DIVISION 22 – PLUMBING

22 0513- COMMON MOTOR REQUIREMENTS FOR PLUMBING

22 0515- EXPANSION FITTINGS AND LOOPS FOR PLUMBING EQUIPMENT

22 0519 METERS AND GAGES FOR PLUMBING

A. UND will purchase and install all meters. The project manager shall contact UND Facilities to install all utility meters, both temporary and permanent. The temp meter shall remain active for the entire project. There shall be no more than 24 hours between the removal of the temporary meter and installation of the permanent meter.

Badger Meter Inc. (BMI) Model 250B (.5” to 1.5”) and Model 228B (2” or 2.5”) (hot water condensate meters) (To be used with new or Billable Accounts)

Installation

1. The installation site should be located in a position where the meter is easily accessible for reading, maintenance and installation.
2. The Badger Meter Inc. meters must be mounted horizontally or upstream vertically.
3. For accurate measurement, the meter must have a straight undisturbed pipe with length of ten (10) pipe diameters upstream and five (5) pipe diameters downstream. If this is not possible, straightening vanes may have to be used.
4. Each meter shall be installed with a check valve in order to prevent backflow.
5. Each meter shall be piped in a fashion that the pipe will be 100% full when condensate flow occurs.
6. Each meter shall be sized properly based on flow and velocity as shown in the following chart.
7. Each meter shall be installed with a Badger Meter Inc. Model 320 Flow Transmitter. The model 320 shall be wired to the building Electro Industry Gauge electrical meter. The Model 320 switch shall be configured for one pulse per 10 gallons.

Specifications
Model 250B and 228B

<table>
<thead>
<tr>
<th>Size</th>
<th>3/4&quot;</th>
<th>1&quot;</th>
<th>1-1/2&quot;</th>
<th>2&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate</td>
<td>1-10 gpm</td>
<td>2-40 gpm</td>
<td>4-80 gpm</td>
<td>10-100 gpm</td>
</tr>
<tr>
<td>Velocity Rates</td>
<td>0.3 Ft/Sec to 15 Ft/Sec</td>
<td>0.3 Ft/Sec to 15 Ft/Sec</td>
<td>0.3 Ft/Sec to 15 Ft/Sec</td>
<td>0.5 Ft/Sec to 30 Ft/Sec</td>
</tr>
<tr>
<td>Temperature (Hot)</td>
<td>221°F</td>
<td>221°F</td>
<td>221°F</td>
<td>221°F</td>
</tr>
<tr>
<td>Gallons per contact with Model 320</td>
<td>10 or 100</td>
<td>10 or 100</td>
<td>10 or 100</td>
<td>10 or 100</td>
</tr>
<tr>
<td>Full scale frequency Hz w/ Model 320 (Hot)</td>
<td>1.7</td>
<td>6.67</td>
<td>13.33</td>
<td>16.66</td>
</tr>
</tbody>
</table>
When connecting to the EIG unit, you need:

Qty. 1 ea.

Badger Meter Inc. Model 250B or 228B
Badger Meter Inc. Model 320
A1026 Power Supply

The application you have already installed would include:

Qty. 1 ea.

Badger Meter Inc. Model 250B or 228B
Badger Meter Inc. Model 320
A1026 Power Supply
350T RF transmitter
WMM Water Meter Monitor

If you want to read the meter via wireless and plug it into the EIG:

Qty. 1 ea.

Badger Meter Inc. Model 250B or 228B
Badger Meter Inc. Model 320
A1026 Power Supply
350T RF transmitter
350R RF receiver which will provide additional output for the EIG

NIAGARA Series MTX (hot water condensate meter) (Existing or Non-billable accounts)
Model 421

Installation

8. The installation site should be located in a position where the meter is easily accessible for reading, maintenance and installation.
9. The Niagara MTX meter must be mounted horizontally with the register on top.

For accurate measurement, the meter must have a straight undisturbed pipe with
length of five (5) pipe diameters upstream and three (3) pipe diameters downstream. If this is not possible, straightening vanes may have to be used.

10. For accurate measurement, the meter must have a straight undisturbed pipe with
length of five (5) pipe diameters upstream and three (3) pipe diameters downstream. If this is not possible, straightening vanes may have to be used.
11. Each meter shall be installed with a check valve in order to prevent backflow.
12. Each meter shall be piped in a fashion that the pipe will be 100% full when condensate flow occurs.
13. Each meter shall be sized properly based on flow and velocity as shown in the following chart.
14. Each meter shall be installed with a Niagra Model 840 switch. The model 840 switch shall be wired to the building Electro Industry Gauge (EIG) electrical
 Specifications
 Model 421 (Hot)

1. UND Steam Service & Condensate Meter Procedure

<table>
<thead>
<tr>
<th>Size</th>
<th>3/4&quot;</th>
<th>1&quot;</th>
<th>1-1/2&quot;</th>
<th>2&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate</td>
<td>1-20 gpm</td>
<td>2-50 gpm</td>
<td>3-85 gpm</td>
<td>4-130 gpm</td>
</tr>
<tr>
<td>Velocity Rates</td>
<td>0.602 Ft/Sec to 12.033 Ft/Sec</td>
<td>0.743 Ft/Sec to 18.561 Ft/Sec</td>
<td>0.473 Ft/Sec to 13.396 Ft/Sec</td>
<td>0.384 Ft/Sec to 12.43 Ft/Sec</td>
</tr>
<tr>
<td>Temperature (Hot)</td>
<td>250°F</td>
<td>250°F</td>
<td>250°F</td>
<td>250°F</td>
</tr>
<tr>
<td>Gallons per contact with 840 switch</td>
<td>10 or 100</td>
<td>10 or 100</td>
<td>10 or 100</td>
<td>10 or 100</td>
</tr>
<tr>
<td>Full scale frequency Hz w/860 pulser (Hot)</td>
<td>38.57</td>
<td>16.66</td>
<td>14.16</td>
<td>21.66</td>
</tr>
<tr>
<td>Pulse/gallons (Hot)</td>
<td>115.71</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

The purpose of this procedure is to maintain standards for metering of UND steam services and steam condensate returned to the steam distribution system. The standards set forth in this procedure shall be enforced with new construction, existing buildings, and maintenance of steam and steam condensate metering systems.

New Construction:

Temporary Metering:

Prior to construction the project manager shall request a steam service to the construction site through UND Facilities Utility Accountant. A fund number or Org number will be required by UND Facilities Utility Accountant at this time. The UND plumbers shall provide and size the temporary meter. The temporary meter will be provided by UND at no cost project. The temporary meter shall be installed by UND Plumbers. The meter and steam installation shall be inspected and approved by the UND Plumbing Department before the steam is turned on. The temporary meter shall be read by UND Facilities Utility Accountant. The Utility Accountant shall be notified when the meter is to be removed from service by the project manager.

At no time will dumping of steam condensate or venting steam to atmosphere be allowed. Billing penalties may be applied to the project and/or contractor if necessary.

Permanent Metering:

The permanent condensate metering shall be sized and installed based on UND steam condensate standards and the engineer on record for the construction project. The meter shall be provided by the construction project. All condensate meters shall be connected to UND’s automated meter reading system under the construction contract. All equipment and wiring necessary to connect to UND’s automated meter reading system will be provided by the
construction contract. All condensate leaving the facility shall be metered. Once the steam condensate meter is installed UND Facilities Utility Accountant shall be notified by the plumbers. The Utility Accountant shall then inventory and tag the meter. The permanent meter shall be read monthly by the UND Facilities Utility Accountant.

At no time will dumping of steam condensate or venting steam to atmosphere be allowed. Billing penalties may be applied if necessary.

**Existing Buildings:**

The permanent condensate metering for each building shall be sized and installed based on UND steam condensate standards. The condensate meter shall be maintained in accordance with UND condensate meter maintenance procedures. The UND Plumbing Department shall be responsible for meter installation and maintenance. If provisions are available, the condensate meter shall be connected to UND’s automated meter reading system.

The Utility Accountant shall be responsible for inventory and tagging of the meter. The meter shall be read monthly by the UND Facilities Utility Accountant.

At no time will dumping of steam condensate or venting steam to atmosphere be allowed. In the event condensate must be dumped for emergency of maintenance purposes, the Communications Center shall be notified when dumping of the condensate began and when dumping of the condensate halted. The communications center shall also notify the UND Steam Plant and UND utility accountant.

**Steam Customers:**

The permanent condensate metering for each steam customer shall be sized and installed based on UND steam condensate standards. The condensate meter shall be maintained in accordance with UND condensate meter maintenance procedures. The UND Plumbing Department shall be responsible for meter installation and maintenance. If provisions are available, the condensate meter shall be connected to UND’s automated meter reading system.

The Utility Accountant shall be responsible for inventory and tagging of the meter. The meter shall be read monthly by the UND Facilities Utility Accountant.

Dumping of steam condensate or venting steam to atmosphere is not allowed. Billing penalties may be applied if necessary. In the event condensate must be dumped for emergency of maintenance purposes, the Communications Center shall be notified when dumping of the condensate began and when dumping of the condensate halted. The communications center shall also notify the UND Steam Plant and UND utility accountant.

An annual inspection of each billable meter shall be conduction by UND Facility Plumbing department to determine condition of metering, piping, and maintenance needs. The UND Facilities PM system shall generate the work order for each annual inspection.
**Meter Size and Installation Requirements:**

The meter size and type shall be determined by UND Plumbing department or the engineer on record for a project. Each Condensate meter shall have a local register and must have an electrical contact output that will pulse each 10 or 100 gallons. The contact output shall be connected to the UND automated meter reading system.

See “Condensate Meter Policy Exhibit A” for approved meter types, sizes, and installation instructions.

**Meter Maintenance:**

Condensate meter maintenance shall be performed by request of a work order. All condensate meter maintenance labor and material shall be charged to steam line distribution.

A work order may be requested by maintenance personnel, UND Utility Accountant, Steam Customer, building occupant, etc. A work order may be generated for but not limited to, the following reasons:

- Non-working meter
- Meter suspected not to be accurate
- Leaking condensate
- Bad check valve
- Improper piping
- Testing and calibration

When a condensate meter is scheduled for maintenance, under no circumstances shall the meter be serviced in the field. When maintenance is conducted, the existing condensate meter will be removed from service. A new or refurbished; tested and certified condensate meter shall be installed and placed in service. The Facilities Department “Meter Change-out Form” shall be used in this process. The completed “Meter Change out Form” shall be forwarded to the UND Utility accountant.

The condensate meter removed from service shall be taken back to the Plumbers test station for repair, calibration, testing, and certification. Once the meter is tested and certified the meter can then be placed in inventory for use at a later date. If the meter cannot be repaired or certified, it shall be discarded.

**Meter Tagging and Inventory:**

A condensate meter inspection and inventory will be conducted in each University of North Dakota building and each steam customer’s building. The purpose of this procedure is to develop a comprehensive inventory of steam services, condensate meters, number of meters in each building, location of each meter, and identify areas that are not metered (whether a portion of a facility or the facility in whole). The number of condensate meters should equal the number of steam services. The objective of the inspection of the meter assembly is to
determine condition and type of condensate meter, size of meter, condition and proper configuration of piping, and velocity of condensate during discharge of condensate pump.

During the inspection process each condensate meter shall be tagged with a unique meter number. The unique meter number will be assigned to each meter by the “facilities utility accountant”. The “facilities utility accountant” will be responsible for maintaining the “condensate meter inventory” database.

At a minimum, but not limited to; the following information will be collected by the plumbers at each meter location:

1. Building Name
2. Building Number
3. Room Number
4. Steam Service/Meter location
5. Meter Manufacture
6. Meter Model Number
7. Meter Size
8. Meter rated minimum flow rate
9. Meter maximum flow rate
10. Meter serial or meter Number
11. Meter Integrator type: (Gallons – Pounds)
12. Meter Integrator Multiplier
13. Remote Integrator manufacture
14. Remote Integrator Model Number
15. Remote Integrator Location
16. Remote Integrator type: (Gallons – Pounds)
17. Remote Integrator multiplier
18. Proper piping (yes/no)
19. Proper and working back flow prevention
20. Measured condensate velocity (FPS)
21. Other
22. Comments

Responsibilities:

UND Plumbers will be responsible for inspection and collecting meter data at each meter site. Plumbers will be responsible for entering data for each meter on each inspection form.

The Facilities utility accountant will be responsible for provision and collection of inspection forms. The Facilities utility accountant will be responsible for data entry into the database for the “Condensate Meter Inventory”.

Technology Advancement Coordinator will be responsible for review of the compiled data from the inspection and inventory process. From the review it will be determined if the proper type of meter and size of meter is installed in each location.
Demarcation line for building versus steam line distribution:

Below is a chart that displays a separation line showing responsibilities for maintenance and billing purposes. Everything right of the demarcation line should be considered part of the steam distribution system; condensate pump, venting, check valve, condensate meter, etc. Everything before the condensate pump or left of the demarcation line will be the building responsibility and/or the steam customer responsibility.

Chart showing the demarcation line for steam condensate distribution

Chart showing the demarcation line for steam distribution
**Nexus® 1252 Meter**

3. **PRODUCT**

3.1 Power Meters

   A. Power meter shall be multi-function 3 phase solid state unit with ability to connect to either 3 phase, 4 wire wye or 3 phase, 3 wire delta circuits.
B. Power meter shall include two 10-character, alphanumeric passwords, which shall protect the unit from unauthorized tampering.

C. Voltage and current inputs to the meter shall conform to the following at a minimum:
   1. Monitor shall accept input of four (4) independent voltage inputs and four (4) independent current inputs of the stated capacity.
   2. Voltage input shall be 120 volts AC with available option for direct connection to voltage circuits of up to 600 VAC without the use of potential transformers.
   3. Voltage input shall be optically isolated to 2500 volts DC. Shall meet or exceed ANSI C37.90.1 (Surge Withstand Capability)
   4. Current input shall be rated for 5 amps with inputs 2x continuous programmable to any CT range.
   5. Current inputs shall be solid U-Bolt stud inputs with a 10 second over-current rating of 100 amps and a 1-second over-current rating of 300 amps.

D. Power meter shall measure and report the following quantities at a minimum:
   1. Voltage, both phase to neutral and phase to phase, for all three phases; Auxiliary voltage; Phase angles for each voltage relative to each other. One cycle, 50 milliseconds and one second readings shall be available simultaneously.
   2. Current, phase A, B, C, N-measured, and N-calculated; Phase angles for each current relative to voltages. One cycle, 50 milliseconds and one second readings shall be available simultaneously.
   3. Watts (total and per phase), VARs (total and per phase), VA (total and per phase), Power Factor (total and per phase) and Frequency. 50 milliseconds and one second readings shall be available simultaneously.
   4. Accumulated Watt-hr, VA-hr, and VAR-hr; Watt-hr received; Watt-hr delivered. VAR-hr and VA-hr reading shall be stored in each of the 4 quadrants of power.
   5. Power demand shall be calculated using four (4) different averaging methods: Thermal Average, Fixed Window Average, Sliding Window Average, and Predicted Average. Values for all averaging intervals must be available simultaneously.
   6. Power meter shall provide updates of all voltage and current readings at intervals of 1 cycle, 50 milliseconds, and 1 second. Readings shall be available for both metering and control. All specified readings shall be made available via the RS485 ports.
   7. Power meter shall provide time-stamped maximum and minimum readings for every measured parameter.
   8. Power meter shall provide coincident VAR readings for all maximum Watt readings.

E. Power meter shall provide the following accuracies:
   1. Voltage accuracy shall be within less than 0.05% for the 1 second readings and less than 0.1% for the 200 millisecond readings.
   2. Current accuracy shall be within less than 0.025% for the 1 second readings and less than 0.1% for the 200 millisecond readings.
3. Power and energy accuracy shall be within less than 0.06% at unity PF and within 0.10% at 0.50 PF.
4. Frequency accuracy shall be within less than 0.01 Hz for the 1 second readings and less than 0.03 Hz for the 200 millisecond reading.
5. The unit shall have an auto-calibration circuit designed to calibrate the readings using an internal reference. The calibration shall commence upon temperature change.

F. Auto-calibration components:
1. 8 Channel sample/hold, for each at the voltage and current channels.
2. Precision internal references with real-time auto calibration for voltage and current channels.
3. The voltage inputs shall be optically isolated to 2500 volts.

G. Power meter shall provide multiple digital communication ports and support multiple open protocols.
1. Meter shall include four (4) independent, digital communication ports. Each port shall be RS485 architecture. Port 1 shall be user selectable as either RS232 or RS485 architecture.
2. Each port shall be user configurable with regard to speed, protocol, address, and other communications parameters. All ports shall support a maximum communication speed of 115k baud simultaneously.
3. Meter shall have an Ethernet port as an available option.
4. Meter shall have an internal modem as an available option.

H. Meter shall offer both Modbus and DNP 3.0 level 2 plus, open protocols as standard configurations. All instantaneous data, logged data, event data, power quality analysis and waveform information shall be available using these open protocols.
1. Up to 136 measurements shall be able to be mapped to DNP Static points in the customizable DNP Point map.
2. Up to 16 relays and 8 resets shall be controlled through DNP.
3. Meter shall be able to hold 250 events of combinations, of four events that are shall be binary input change, frozen counter, counter change, analog change.
4. Flexible combinations of 4 events such as binary input change, frozen counter, counter change, and analog change shall be available for up to 250 events.
5. Meter shall allow freeze commands.
6. Third party certification shall be available.

I. Power meter shall enable users to perform Flicker analysis and shall comply with the Flicker requirements of EN50160.
1. The unit shall provide users with logging and monitoring for instantaneous Short term readings (PST-10min) and Long term readings (PLT-4 hour).
2. The meter shall be able to log Flicker readings.
3. Flicker shall be available for both 50Hz and 60Hz systems.

J. The ability to view interharmonics, the discrete frequencies that lie between the harmonics of the power frequency voltage and current, shall be available.
1. Frequencies shall be able to be observed, which are not an integer multiple of the fundamental and shall be able to appear as discrete frequencies or as a wide-band spectrum.
2. User shall be able to set a starting point anywhere in the waveform, assuming there will be enough sample points available after the starting point.

K. Power meter shall provide sequence of events capture and recording.
   1. Meter shall have at least eight high-speed status inputs for capturing external events.
   2. All high-speed status inputs shall be monitored at a user set rate from 1 to 8 samples per millisecond.
   3. All changes in status shall be time stamped to the nearest millisecond and placed in an event log with time and event label information.
   4. Event log shall enable users to recreate sequence of events involving external status points.
   5. High-speed status inputs shall be able to trigger waveform recording to the waveform log.
   6. Status inputs shall be configurable for event monitoring, pulse accumulation, or pulse synchronizing.

L. Power meter shall provide a separate IRIG-B input for time synchronizing to GPS time signal.
   1. IRIG-B input shall accept un-modulated time signal input from a standard GPS satellite clock.
   2. Time input shall enable time synchronizing to one millisecond and shall not be subject to network or other delays.

M. Power meter shall provide an external display to accommodate access to readings locally and/or remotely.
   1. Display shall be a three line, LED format, P40N touch screen display, or a LCD format, P60N touch screen display.
   2. The meter shall be capable of providing readings to a P40N, P41N, and P43N series of LED displays simultaneously.
   3. LED displays shall be 0.56-inch size and display shall include 10-character alphanumeric segment to provide legend and scaling information for displayed values. The LED display shall use one communication port.
   4. LCD displays shall be large 320 x 240 pixel displays and shall provide real-time readings, harmonics, waveforms and phasors from power monitors. The LCD display shall be able to display up to 8 meters per display.
   5. Display shall connect to Power Meter via RS485 communications architecture. The communication channel shall be isolated at the display to avoid the introduction of noise.
   6. Display shall be able to be powered directly from Power Meter or from an auxiliary power supply.
   7. Display shall communicate with Power Meter using Modbus protocol.

channels. It shall be capable of being connected up to 5,000 feet from the Power Meter.

8. Display shall be surface mounted for ease of installation.

N. Power meter shall be equipped with non-volatile RAM for recording logs and programming information.

1. Memory options of Standard and Advanced shall be available.
2. Meter shall store historical trending data, power quality data, and waveform recordings in memory.
3. Memory shall be allocated to the various logging functions required. All logging features required shall be simultaneously available at the specified levels. Exercising any one feature at the specified level shall not limit exercising of any or all other features to their full, specified level.
4. Meter shall store all programming and set-up parameters in non-volatile memory. In the event of loss of control power, meter programming data stored in memory shall be retained for at least 10 years.

O. When supplied with appropriate memory option, power meter shall provide historical data logging for trending of measured values.

1. Power meter shall contain two independent data logs.
2. Each historical log shall be user configurable. User may select measured quantities and reading intervals for each log.
3. Each historical log shall record at least 170 days of data where 5 readings are being stored every 15 minutes.
4. One of the historical logs shall be configurable for time of use recording.

P. The monitor shall internally record and store Time of Use.

1. The following Time of Use parameters must be included:
   a. Twenty-year calendar
   b. Four seasons
   c. Twelve Holidays per season
   d. Four TOU schedules per season
   e. Eight tariff registers
2. The meter must display the following information in real-time when the TOU is enabled:
   a. Current month accumulations
   b. Previous month accumulations
   c. Current season accumulations
   d. Previous season accumulations
   e. Total accumulations to date
3. Full four quadrant accumulations for Watt-hr, VAR-hr, VA-hr and coincident VARs during peak watt demand including max demand, shall be available for each tariff schedule, each season and for total accumulations.

Q. When supplied with appropriate memory option, power meter shall provide extensive power quality monitoring capability.
1. Power meter shall measure and record the magnitude and phase angle of all real time harmonics through the 128th for all voltages and currents. Meter shall provide %THD and K-Factor for all channels.
2. All harmonic magnitude values shall be available through the digital communications ports in real time.
3. Power meter shall capture and record all ITIC/CBEMA quality events.
4. ITIC/CBEMA events shall be date/time stamped to the millisecond. Entries to CBEMA log shall include date/time stamp, duration, and magnitude information. The CBEMA log shall be downloadable through the digital communications ports.
5. The CBEMA log shall hold over 1024 events in a revolving FIFO format.
6. Power meter shall capture and record out-of-limit conditions in a log. Entries to Limits log shall be made anytime a monitored quantity exceeds the user set limit assigned to that quantity.
7. Entries to the Limits log shall be time stamped to the millisecond and include the measured quantity value and label.
8. The Limits log shall hold over 1024 events in a revolving FIFO format.
9. The meter shall incorporate an interface to AI Reports Artificial Intelligence Reporting Software.

R. When supplied with appropriate memory options, power meter shall provide waveform recording to capture and record transients and quality problems on current and voltage waveforms.

1. Meter shall sample waveform at a user configurable rate of 16 to 512 samples per cycle (60Hz cycle).
2. Meter shall hold at least 96 records of waveform recording in non-volatile memory. Each record shall be a minimum of 8 cycles in duration at the highest sample rate or 64 cycles in duration at the lowest sample rate.
3. Each waveform record shall include pre-event and post-event data.
4. Waveforms shall be recorded with time resolution to within one (1) millisecond.
5. A waveform record shall be taken whenever the RMS value of voltage or current exceeds user-set limits.
6. User shall be able to configure meter so that a waveform record shall be taken whenever a status change occurs on any one of the eight high-speed status inputs.

S. Power meter shall have expandable auxiliary Output capability.

1. Meter shall allow connection of external Output modules.
2. Up to four (4) 8 channel external Output modules shall be capable of being powered directly from the power meter. An auxiliary power supply shall be available to power additional Output modules if needed.
3. External Output modules shall be isolated from the power meter and from each other.
4. Output modules shall connect to the power meter using RS485 communication architecture and shall be capable of being placed up to 5000 feet from the power meter.
5. External Output modules shall communicate with the power meter using Modbus protocol. Closed protocols shall not be accepted.

6. External Output modules shall have four to eight channels each and shall allow the use of 0-1 mA outputs, 4-20 mA outputs, digital pulse outputs, and control relay outputs.

7. External Output modules shall be able to be added to the meter after installation to provide upgrade capability after the initial installation is complete. Changing the power meter shall not be required to provide this upgrade capability.

T. Power meter shall be programmable by software supplied by the meter manufacturer.
   1. Software shall have a user-friendly, Windows compatible interface.
   2. Software shall operate on Windows 98, Windows NT 4.0, XP, or VISTA operating systems.
   3. Software shall include capacity to program meter, download meter, and analyze downloaded data files.
   4. Software shall store all data in an ODBC compliant database. Data based storage shall include all log and waveform data.

U. Power meter shall be appropriately constructed to provide long life in abusive physical and electrical environments.
   1. Meter shall be housed in an all-metal enclosure with no visible openings and no exposed circuit boards.
   2. Meter shall operate successfully at temperature extremes from –40º C to +80º C.
   3. Meter shall be UL listed.
   4. Meter shall operate with control power from 90 to 276 volts AC/DC. Meter shall have a power supply option to operate with control power of 18 to 60 VDC.
   5. Meter shall have a standard 4-year warranty.

V. Power meter shall be Electro Industries / Gaugetech model: Nexus® 1252 meter.
   1. Approved model number is EIG Nexus 1252-D2-P40N.
   2. For expanded internal memory order option S for Standard and A for Advanced.
   3. Order option –G for 600 Volt phase-to-phase direct connection. Do not specify this option if meter is to be used with potential transformers.
   4. Approved Output modules options list:
      a. INP2 – 56K with Dial-Out
      b. INP200 – 10/100 BaseT Ethernet
      c. 1mAON4 – 4 analog outputs, 0-1mA
      d. 1mAON8 – 8 analog outputs, 0-1mA
      e. 20mAON4 – 4 analog outputs, 4-20mA
      f. 20mAON8 – 8 analog outputs, 4-20mA
6. For specification information, contact Electro Industries/GaugeTech at:

Electro Industries/GaugeTech
1800 Shames Drive
Westbury, NY 11590
Phone: 516-334-0870
Fax: 516-338-4741

22 0533 HEAT TRACING FOR PLUMBING PIPING

A. SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

2. Heating Element: Pair of parallel No. 16 or No. 18 AWG, tinned, nickel-coated, stranded copper bus wires embedded in cross-linked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

B. CONSTANT-WATTAGE HEATING CABLES

1. Retain this article for snow and ice melting on roofs and in gutters and downspouts.

C. CONTROLS

1. Pipe-Mounted Thermostats for Freeze Protection:
2. Precipitation and Temperature Sensor for Snow Melting on Roofs and in Gutters

22 0548 VIBRATION AND SEISMIC CONTROL FOR PLUMBING

22 0553 IDENTIFICATION FOR PLUMBING AND EQUIPMENT

A. Valves shall be identified with a brass tag with brass ball-chain affixed to each valve indicating its enumeration and marked on the “As Built” as a legend which indicates
what each numeral value serves accordingly. The legend will be provided to UND’s Preventative Maintenance Coordinator.

B. Valves that are hidden from view behind ceiling tiles/access panels shall be indicated with color coded round stickers placed as near to the valve location as possible on the ceiling grid/panels. Color codes shall be as Follows:

1. Dom Cold water: Blue dot
2. Dom Hot water: Green dot
3. Dom Hot recirc: Green dot
4. Natural Gas: Yellow dot
5. Compressed air: Black dot
6. Hot water heat: Orange dot
7. Steam/Condensate: Gray or Silver dot
8. Sprinkler: Red dot
9. Chilled water: Purple dot

C. Piping Identification:

1. Contents and direction of flow on all piping (steam, gas, water, condensate, etc.) shall be identified by labeling.
   a. Labels on piping up to 1-1/4” size shall be a minimum 1/2” high.
   b. Labels on piping larger than 1-1/4” size or pipe covering shall be a minimum of 1” high.

Labels shall be applied at all points where pipes pass through walls, at each change of direction and on each 20 feet of straight lengths.

2. Pipe identification shall be as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>ABBRV.</th>
<th>Pipe Color</th>
<th>Lettering Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Water (Domestic)</td>
<td>DCW</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>Hot Water (Domestic)</td>
<td>DHW</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>Hot Water Return (Domestic)</td>
<td>DHWR</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>Reverse Osmosis</td>
<td>RO</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>Tempered Water (Domestic)</td>
<td>DTW</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>Storm Drain</td>
<td>STORM</td>
<td>Gray</td>
<td>White</td>
</tr>
<tr>
<td>Sanitary Drain</td>
<td>SAN</td>
<td>Gray</td>
<td>White</td>
</tr>
<tr>
<td>Vacuum</td>
<td>VAC</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>COMP AIR</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>GAS</td>
<td>Black</td>
<td>White</td>
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<tr>
<td>115 PSIG Steam</td>
<td>STM-115</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>60 PSIG Steam</td>
<td>STM-60</td>
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<td>White</td>
</tr>
<tr>
<td>15 PSIG Steam</td>
<td>STM-15</td>
<td>Black</td>
<td>White</td>
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<tr>
<td>Low Pressure Condensate</td>
<td>LP COND</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>High Pressure Condensate</td>
<td>HP COND</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Pumped Condensate</td>
<td>PCOND</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Condenser Water Supply</td>
<td>CONDWS</td>
<td>Green</td>
<td>White</td>
</tr>
</tbody>
</table>
Condenser Water Return  CONDWR  Green  White
Chilled Water Supply    CHWS  Green  White
Chilled Water Return   CHWR  Green  White
Chilled Water Glycol Supply  CWGLS  Green  White
Chilled Water Glycol Return  CWGLR  Green  White
Heating Water Glycol Supply  HWGLS  Green  White
Heating Water Glycol Return  HWGLR  Green  White
Heating Water Supply  HWS  Green  White
Heating Water Return  HWR  Green  White
Fire Sprinkler Piping  FIRE SPRINKLER  Red  White
Radioactive  Radioactive  Orange  Black
Toxic  Toxic  Orange  Black
Foam  Foam  Red  White
Carbon Dioxide (Co²)  Carbon Dioxide  Red  White
Halon  Halon  Red  White

22 0716 PLUMBING EQUIPMENT INSULATION

A.  Steam and condensate piping in areas prone to flooding, such as steam vaults, shall be piped using “Foam Glass” wrapped in a metal jacket.

B.  For High Temperature Equipment Insulation for equipment inside the building in conventional equipment rooms the following shall apply:

   a.  All steam valves including control valves, expansion joints and the access end of strainers shall be covered with a custom fabricated insulation jacket secured around the fitting. Insulation Systems will be custom designed and engineered for each individual item which is not a standard product based on type of application, operating temperature, and environment. A close contour fit is essential for proper thermal performance and neat appearance.

   b.  Insulation Jacket shall be constructed of Teflon Impregnated Fiberglass Cloth with a minimum temperature rating to 500°F and Dark Grey in color. Insulation shall be a minimum of one (1”) Inch Thick.

   c.  Insulation jacket shall be secured to the fitting with stainless steel buckle and strap assembly, Grey color, Maximum Temperature Resistance 250°. Insulation Seams which do not tightly butt one another are Not Acceptable.

   d.  All reusable insulation blanket assemblies shall be labeled with laser label. The tagging systems will facilitate installation and reinstallation of all blankets and enable the manufacturer to provide replacements upon request by number assigned as imprinted on the label.
22 0719 PLUMBING PIPING INSULATION

C. All heating and chilled water pipes shall have adequate insulation.

D. Roof drain sumps shall be insulated as specified for fittings.

E. On domestic water, a pipe insulation protection saddle of 22 gauge galvanized sheet metal for piping 3” diameter and smaller, and 18 gauge for piping larger than 3” diameter, shall be provided at every pipe hanger or support. The saddle shall be at minimum length of 10 inches.

1. All domestic piping smaller than 2”, no saddle required below the insulation
2. Both inserts and saddles shall be provided for all piping 2” and larger.

F. Hot and Cold Line Insulation

1. All water piping in tunnels and within the building as well as all rain leaders, including those concealed and in furred spaces or pipe chases, shall be insulated with glass fiber pipe insulation in one piece molded sections, 4 lb. nominal density, and of the following thickness:

<table>
<thead>
<tr>
<th>Application</th>
<th>Pipe Size</th>
<th>Insulation Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold water lines</td>
<td>1-1/2” and less</td>
<td>½”</td>
</tr>
<tr>
<td>Rain Leaders</td>
<td>2” and larger</td>
<td>1”</td>
</tr>
<tr>
<td>Hot water lines</td>
<td>1” and less</td>
<td>1”</td>
</tr>
<tr>
<td>Hot water lines</td>
<td>1-1/4” to 4”</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>120°F - 200°F</td>
<td>5” to 6”</td>
<td>2”</td>
</tr>
<tr>
<td></td>
<td>8” and over</td>
<td>2-1/2”</td>
</tr>
<tr>
<td>Hot water lines</td>
<td>1” and less</td>
<td>1”</td>
</tr>
<tr>
<td>Hot water lines</td>
<td>1-1/4” to 2”</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>201°F - 250°F</td>
<td>2-1/2” to 4”</td>
<td>2”</td>
</tr>
</tbody>
</table>

2. Insulate floor drain sumps and all horizontal sanitary waste pipe and fittings for all floor drains above grade receiving cooling coil condensate.
   a. Insulate horizontal sanitary waste line from floor drain to nearest vertical sanitary riser.
   b. Insulation shall be 1/2” thick glass fiber pipe insulation, 4 lb. density.

G. Unless specified, the application of all insulation shall be in accordance with the manufactures published recommendations.

H. Insulation shall be installed full thickness through all wall and floor penetrations.

I. Insulation shall be installed at full thickness through oversized pipe hangers and supports with appropriate ridged inserts and protection saddles.
J. All insulation work under contract shall be done by skilled, competent workmen familiar with this type of work. All insulation work shall present a neat, finished and workman like appearance.

K. Insulation shall be applied over dry clean surfaces, butting adjoining sections firmly together.

L. All insulation, jackets and PVC coverings shall have a flame spread rating of 25 percent or less and a smoke developed rating of 50% or less.

M. Exterior or Exposed Piping
   1. Apply metal or PVC jacket with 2” overlap at seams and joints.
      a. Seal seams and joints weather tight with manufacturers recommended sealant.
      b. Apply the jacket such that the longitudinal seam is on the bottom of pipe.
   1. When using metal jacket, secure jacket with stainless steel bands every 12” at end joints.

22 1005 PLUMBING PIPING

A. Plumbing piping material shall be soldered, crimped, pressed, threaded, glued, no hub or welded. All parts and materials must be lead free. Victaulic piping may be accepted where it is applicable and code allows. If Victaulic piping is used the system needs to be rated for failure temperatures, not just normal operating temperatures. The engineer of record must provide the failure temperatures for each system and provide a 15-year warranty from the vendor at the failure ratings.

   1. Sanitary System Type: Standard cast iron pipe system or schedule 40 PVC | ABS. If copper is used for drain lines, use only Type "L" hard copper tubing, not DWV weight copper.
   2. Cold & Hot Water System Type: Copper pipe system with all lead free components. Plastic may be used when approved upon request.

B. Service isolation valves should be provided for plumbing systems to prevent shutting down an entire building to work on a bathroom, drinking fountain, etc. All bathroom groups should have isolation valves, all floors should have the ability to be isolated independently and where capable wings of floors should have isolation valves. All isolation valves shall be accessible in ceilings or access panels. Final valve locations are to be clearly identified on mechanical drawings provided to Facilities Management.

C. Pipes penetrating exterior walls must be installed to prevent breakage when building settles or go through expansion and contraction due to temperature changes. Use metallic pipe for five-foot minimum distance outside building perimeter. Prefer spools cast in walls with hubs on either sides, or packed sleeves.
D. Any floor drain or sump pit and associated piping that could potentially be used to
dump hot liquids such as condensate for a temporary amount of time will be of a
metallic material as to not damage the drain, pump or piping. A minimum of 15 feet of
metal pipe is to be used. Pump must be rated for high temperature. UND Plumbing
Shop is to approve the drains; Engineer is to design.

E. At every point where piping and duct work penetrate a floor slab, except slabs on grades,
a cast-in sleeve or other curbing at least 1” high must be provided so that any leakage of
water or liquids must be at least 1” deep in order to spill through floor penetrations.

F. Sump drains shall be piped to the storm sewer, unless prior approval is given by UND
Mechanical Ops Coordinator. If piped outside, the water should not run over any existing
pedestrian walks or driveways. Provide proper slope away from the building for drainage.

G. For future use, main runs of piping shall utilize plugged tees instead of elbows. All plugs
must be anchored, secured, and leak proof but must be available for future use.

H. Valves need to be of quality design and materials to ensure they move freely and seal
tightly after sitting for more than a year and to be of adequate quality in order to maintain
that performance after 20 years. Valves should be constructed of proper materials to
prevent corrosion or rusting, especially with valves exposed to moisture or condensation.
All valve components are to be lead free. Lead free valves with packing nut are required
and a minimum rating of 300 WOG. Provide full-port ball valves at all water lines up to
3 inches in diameter whenever possible. Over 3” can be of the gate or globe style valves.
Butterfly valves will not be acceptable unless approved by UND Mechanical Operations
Coordinator beforehand.

I. Each restroom plumbing fixture supply and drain line tree shall be easily accessible
within a chase with access to the chase through a full height door. Install the chase with
a minimum width of three (3) feet.

J. All pipes should be accessible to work on by use of tunnels, chases, crawl spaces,
accessible ceilings, etc.

K. All floors susceptible to water shall drain to floor drains. Indicate the floor pitch on the
drawings.

L. All building sanitary drainage systems with fixtures below grade shall incorporate
backflow prevention strategies, e.g. backwater valves, knife gate valves or sewage
ejectors.

**22 1006 PLUMBING SPECIALTIES**

A. No roof drains shall be placed over joints.

B. All roof drains shall be run internally.
C. The base of all storm and sanitary sewer stacks shall have a clean-out. Clean-out plugs should be set with a suitable lubricant to facilitate removal.

D. Hose bibs should be provided at 100 ft. intervals for exterior use (frost-proof type). All bibs should be key operated with inside valve control. All cooling towers and air cooled chillers must have a hose bib within 10 feet of its location. This must be approved by the HVAC Systems supervisor.

E. Floor drain design shall include enough slope to provide for proper drainage. This is especially important if ceramic floor tile is to be installed.

F. Refer to Part 1 of the Grand Forks City Code: Chapter XV Waterworks & Sewage Systems: Article 8 Fats, Oils, and Grease (FOG) Control. Any additional changes need to be approved by UND Facilities Management. Check for updated versions at the Grand Forks website.

G. All food service establishments possessing cook sinks, floor troughs, floor sinks, pulpers, extractors (excluding hand sinks), are required to install grease interceptors to prevent the discharge of FOG to the public sewer system. Grease interceptors shall be approved at the time of design. Grease interceptors shall be installed to receive the drainage from plumbing fixtures and equipment with grease-laden wastewater located in food service establishments.

H. Schier and Highland Tank are acceptable grease interceptor brands to use on campus
   1. When a Highland Tank grease interceptor is used, a hot water hose faucet is required to clean out the tank.

I. Grease interceptors are not required for residential users.

J. All food service establishments shall implement and adhere to the best management practices that are part of the city’s FOG control program.

K. Except as provided herein, food waste disposal units shall be removed from all existing food service establishments.
   1. However, a food service establishment may continue to operate a food waste disposal unit provided that it is operated with the use of a screen.
   2. All food waste disposal units are required to have an Insinkerator Mini-Waste Xpress System.
   3. Failure to utilize a screen shall be basis for an order requiring the removal of the food waste disposal unit at the expense of the food service establishment.

L. Food waste disposal units, including grinders, garbage grinders, or garbage disposals, shall not be allowed in any newly constructed food service establishment.
M. To minimize the discharge of FOG into the sanitary sewer system, best management practices shall be implemented by all food service establishments. This includes kitchen practices and employee training that are essential in minimizing FOG discharges. These best management practices are listed in the city’s FOG control program. Food service establishments are required to maintain all grease removal devices in accordance with the language of this article.

N. All new food service establishments shall install grease interceptors in accordance with the Uniform Plumbing Code (UPC).

O. All food service establishments are required to submit the drainage plumbing plans to the environmental specialist or designated representative for approval prior to construction. Failure to submit plans or construct on accordance with approved plans is a violation of this article.

P. New facilities are required to maintain a grease interceptor by this, or other applicable ordinances. The new facilities shall install such a unit prior to commencement of discharge into the sanitary sewer.

Q. If a new food service establishment has no dishwasher but has a triple compartment sink, a mop sink, and hand sinks, the city may waive the necessity of installing an interceptor. The city will determine whether a facility, based upon its operations and kitchen fixtures, shall be required to install an interceptor.

R. The city may also determine whether plumbing fixtures may be connected to the sanitary sewer line separate from the domestic sanitary sewer line. In such Instances:
   1. The separate sanitary sewer line shall be equipped with a cleanout located outside of the building to allow access for sampling.
   2. The city may determine through sampling that the facility’s discharge exceeds the city’s limit for fat’s oils, and grease, whether emulsified or not, of one hundred (100) mg/l. In such instances:
      a. The user shall be required to install an appropriately sized interceptor. The separate sanitary sewer line is to allow easier installation of an interceptor should one be required if there is a significant amount of oil and grease present in the discharge.
      b. This line may be combined with the domestic sanitary sewer at a point after this cleanout.

S. Existing food service establishments not equipped with a grease interceptor shall install an adequately sized grease interceptor when the kitchen is remodeled involving structural renovations in their food preparation area including the sewer system or if the discharge causes excessive grease accumulation in the sanitary sewer.
1. An existing food service establishment changing from one class of facility to another shall be required to install an approved grease interceptor.

T. All grease interceptors shall be constructed in accordance with chapter 4-02 of the Uniform Plumbing Code.
   1. There shall be a minimum of one manhole per ten feet of interceptor length to provide access for cleaning.
   2. Manhole covers shall be gas-tight in construction and have a minimum opening dimension of 24”. Concrete covers are not acceptable.
   3. In areas where traffic may exist, the interceptor shall be designed for the appropriate traffic load.
   4. The access manholes shall extend at least to finished grade and be designed and maintained to prevent surface and ground water from entering the grease interceptor.
   5. The size, type, and location of each grease interceptor shall be approved by the environmental specialist or authorized representative before each installation although interceptors are usually located outside the facilities.
   6. The city is authorized to make determinations of grease interceptor adequacy and need, based upon review of relevant information regarding grease interceptor performance, maintenance, and facility site and building plan review and to require repairs to and modification or replacement of such interceptors.
   7. The minimum approved grease interceptor size is 750 gallons and the maximum approved size is 2,000 gallons, working capacity.

U. Grease traps shall be sized according to fixture volume to allow for proper FOG removal.

V. In the event that an outside grease interceptor is not practical in the new construction, a grease trap(s) shall be required on waste lines leading from kitchen floor drains, mop sinks, food preparation and washing sinks, and other fixtures or equipment where grease may be introduced into the sewer system.

W. Food service establishments that have grease traps or that are required to install them are subject to the requirements below:
   1. The grease trap may be set on the floor or partially or fully recessed in the floor to suit piping and structural conditions. Baffle systems and all other internal pieces shall be removable to facilitate cleaning and replacement, but must be in place at all other times.
   2. All grease traps, flow control, air intake, and interceptors shall be installed to manufacturer’s specifications and shall be provided with proper venting. In
addition, the grease traps shall be installed with sufficient clearance for the removal of trap cover for cleaning.

22 1500 GENERAL SERVICE COMPRESSED AIR SYSTEMS

22 3000 PLUMBING EQUIPMENT

A. Domestic water heaters should be located in a heated area as close as possible to the larger demand sources.
   1. Each domestic water heater shall have a service area of 4'-0” by 4'-0” in front of the unit clear of obstructions.
B. Steam hot water heaters shall be instantaneous. The style installed shall be one that is easy to service, requires low maintenance and has economical parts for replacement. Our requirement for steam water heater is Cemline. For ease of coil removal during maintenance horizontal water heaters are to be specified unless approved by the UND Plumbing Supervisor.
   1. AO Smith or Bradford White is the requirement for gas or electric water heater brands.

22 4000 – PLUMBING FIXTURES

A. The plumbing system shall be designed to provide excellent service to the occupants and incorporate water saving fixtures. The plumbing system shall utilize fixtures and components that are easily replaceable, economical and that have ready local access to replacement parts and components.
B. Fixtures
   1. Floor mounted toilets (1.28 - 1.6 GPF) shall be white, elongated supplied by Kohler with open front seats
   2. Provide wall hung water closets (1.28 - 1.6 GPF) supplied by Kohler with white, elongated, open front seats.
   3. Toilet seats shall be white elongated open front with self-sustaining hinge and no cover.
   4. For non-tank style water closets install automatic flush valves (1.28 - 1.6 GPF) supplied by Sloan.
   5. White Vitreous China Urinals supplied by Kohler are preferred with flush valves (1/2 GPF) supplied by Sloan.
   6. Vitreous china lavatories supplied by American Standard or Kohler.
   7. Moen, Kohler, or Sloan commercial grade faucets with lever handles on all lavatories and sinks.
      b. Use water saver aerators in all sinks and wash basins.
   8. Sloan hands free lavatory faucets with electric power and battery backup.
   9. Moen or Symmons shower valves.
      a. Water saver shower heads should be installed in all shower rooms.
   10. Elkay electric water coolers constructed of stainless steel with bottle fillers.
11. Elkay or Dayton stainless steel kitchen and bar sinks.

C. All laboratories shall be supplied with emergency shower and eye wash stations per code.

D. For a specific list of approved fixtures, see cutsheets located at V:\UND Design Standards\Division 22 – Plumbing\Standard PL Fixtures

22 4300 – HEALTHCARE PLUMBING FIXTURES

A. Lavatories: Typical sink installations are Kohler Greenwich K2032-0 vitreous china white 20-¼” x 18¾” (4” center) vitreous china white ADA lavatory with back-splash and back wall mount. Preference for lavatory faucets is Kohler Triton K-7404-5A complete lavatory faucet with ADA compliant wrist blade handles and aerator. For sinks, we understand that, based on the application, different sinks may be desired. If the design is different from what is listed here, Facilities Management will want to review the recommendation prior to approving, to ensure what is selected will be easy to clean and service.

22 6005 – MEDICAL AIR, GAS AND VACUUM SYSTEMS