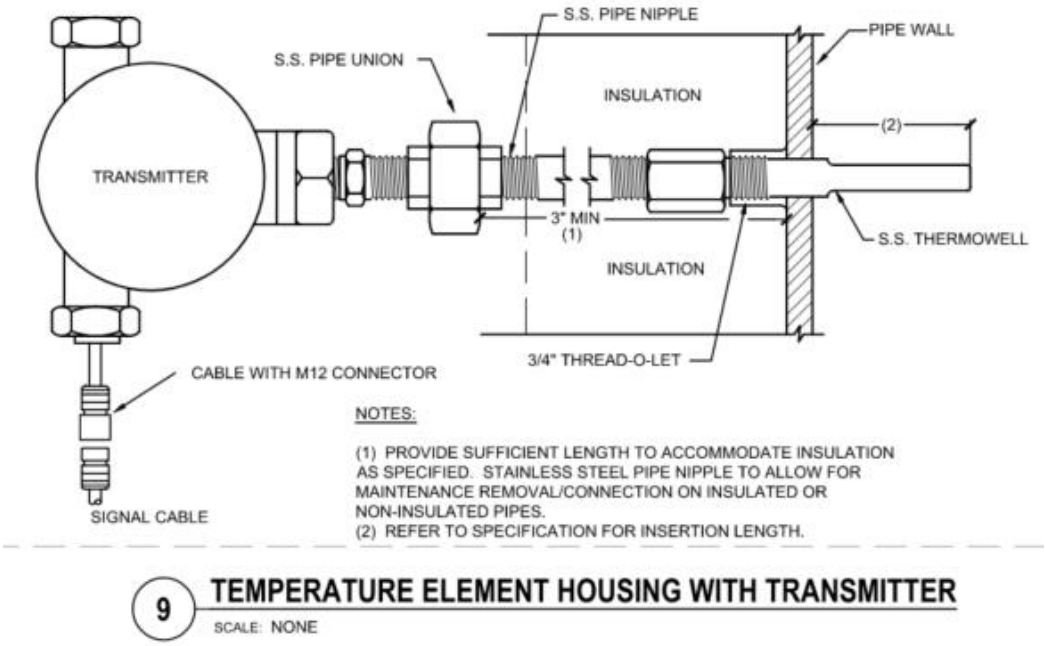
Notes:

1. Follow manufacturer recommendations for meter, thermowell, and sensor installations.
2. Thermowells are considered flow obstructions for flowmeter straight-run requirements.

B. District Steam – Refer to A336300 Steam Energy Distribution for additional details.



C. Temperature Transmitter Assembly

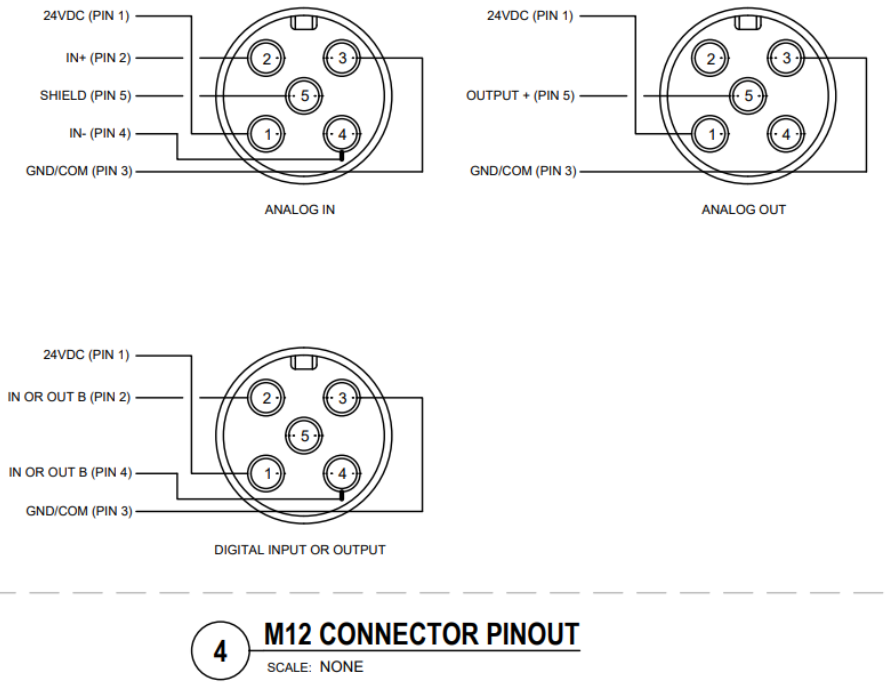


9 **TEMPERATURE ELEMENT HOUSING WITH TRANSMITTER**
SCALE: NONE

Notes:

1. Nipple-union-nipple configuration shall ensure the end of temperature probe fully inserted in the thermowell is in the path of water flow.

D. Temperature and Pressure Transmitter Wiring



Notes:

1. Reotemp and Pressure sensors 4-20ma Analog signal will use a 5 pin M12 connector.
    a. Pin 1 24VDC positive,
    b. Pin 2 not used
    c. Pin 3 24VDC negative return signal,
    d. Pin 4 not used
    e. Pin 5 shield connection to ground.
2. M12 connector shall be ordered as part of the submittal package to be approved by the designer. The M12 connector will be factory installed or included with the sensor / meter to be field installed.
3. The M12 cabling connections from the sensor / meter will be terminated to a five-pole terminal strip. At the end of the conduit transition to the sensor / meter, vendor will add a single gang box matching the rating of the conduit. The twisted shield cable will originate at the control system I/O module and be torqued to the valve set by the terminal strip. The transition to the M12 cabling from the gang box will have a metal compression connector with rubber gasket to provide strain relief for the cable.

Revision History

Date	Changes	Notes
12/17/2025	Minor clarifications of previous	
10/02/25	Modified REO-Temp model numbers and confirmed calibration and operational ranges.	
09/18/25	Dedicated Controller addition, DP calc from gauge pressures and reference to Siemens graphics standard specifications document. Update that information is required on multiple views on Desigo FlexClient and ClickOnce interfaces.	
09/09/25	PI point information to be provided from vendor	
06/05/25	M12 Connectors requirement and pin-out added.	
03/25/25	Bray confirmed as base of design for thermal distribution valve and to use 110V as actuator power. Valve type set on pipe sizes in specification.	
11/14/24	Updated EAM entries and Tag references. Color schemes removed based on other sections.	
10/22/24	EPDM for HHW Flow, electronics working height access, temperature ranges by medium type,	
05/13/24	Update of selection of Katronics KatFlow and move from Siemens Sitrans Ultrasonic Flowmeter as base of design. Update of section of Setra 206 pressure sensor from Setra 209 as base of design.	