Heat meters—an introduction.

A heat meter is a device which measures thermal energy provided by a source or delivered to a sink, by measuring the flow rate of the heat transfer fluid and the change in its temperature ($\Delta T$) between the outflow and return legs of the system. It is typically used in industrial plants for measuring boiler output and heat taken by process, and for district heating systems to measure the heat delivered to consumers.

It can be used to measure the heat output of say a heating boiler, or the cooling output from a chiller unit.

A heat meter is composed of three parts; a flow sensor, a matched temperature sensor pair, and a calculator (also known as an Integrator). The sum of the parts is a heat meter.

There are a number of different types of meters:

- **Complete** - the complete heat meter does not have separable sub-assemblies,
- **Combined** - this has three separable sub-assemblies: the flow sensor, the calculator and the temperature sensor pair or a combination of these, and
- **Hybrid meters** - like the combined meter, this has three separable sub-assemblies. The difference is that these are assembled for certification and its certification depends on the separate parts remaining combined.

The flow sensor can be: Mechanical, Ultrasonic or Electromagnetic. Each of these flow sensors has its own advantages and disadvantages.

Flow meters are designed to operate at a nominal flowrate, and should be operated at or just below this flow for most of the time. This is referred to as $qp$ which is defined as the highest flowrate that is permitted permanently for the heat meter to function correctly.

Flow meters will typically be capable of operating at twice $qp$ for short periods of time. This is referred to as $qs$ the highest flowrate that is permitted for short periods of time for the meter to function correctly.

Flow meters can operate at lower flows than the nominal flow. The lowest flowrate that is permitted for the meter to function correctly is referred to as $qi$. Some meters will operate at flowrates below $qi$ but will be outside their calibration range.

The ratio between $qp$ and $qi$, referred to as the turn down ratio, can be as high as 100:1 but may be as low as 30:1.

Pipe size does not always accurately reflect the correct meter to choose, flow rate is more important.
Heat Meter accuracy

As the heat meter operates at its low end of operation the accuracy of the meter reduces and hence it is important to size the meter correctly and as close to the qp point as possible.

Heat Meters and the RHI

The government has introduced the Renewable Heat Incentive (RHI) to support renewable heat generation in the domestic sector. The scheme will offer tariff payments for supported technologies which include MCS (or equivalent)-certified solar thermal systems, ground source heat pumps, air source heat pumps and biomass boilers or stoves with back boilers for use in the domestic sector.

All RHI installations should be made meter-ready. In addition, in some cases, applicants will require metering for payment in order for their systems to be RHI-compliant, whilst in other cases, applicants could be paid extra for monitoring of system performance.

MCS guidelines make three distinct types of meter installation

- **Meter-ready** - All RHI installations should be meter-ready for DECC’s own metering to be fitted to the site if selected.

- **Metering for payment** - Where a heat pump or biomass boiler is installed alongside certain other heating systems or where the installer is advised that the property is a second home, then the renewable heating system shall be metered in order to receive payment under the RHI. See Figure 4 for guidance.
Metering and Monitoring Service Packages - A Customer may install an optional metering and monitoring service package for either a pellet biomass boiler or a heat pump for which they will receive a financial uplift. The specifications for installation of meters as part of these packages are detailed in this section along with any other requirements in order for the package to be installed in a form that is compliant with the RHI.

For information on Metering for payment and Metering and Monitoring Service Packages it is recommended that the MCS document *MCS Domestic RHI Metering Guidance V1.0* is consulted. As a guide the required accuracy of the meters for payment are reproduced below.

<table>
<thead>
<tr>
<th>Sensor type</th>
<th>Accuracy class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat meter</td>
<td>Class 3 Measuring Instruments Directive (MID) [3]</td>
</tr>
<tr>
<td>Electricity meter</td>
<td>Class A MID</td>
</tr>
<tr>
<td>Gas meter</td>
<td>Class 1.5 MID</td>
</tr>
<tr>
<td>Oil meter</td>
<td>Class 1 MID</td>
</tr>
</tbody>
</table>

The section below covers ‘meter ready’ installations only.

**Meter Ready Installations**

Some installations incentivised through the RHI will have DECC’s own metering fitted where the metering data may then be used to allow DECC to evaluate the effectiveness of the policy and data may be shared with MCS.

DECC intends to install meters to monitor the heat output from a renewable heating system, the energy consumed by those same heat sources, and the heat output from any back-up fossil fuel systems. This could require engineers, appointed by DECC, to install a number of heat meters, electricity meters or other energy meters, depending on the specific heating system and manner of installation. In addition, DECC will install a number of temperature sensors to develop an understanding of the behaviour of a range of heating systems, for example temperature measurement of space heating flow and domestic hot water flow. The sensor outputs will be connected to a logger that will store all readings and regularly transmit them to a centralized secure data source.

All RHI-compliant renewable heating installations should be made meter-ready. MCS installers should:

1) **Leave sufficient space for appropriate meters to be fitted in defined locations; Heat pumps**

   The flow meter and return temperature sensor of the heat meter(s) take up the most space and need to be situated on the return pipework between the circulation pump and the distribution system. The required length of straight pipework between isolation valves is 20 times the pipe diameter to enable DECC’s chosen metering to be installed on the return pipework. The table over shows the length of straight pipe required for a number of standard pipe sizes.
Factsheet

Heat Meters and the RHI

<table>
<thead>
<tr>
<th>Pipe Diameter (mm)</th>
<th>Total length of straight pipework required in return pipe (mm)</th>
<th>Total length of straight pipework required in the flow pipe (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>300</td>
<td>175</td>
</tr>
<tr>
<td>22</td>
<td>440</td>
<td>175</td>
</tr>
<tr>
<td>28</td>
<td>560</td>
<td>175</td>
</tr>
<tr>
<td>35</td>
<td>700</td>
<td>175</td>
</tr>
<tr>
<td>42</td>
<td>840</td>
<td>175</td>
</tr>
</tbody>
</table>

For each location where a heat meter is required, a section of pipe of 175 mm should be left for the heat meter temperature sensor in the flow pipework. This should be no more than 2 m from the flow meter.

2. Install low pressure-drop isolation valves to avoid the need to drain systems when fitting heat meters; These should be installed at each point where heat metering is required. Heat metering installed between the isolation valves should be able to record the total heat output from the heating system (excluding individual room heaters and immersion heating, the latter of which will be monitored through electricity sensors). Therefore, if there are several return pipes connected to a renewable heating installation, then each one will need to be heat metered, and each one will need to be fitted with isolation valves with sufficient separation to allow heat meters to be installed.

3. Leave sufficient pipework accessible, i.e. not boxed in or under floor boards, to enable meters to be fitted;

Feedback information about the installation

DECC will need to know a number of factors about a site so an application will not be considered to be “meter-ready” if such information has not been provided. The information shall include the following:

To be fed back to MCS through the Compliance Certificates:
Whether it has been possible to make a system meter-ready in accordance with the above requirements and, if not, the reason why;

To be reported to the Customer as part of the document pack (so that the Customer can respond to DECC questions at a later date):
Whether the thermal transfer fluid in any metering location is composed of water or a water/inhibiter/antifreeze mixture and what are the components of the mixture concerned;
Whether the heat pump provides hot water and whether this is also heated with an immersion heater, solar thermal or other system;
Whether the heat pump has a single-phase or three-phase connection.

Notes on making an installation ‘meter ready’

Heat meters that have been used by DECC in their metering programmes in the past have required a mains electricity connection. Therefore, at the same time as installing isolation valves for the heat meters, installers should consider the placement of an easily-accessible electricity supply to power the heat meters.
Communications.

Heat meters can have various options in how the information is transferred from the meter to elsewhere. This can simply be a display on the unit itself or a full wired communication system. Kensa can offer three different types of communication:

1) **Local display**— In built display on the heat meter which allows local reading of the amount of heat produced.

2) **M-Bus communications**— A two wire signal cable can be used to connect each heat meter together and back to a central unit. This central unit can be configured to text, e-mail or upload meter readings to a website. The central unit can accept up to 8 heat meters. If the number of meters is larger than this an additional expansion model is required. The system also needs to be within an area where a mobile signal can be obtained.

3) **Wireless**—Readings from wireless units can simply be obtained when a receiving unit passes close by. This is usually by means of a USB stick connected to a power supply or laptop. The readings can simply then be downloaded to the laptop. It does involve the receiving unit being in the vicinity of the heat meter, for example someone carrying the receiving unit and walking by the installation.
Is heat pump or biomass boiler supplying heat to the same domestic property as an additional heating system(s)?

Does the additional heating system(s) at the property only include one or more of the following:
- Solar collector,
- A system that is installed or used so as to heat only one room,
- An air heat recovery device that does not have a heating element
- An immersion heater for a domestic hot water cylinder or any other plant that solely provides domestic hot water
- A supplementary electric heater which is controlled by the same control system as the control system governing the biomass boiler or heat pump?

Is the plant capable of using more than one type of heating fuel. This excludes:
- additional fuel used for ignition purposes;
- different types of biomass for a biomass boiler;
- where the secondary fuel is only used by a supplementary electric heater which is controlled by the same control systems as those governing the biomass boiler or heat pump; or
- where the secondary fuel is only used by an immersion heater for a domestic hot water cylinder or any other plant that solely provides domestic hot water?

Has the applicant advised that the property is classified as a second home, that is occupied for less than 183 days a year?

Has a biomass boiler been installed, has it been installed so as to provide less than 100% of the space heating of the entire domestic property?

Is heat pump or biomass boiler supplying heat to the same domestic property as an additional heating system(s)?

YES NO

Does the additional heating system(s) at the property only include one or more of the following:
- Solar collector,
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Is the plant capable of using more than one type of heating fuel. This excludes:
- additional fuel used for ignition purposes;
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If a biomass boiler is being installed, has it been installed so as to provide less than 100% of the space heating of the entire domestic property?

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Is heat pump or biomass boiler supplying heat to the same domestic property as an additional heating system(s)?

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