The University of Manchester

DIRECTORATE OF ESTATES

PROCEDURE AND INFORMATION MANUAL

EPM PM21 – Energy and Water Metering Specification

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1 Introduction and Purpose

The purpose of this document is to provide advice and guidance on specifying and installing all types of metering for the University. The emphasis is to ensure that the correct meter is selected and that it is installed correctly.

2 Scope

The scope of this specification extends to:

- Facilities Maintenance and Compliance (FMC) staff,
- Projects Team staff,
- Project Managers,
- Project Mechanical and Electrical Consultants,
- Mechanical and Electrical Contractors,
- Meter Maintenance Contractors

3 Document Control

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Version	Date	Reason for change
3	09 June 2025	General re-structuring of the document Update to preferred meter make/models

Document control box	
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4 Roles and responsibilities

4.1 Head of Energy (FMC)

4.1.1 The Head of Energy for FMC will control the Energy and Water Metering Specification and will be responsible for updating the document.

4.2 Project Manager

4.2.1 The Project Manager is only to consider the project to be completed upon receipt of a certificate from Coherent Research stating that all the meters for the project have been commissioned and installed onto the Coherent Data Collection, and that the meter pulse input values have been verified as completed and the fiscal meter total consumption synchronised with the software.

4.3 Project Mechanical and Electrical Consultants

4.3.1 The consultants who design the mechanical and electrical building services for the project must agree with the University the position and number of the electrical and mechanical metering to comply with all current building and upcoming regulations and the University metering specification.

4.3.2 Each consultant will then produce a schematic drawing for each of the services, which will be sent to the University for comments. After which copies will be sent to Coherent Research.

4.3.3 Each consultant will communicate with Coherent Research or a University representative to ensure the correct metering network communications and communications equipment are specified prior to producing a tender drawing for the installation contractors.

4.3.4 Upon agreement with the University and Coherent Research, each consultant will produce metering network tender drawings for the installation contractor to provide the costs to supply and install the metering equipment.

4.3.5 The mechanical pipe schematic for heating should include pipe sizes / flow rate and at each heat meter position should state the number of straight lengths of upstream pipe diameter and downstream pipe diameters to promote laminar flow for heat meter accuracy.

4.3.6 For all communications between the consultant, Coherent Research and prospective M&E contractors the project will be identified with a unique name to identify quotations and for order tracking in case of multiple enquiries for quotations to the suppliers.

4.3.7 The electrical consultant is required to produce drawings of the communications networks highlighting roles and responsibilities for the installation of:

- Daisy linking cabling between electric meters and Coherent netport communications devices,
- Cable links connections between pulse output meters and the Coherent Modbus pulse counters,
- Models wiring to connect inverters and heat meters,
- Fused spur power supply for the IDC units and power supply for any major devices (e.g. steam meters, heat meters),
- Data socket outlets with the connection to the University IT network.

4.3.8 At the start of any Project the electrical consultant will liaise with the University IT network engineers to obtain spare ports in existing computer switches (Failure to reserve spare ports at this earliest opportunity may result in the project having to purchase an additional computer hub switch). At the same time IT networks will be able to issue the IP address for any Ethernet connectivity for metering and any BMS requirements.

4.3.9 The consultant shall be responsible to ensure that all metering is installed as per the manufacturer's instructions and the University specification. (Reference should be made to the University metering specification and the current University metering guide).

4.4 Mechanical and Electrical Contractor

4.4.1 The M&E contractor will be responsible for procuring the metering equipment and its installation, including any cabling, power supplies and data sockets as specified in the tender documentation provided by the M&E consultants.

4.4.2 The contractor will be responsible to ensure that all metering is installed as per manufacturer's instructions and the university specification.

4.4.3 The M&E contractor will include costs to procure the services of the manufacturer representative specialist engineer to commission the metering equipment (It is important M&E contractors do not neglect to account and purchase the manufacturer's commissioning costs with the purchase of the metering equipment).

4.4.4 The M&E contractor along with the installation of the meter, will purchase from Coherent Research the cost to supply and commission the AMR communications to enable the metering equipment to communicate with the Coherent Data Collection Server. The cost will include for setting up the meters on the Coherent Software and an onsite presence. This will enable the commissioning and testing of the meters allowing the commissioning engineer to provide a completed meter handover sheet to the contractor and Project Manager for signing off.

4.5 Meter Maintenance Contractor

4.5.1 FMC employ a contractor to carryout maintenance on university energy meters.

4.5.2 The Meter Maintenance Contractor will liaise with Coherent to provide an onsite presence to enable new meter communications to be commissioned, check the meter pulse outputs, and provide local readings to enable synchronisation of the meter total with the value in the Coherent software.

4.5.3 Micronics Flowmeters Non-Invasive Heat Meter installations can be commissioned in situ under the supervision of the Meter Maintenance Contractor.

4.5.4 The meter maintenance contractor can offer advice to the M&E Consultants and M&E Contractors to enable them to comply with the University's specifications.

5 Compliance Requirements

5.1 Building Regulations Part L

5.1.1 As per the building regulations, energy submetering systems should be installed in new buildings, or when fixed building services are provided or extended in an existing building, and should meet all the following requirements:

- The various end-use categories, such as heating, lighting and cooling, should be submetered in such a way that at least 90% of the annual energy consumption of each fuel can be assigned to an end-use. Detailed guidance on how to achieve this is given in **CIBSE's TM39**.
- Metering should enable the comparison of forecast energy use and in-performance energy and facilitate energy reporting.
- Metering should allow the energy use of different tenants within the building to be individually monitored.
- The outputs of any renewable systems should be separately monitored.
- In buildings with a total useful floor area greater than 1000m^2, automatic meter reading and data collection facilities should be installed.
- CHP plant metering should be provided to measure hours run, electricity generated, and fuel supplied to the CHP unit. Metering of parasitic loads, useful heat output and heat rejection should also be considered.

5.2 Display Energy Certificates

5.2.1 The purpose of Display Energy Certificates (DECs) is to raise public awareness of energy use and to inform visitors to public buildings about the energy use of a public building. DECs provide an energy rating of the building from A to G, where A is most efficient, and G is the least efficient and are based on the actual amount of metered energy used by the building over a period of 12 months.

5.3 Energy Monitoring and Targeting

5.3.1 The University is committed to reducing energy consumption across campus. Metering is an important tool to help the building occupants understand their patterns of usage and identify un-necessary usage. A large proportion of the energy and water consumed by the university cannot be controlled using a Building Management System or other forms of building controls such as lighting control and water management controls. It will be necessary for some academic consumption uses to be monitored to help drive down energy / water consumption within university departments.

5.3.2 Building energy use is available to be viewed by staff and students through the Energy Manager Live online platform. Access can be made available through the FMC Energy Team energyteam@manchester.ac.uk.

5.4 Heat Networks Billing and Information Regulations 2014 (Amended 2020)

5.4.1 The regulations cover most district heat networks and communal heating systems within the UK including England, Scotland, Wales and Northern Ireland. The regulations cover the use of most networks including residential, commercial, industrial and public sector. Residential includes the supply of heating to student accommodation even where the cost of heating is included in the rental terms. It is a criminal offence under MID Regulations in UK to use non- approved meters for billing and MID makes no distinction between primary supply meters and secondary sub-meters used for billing.

5.5 Recharge Information.

5.5.1 The university is required to install accurate metering to enable energy and water consumption to be measured to enable internal and external invoices to be produced.

5.5.2 It is the policy to ensure if requested, Half Hourly data or other consumption information that may be requested by the internal or external organisation is supplied as a hard copy or online using the Coherent Data Collection Server to back up invoice calculations.

5.5.3 It is a criminal offence under MID Regulations in UK to use non-approved meters for billing and MID makes no distinctions between primary supply meters and secondary sub-meters used for billing.

6 Health and Safety (H&S) considerations

6.1 General

6.1.1 Meters will need to be accessed regularly for maintenance, calibration and to obtain readings.

6.1.2 Meter readouts should be installed in easily accessible, safe, locations, ideally below head height to prevent injury from falls or back strain. There have been numerous instances where meters are installed at inappropriate heights or locations.

6.1.3 Consideration needs to be given to provide permanent access from a purposely constructed platform to prevent the future need to use stepladders or the need to construct a temporary platform.

6.2 Electric Metering (University sub meters)

6.2.1 Health and Safety is important to eliminate the risk to life or injury and this includes electric meters. The main risks are:

- Electrocution from the voltage source applied to the electric meter, HV and LV current transformer operated meters. HV metering requires the use of Voltage Transformer. Typical ratios of: - 11KV / 110V or 6.6KV / 110V
- Electrocution from Whole Current connected meters. For most of these meters the maximum continuous rated loading is 100 amps per phase. However, some of the latest meters are rated up to 200 amps per phase.

- Electrocution from the current transformers used to measure phase currents and reduce the output to a safe value to be applied electric meter. Before working with current transformers under load the CTs require to be shorted out. Hence the important of connecting CTs to test terminal blocks or WAGO “linked” shorting terminals.
- Fire and or explosion if the current transformer terminals are left open circuit whilst the phase cable is carrying a load then the induced EMF can cause a heating effect.
- Fire and or explosion there have been instances where a contractor’s electricians have incorrectly connected current transformer, failed to the check connections, or crossed over connections on the meter between the CT and voltage source terminals.

6.3 Steam Metering

6.3.1 The main risks with steam systems / metering are that of Scalding or Burns when equipment needs to be removed.

6.3.2 To ensure no risk of scalding / burns from the removal of steam equipment from pipe work, two valve isolation is required.

6.4 Heat Metering

6.4.1 Heat metering relating to Low Temperature Hot water (LTHW) up to 90°C and Medium Temperature Hot water (MTHW) up to 145°C.

6.4.2 The main risks with hot water systems / metering are that of Scalding or Burns when equipment needs to be removed.

6.5 Gas Metering (University sub meters)

6.5.1 Fire and or explosion - to prevent an unsafe condition occurring which could produce a fire and or explosion, all gas meter pulse outputs are to be galvanic isolated from the monitoring equipment with the use of a chatter box.

6.5.2 Risk of gas escape - All gas meters are to be installed and commissioned to maintain the gas integrity by a suitably qualified gas engineer.

7 Data Collection / Communications

7.1.1 All electric meters are to be connected to a Coherent IDC, Coherent IDCi connected to an Ethernet data socket using RS232 or RS485 cabling with various Coherent Adapters.

7.1.2 Some these electric meters may be connected to a Coherent server using a Coherent GPRS Modem using the appropriate Coherent Adapter. GPRS Modems are moving from using a mobile number for data communication to wireless comms using an IP Address.

7.1.3 The Coherent IDC is to be hardwired to an 8-input channel Coherent Modbus Pulse Counter to collect pulse output meters.

7.1.4 The Modbus Pulse Counter can be daisy linked to up to 31 Modbus devices, such as additional Coherent Modbus pulse counters, Calec ST Modbus heat meter integrators, Danfoss inverter drives etc. The University’s preference is for no more than 20no. devices to be daisy linked.

7.1.5 Pulse outputs from each, gas, water, steam, and air flow meters are to be hardwired using a screened Beldan 2 pair cable to the Coherent Modbus Pulse Counter.

7.1.6 The Coherent Modbus Pulse Counter channel can be used to replicate a pulse input to provide a pulse output for another device. The 8-channel device can be set up to provide up to 4 duplicated pulse outputs from a maximum of 4 pulse inputs.

8 Meter Types

8.1.1 All meters are to be installed as per EPM PM21 and with reference to CIBSE TM 39.

8.2 Fiscal Electric HH Meters

8.2.1 The meter for a new half hourly metered supply will be purchased by the University and installed by the appointed Meter Operator (MOP).

8.3 Fiscal Electric NHH Meters

8.3.1 The meter for a new non-half hourly metered supply shall be purchased by the University and installed by the appointed MOP.

8.4 Electric Meters for Solar Arrays

8.4.1 All solar arrays are to be metered using an Emlite EMP1 meter connected to the Coherent server for remote monitoring.

8.5 University Electric Sub Metering (LV Switchboards)

8.5.1 Before any metering arrangements are authorised and installed, a schematic of the metering layout must be agreed with FMC Energy Team.

8.5.2 Electric meters for monitoring the outgoing ways are to be mounted on a dedicated meter marshalling panel located remote from the LV switch board in an adjacent room or in locked cage to prevent unauthorized access to the switchboard.

8.5.3 The electric meters for all outgoing circuits from the LV switchboard are to be in a meter marshalling panel which includes (fuses and a neutral link) for isolation of the voltage source to each meter and a Test Terminal Block to enable the current transformers to be shorted out.

8.5.4 All LV Switchboard circuits including spare ways for further use will be equipped with current transformers, which should be shorted out before dispatch from the manufacturing facility.

8.5.5 The current transformers shall be connected to the Test Terminal blocks with cables with a minimum size of 2.5mm2. The maximum cable length between the current transformers shall be no greater than 10 meters. For longer lengths the cable size shall be increased. (Refer to appendix - Current Transformer VA burden).

8.5.6 For estimating purposes, the contractor is advised to allow for 4.0mm cables, singles or multicore (maximum 6 core plus earth) to connect to the current transformers.

8.5.7 Each current transformer shall be installed using two separate cables. The practice of using a single cable and linking the current transformer secondary terminals shall not be allowed.

8.5.8 The only electric meter allowed to be installed on to the LV Switchboard is a Schneider PM 5101 Modbus electric meter to monitor each transformer incoming supply. This meter simultaneously displays all three phase currents to aid the University Electrical Team when supplies are either being powered down or re-established. The PM5101 is not remotely monitored to eliminate signal cabling in the switch room

8.6 University Electric Sub Metering (Distribution Boards / Equipment requiring a Current Transformer Operated Meter)

8.6.1 Where an electric meter is required to be installed local to a distribution board an Emlite EMP1 will be installed onto a purpose fabricated metal enclosure (size 470mm Wide x 490mm High x40mm Depth) painted to match the standard University specified distribution board.

8.6.2 The enclosure will house a 3 phase Current Transformer Block, Test Terminal Block and a triple pole and neutral fused switch to isolate the voltage source to the current operated meter.

8.6.3 The Emlite EMP1 electric meter is to be installed on to the enclosure door which shall be hinged and provided with the means to fit a padlock. The door will require two 20mm hole, one for the cables to connect the meter and one for meter communications Cat 5e communications cables. 20mm knock out are to be provide on each side of the enclosure for a stuffing gland and comms cabling.

8.6.4 A suitable enclosure has been designed with the University Electrical Team and is available from Autometers UK Ltd.

8.7 Electric Sub Metering. (Distribution Boards / Equipment requiring a Whole Current Operated Meter)

8.7.1 Meters can be installed to monitor lighting distribution boards and other equipment (duty/standby air compressors, split air conditioning units. which can be isolated to change the electric meter without disruption to users). In such a situation, agreement with the University Energy Team must be authorised to use a 100 Amp Whole Current Electric Meter.

8.7.2 Where authorized by the University Energy Team Emlite EMP1 Whole Current meter will be installed inside a purpose fabricated enclosure (size 300mm Wide x 490mm High x 140mm Depth). A suitable enclosure is available from Autometers UK Ltd.

8.8 Fiscal Gas Meters

8.8.1 All fiscal gas meters are to be installed with a pulse output connected to a splitter box to enable the pulse out to be used by,

8.8.2 The gas supplier to provide monthly AMR readings for invoicing purposes.

8.8.3 A pulse output for connection by hardwire or wireless technology using a Dresser 103- e chatterbox to provide half hourly data to the University Energy Metering System.

8.8.4 A pulse output to connect National Grid equipment monitoring equipment as required.

8.8.5 The project is to liaise with the Gas Supplier to provide a Customer Pulse Output from the fiscal meter. This is chargeable from the Gas supplier.

8.9 Gas Sub Meters

8.9.1 Gas meters will be installed in locations with reference to the University metering guide, CIBSE TM39 and Part L Building Regulations.

8.9.2 Each gas meter output is to be connected using a Dresser chatterbox for remote monitoring. The Dresser chatterbox 103-e is an isolation device capable of connecting 4 imports and having 4 outputs or can be configured for one import for duplicate outputs.

8.9.3 Each gas fired heating boiler is to be fitted with a gas meter.

8.9.4 Each gas fired DWH fired boiler is to be fitted with a gas meter.

8.9.5 The supply to catering equipment is to be fitted with a gas meter.

8.9.6 The supply to laundry equipment (student accommodation) is to be fitted with a gas meter.

8.9.7 Any laboratory or workshop supply is to be fitted with a gas meter.

8.9.8 The designer shall specify to install either an ITRON (ex- Actaris) diaphragm meter or an ITRON MZ Rotary meter or Delta QD gas meter, each fitted with the appropriate pulse output unit.

8.9.9 It is preferred to specify a diaphragm (positive displacement) meter for smaller boiler and if space allows. The diaphragm meter is the most accurate, however their drawback is their physical size, especially the larger capacity meters.

8.9.10 The ITRON Delta QD meter is a low-capacity positive displacement meter used when there is insufficient space for an equivalent through-put diaphragm meter.

8.9.11 To prevent premature failure, it is important the supply to a gas meter is filtered as recommended in the manufacturer's instructions. This is particularly relevant for rotary type meters.

8.9.12 The designer shall specify to install line sized gas meters for all situations. The practice of installing smaller sized gas meters into a gas line to reduce cost is not allowed.

8.9.13 Note: This practice has been carried out previously which has resulted in gas equipment going to lock-out due to pressure reductions within the pipe work at the maximum firing load.

8.9.14 The designer is required to verify which gas meters are to be installed with consideration to the pressure drop across the meter and the most appropriate turndown ratio.

8.10 Steam Meters

8.10.1 Steam meters are to be installed in locations with reference to EPM PM21, CIBSE TM39 and Part L Building Regulations. Such locations to be considered should be:

- The main supply to the building
- The steam supply to LTHW plate heat exchangers
- The steam supply to DHW plate heat exchangers
- The steam supply to autoclaves or any other steam utilising process.

8.10.2 The University can experience high turndown ratios throughout the heating season. The choice of steam meter must consider the turndown ratio against the steam meter cost, especially for large steam pipe sizes.

8.10.3 For pipe sizes 50mm, 80mm and 100mm the Spirax Sarco TVA may be specified. Adjacent to each TVA meter a 240volts socket outlet will be installed for 240 volts / 24-volt DC plug-in transformer. These steam meters are to be supplied with a Modbus RTU output card.

8.10.4 For pipe sizes greater than 100mm the Spirax Sarco IVLA meter is to be specified connected to a Spirax Sarco M800 steam conditioning unit. The device is to be supplied with a Modbus RTU output.

8.10.5 For pipe sizes less than 50mm a Spirax Sarco TFA steam meter will be used. The smallest available size is a DN 25 meter. The steam meter is to be supplied with a Modbus RTU output card.

8.10.6 To ensure metering accuracy the steam meter must be installed with at least SIX straight unobstructed pipe lengths BEFORE the meter and THREE straight pipe lengths AFTER the meter. No tap offs for drain points, tap offs for pressure gauges or thermometer pockets should be located within these straight lengths.

8.10.7 The orientation of the steam flowmeter can influence the operating performance. Installed in horizontal pipe. The meter has a steam pressure limit of 32 bar g, and a 50:1 turndown. If the meter is installed with a vertical flow direction, then the pressure limit is reduced, and the turndown ratio will be affected if the flow is vertically upwards.

8.11 Heat Meters

8.11.1 All heat meters are to be supplied with the manufacturer’s calibration certificates.

8.11.2 Heat meters are to be installed in locations with reference to EPM PM21, CIBSE TM39 and Part L Building Regulations such as:

- Variable Temperature Circuits
- Constant Temperature Circuits
- Hot water generated by renewable equipment i.e. Ground or Air Source Heat Pumps and solar thermal generators.

8.11.3 The installation locations needed to be assessed which reference to separable, identifiable loads.

- Building heating zone orientation, (North, South, East or West facing facades).
- Building zone temperature set point (VT and CT Circuits).
- Time of Use (BMS control of a single large or group of heating circuits using a Time Schedule
- Demand (Heating circuit use controlled by Occupancy Demand)

8.11.4 Heat meters are to be specified to be installed as manufacturer’s instructions. The accuracy of any heat metering installation is dependent on complying implicitly with the manufacturer’s installation instructions.

8.11.5 To ensure laminar flow in the metering section of pipe work the manufacturer will stipulate the required number of upstream pipe and downstream pipe diameters of straight lengths of pipe. Even an insertion temperature probe can disrupt the laminar flow.

8.11.6 Reference should be made to the National Measurement System. Good Practice Guide: - An introduction to flow meter installation effects.

8.12 Non-Invasive Heat Meters (heating and cooling supplies)

8.12.1 The university preference is the use of Rotatherm (ex-Micronics Flowmeters) Non-Invasive Heat Meters to overcome issues with poor installation practices of mechanical contractors when using Invasive Heat Meters.

8.12.2 Non-invasive heating metering installations are the preferred method using Micronics Heat meters suitable for, Stainless Steel, Mild Steel, Copper and Plastic Pipes

8.12.3 Micronics Heat Meter types for heating and cooling applications:

- U1000-HM type where the meter is strapped to the pipe with Gel Pads and clamps for pipe temperatures up to 85C:
  i. 22mm- 115mm Pipe O/D IP54 U1000-HM with Modbus and Pulse Output
  ii. 125mm- 180mm Pipe O/D IP54 U1000-HM with Modbus and Pulse Output
- U1000-HM-WM (preferred over the pipe mounted units) where the sensors are strapped to the pipe with gel pads and clamps whilst the meter is wall mounted in a remote location for pipe temperatures up 130°C.
  i. 22mm- 115mm Pipe O/D IP68 U1000-WM-HM with Modbus and Pulse Output
  ii. 125mm- 180mm Pipe O/D IP68 U1000-WM-HM with Modbus and Pulse Output
- U3300 where the sensors are strapped to the pipe with Gel Pads and clamp whilst the meter is wall mounted in a remote location for pipe temperatures from -20°C to 135°C or -20°C to 200°C dependent upon the heat meter specified.
  i. 50mm -300mm Pipe O/D IP68 U3300 Type B with Modbus and Pulse Output.
  ii. For Pipe O/D greater than 300mm an IP68 U3300 Type B with extra Guide Rail with Modbus and Pulse Output.

8.12.4 To ensure accuracy, the manufacturer recommends 20 pipe diameters of straight pipe lengths before and 10 pipe diameters after the flow meter to promote laminar flow.

8.12.5 The U1000 and U3300 are to be commissioned in situ using the manufacturer’s representative or the University Meter Maintenance contractor having been trained by the manufacturer.

8.12.6 Chiller units for cooling and process cooling outputs of the individual machines are to be metered.

8.13 Invasive Heat meters

8.13.1 All invasive heat meters are to be specified to be installed into the return flow circuit. This is considered as good practice by manufacturers to prompt long in-service life of the flow meter.

8.13.2 Solar thermal plant will be filled with a Glycol / Water mixture. Over time the mixture’s viscosity will change between the time intervals when fluid needs to be changed. To take account of the viscosity changes a Sontex Supercal 531 invasive meter is to be installed.

8.13.3 The Sontex Supercal 531 shall be mains powered fitted with Modbus output for remote monitoring on the Coherent server.

8.13.4 The manufacturer will require the percentage of the Glycol to Water mixture to calibrate the meter for the installation.

8.13.5 The meter shall be installed as manufacturer’s installation instructions taking account of the required upstream and downstream straight pipe lengths before and after the meter for laminar flow.

8.14 Heat Metering for the Renewable Heat Incentive

8.14.1 The Renewable Heat Incentive is now closed for Domestic and Non-Domestic schemes.

8.15 Water Meters

8.15.1 Water meters are to be installed in locations with reference to the guide, CIBSE TM39 and Part L Building Regulations. Such locations include:

- Storage water tank for through put monitoring (Legionella)
- Leakage Monitoring
- Reclaims from United Utilities for makeup water used by steam raising plant water used for laboratory and/or workshop applications.
- Water used for AHU humidity equipment.

8.15.2 A water meter will be installed to every water supply pipe into a property. This may be a water utility billing water meter or a university sub-meter.

8.15.3 University submeters will be an ITRON Aquadis Meter for pipe sizes up to 40mm fitted with a Cyble Pulse Output unit. For larger pipe sizes an ITRON Flostar meter is to be used fitted with a Cyble Pulse Output unit.

8.15.4 A water meter will be installed to the inlet and outlet of every cold-water storage tank to enable leakage monitoring and Legionella monitoring to ensure that there is a regular turnover of the tank contents as defined by the current Legionella regulations.

8.15.5 A water meter will be installed to each cold water make up to supply steam generating systems.

8.15.6 A water meter will be installed to specific laboratory / workshop equipment or process which may require water for a “one shot application “. For example, a Reverse Osmosis Plant or a Helium recovery compressor.

8.15.7 Normally, such processes for chilled water (CHW) applications in laboratories will be fitted with a re-circulated water supply which may have to be chilled. In such circumstances any emergency make-up water supply should be metered should the chilled water process plant fail. This make-up water may not be required to be monitored remotely if the make-up to the process is required infrequently. In this case the water meter will be installed to aid maintenance staff when searching for leakage within a building.

8.15.8 A water meter will be installed to the make-up water supply to a single or group of pressurisation units for LTHW and CHW plant.

8.15.9 A water meter is to be installed to EnwaMatic side stream filters fitted to LTHW and CHW plant to ensure correct operation.

8.16 Compressed Air Meters

8.16.1 Compressed air systems and equipment can waste large amounts of electricity due air leaks in the system or due to inappropriately designed systems.

8.16.2 Large air compressors supplying the general service air for a building shall be fitted with an air flow meter provided with Modbus communication to monitor the airflow whilst comparing the electrical consumption.

8.16.3 Large air compressors used for academic experiments may need to be fitted with an airflow meter as directed by Energy Team. Such an example would be a compressor used to provide air for a nitrogen production plant.

8.17 Danfoss Inverters

8.17.1 Danfoss Inverters are to be supplied with the optional Modbus Output Card. The Modbus output is to be connected to the Coherent IDC. The BMS system can then also have access to the Danfoss Modbus Register Map when Port 502 is enabled on the IDC. The BMS will require the IDC IP Address and Modbus Address for the inverter or other Modbus device.

8.17.2 If an inverter is to be mounted on an open roof plant room space, it should be installed inside an IP68 rated enclosure.

9 Common Installation Errors

9.1.1 **Incorrectly wired** meters can result in measurement errors of up to 75%.

9.1.2 Current transformer ratios have been **incorrectly programmed**. The measurement error will be in proportion to the CT Ratio Error.

9.1.3 A more pronounced error resulting in a greater reduction of perceived energy consumed is when the voltage source applied to the meter is **out of phase** with the current. Hence, the need to carry out a calibration test with the meter under partial load using a calibration instrument.

9.1.4 **Current Transformer VA Burden** - When choosing the VA of a current transformer, the burden of the instrument should be considered. For example, moving iron panel meters require a VA of less than 2.5. Where possible the instrument is remote from the CT, the VA imposed by the length of the connection wires should be taken into consideration.

10 Further Guidance

- CIBSE Guide TM39 Building Energy Metering 2010 ISBN 9781906846114
- CIBSE Guide TM46 Energy Benchmarks 2008 ISBN 9781903287958
- Carbon Trust Metering; Introducing the techniques and technology for energy data management.
- Carbon Trust Advanced metering for SMEs Carbon and cost savings
- The Energy Performance of Buildings (Certificates and Inspections) Regulations (Northern Ireland 2008, SR 2008/170, amended by SR 2008/241, SR 2009/369 and SR 2013/12
- HSE Legionella ACOP Publication: - Essential information for providers of residential accommodation
- Heat Network Billing and Information Regulations 2014
- The Energy Performance in Buildings EU Directive 2006 Articles 9, 10, and 11

11 Meter Technical Specifications

11.1 Electricity Meter – EMP1

Meter variants

Popular meter variants -

EMP1.cx

- CT operated
- Two configurable SO energy pulsed outputs
- Auxiliary control relay
- No display backlight
- IEC optical port

EMP1.ax

- As per EMP1.cx version but Direct Connected

Cellular Communication Module variants (MC12 range)

A range of communication modules using cellular technologies are available -

MC12.t1

- GPRS communications

MC12.q1

- LTE Cat 1 bis communications
- Includes GPRS fallback

LTE Cat 1bis is primarily LTE Cat 1 with a single receive antenna. All the other device characteristics, such as uplink, downlink, data rates and protocols, remain the same. Operates on the extensive population of existing 4G cell base stations and offers a range of network roaming options.

MC12.q7

- LTE Cat M1 communications
- Includes GPRS fallback

LTE-M is a branch of LTE technology built for Machine-to-Machine communication. The benefits of LTE-M include lower power consumption and extended range. LTE-M uses a modified version of the LTE radio protocols.

All communications modules may be used with the SIM or network provider of your choice.

Antenna mounting is simple with a standard SMA type connector being mounted in the rear of the module. The antenna connection is inaccessible to the public once fitted. The design of the module allows wired or stub antennas to be easily fitted.

Communications may be serviced with disconnecting the supply to the meter.

11.2 Heat Meter - ULTRAFLO U1000MKII-FM-WM

Measurement Technique: Ultrasonic, cross-correlation transit time method for flow measurement.

Turn Down Ratio: 100:1

Accuracy: ±1% – 3% of flow reading for >0.3m/s (1 ft/s).

Flow Velocity Range: 0.1m/s – 10m/s (0.3 ft/s – 32 ft/s).

Pipe Range: Available in 2 options. 22mm to 115mm and 125mm to 180mm OD. Note Pipe size is dependent on pipe material and internal diameter.

Pipe Material: Steel, Stainless Steel, Plastic and Copper

Water Temp Range: 0°C – 85°C (32°F – 185°F).

Pulse Output: Pulse or Frequency. Pulse for Volume flow and Alarms. Frequency for flow rate. The pulse output can be configured as a loss of signal or low flow alarm. Opto-isolated MOSFET volt free contact (NO/NC).

4-20mA Output: Optional 4-20mA flow proportional output. Maximum load 620Ω.

Modbus Communication: Optional Modbus RTU slave, RS485 serial link hardware layer. Modbus connection cable is 1m.

External Power Supply: 12V – 24V ±10% AC/DC at 7 watts per unit. Optional plug in 12V power supply.

Electronics Enclosure: IP54.

Input/Output Cable: 5m x 6 core for power in, 4-20mA and pulse out.

Dimensions: 250mm x 48mm x 90mm (10" x 2" x 4")
(electronics + guide rail).

11.3 Heat Meter - ULTRAFLO UF3300

Temperature sensors with UF3300 heat/energy meter.
Improved data logger logs energy and flow all date stamped.
Measurement Technique: Ultrasonic, cross-correlation transit time method for flow measurement and PT100 Class B 4 wire for temperature measurement.
Heat Meter Standard: The Heat/Energy calculation is designed to comply with EN1434 section 6.
Temperature sensors: Clamp-on PT100 Class B 4 wire, range 0°C – 200°C (32°F – 392°F), resolution 0.1°C (0.18°F). Minimum delta T is 0.3°C.
Enclosure: The UF3300 enclosure is IP65 rated.
'A' Transducers: 13mm OD to 115mm OD pipes, IP54 with IP68 option.
'B' Transducers: 50mm OD to 2000mm OD pipes, IP54 with IP68 option.
Transducer Operating Temp: 'A'&'B' -20°C to +135°C. 'A'&'B' Optional Hi-Temp -20°C to +200°C.
Flow Range: 0.1m/sec to 20m/sec bi-directional.
Turn Down Ratio: 100:1.
Accuracy: +/- 0.5% to +/- 3% depending on pipe size for flow rate > 0.2m/s.
Data Communications: USB, supports most USB 2.0 BOM drives.
3 x Pulse Output: Pulse or Frequency. Opto-isolated MOSFET relay.
Max Current: 150mA. Isolation: >100V AC/DC. Pulse for volume flow and alarms, frequency for flow and power rate. The pulse outputs can be configured including: flow totals, energy, loss of signal, low flow alarms.
Volumetric mode: Pulse repetition rates: up to 50 pulses/sec (depending on pulse width).
Frequency mode: Max. pulse frequency: 200Hz.
Flow at max frequency: User selectable.
4-20mA Output: 4-20mA flow proportional output, optically isolated 1500 volts, 620 ohms maximum load.
Power: 86V to 264V AC. Optional 24V a.c./d.c. 1A max.
Languages: 4 user languages including English, German, French and Spanish
CE approved
Data Logging: 100,000,000 data points. 12 named sites. Download via USB to CSV file and export to Excel. Logs application details, time, date, flow rate, forward total, reverse total, flow velocity, flow side temperature, return side temperature, temperature difference, power, total energy, signal quality, signal SNR, signal status.