Guidance on Measurable Heat & Monitoring Methodology Plan Approval

v.1 May 2020

This guidance may be subject to review and be changed or withdrawn in light of regulatory or legislative changes, future government guidance or experience of its use.

For this guidance to be useful it needs to be updated regularly and maintained with the latest information; so, if you are aware of any other information which may be of use and suitable for the guidance or you believe that some of the information in the guidance is incorrect or outdated, please let us know

Introduction

Installations under the Greenhouse Gas Emissions Trading Scheme ("ETS"), who are applying for free allocation of allowances, are now required to have in place a Monitoring Methodology plan (MMP) as well as the Emissions Monitoring Plan (MP). The MMP requires a number of parameters to be monitored for the purposes of determining free allocation as well as information to understand the efficiency of the installation. Where applicable, Operators need to provide accurate information on the amount of heat produced, consumed, imported and exported as terajoules (TJ) of net measurable heat. While the monitoring of heat for ETS purposes is not new, the MMP now requires the operator to demonstrate a higher level of accuracy of the measurement systems employed than in Phase III.

This guidance explains how SEPA will approve MMPs for installations required to monitor net measurable heat and sets out metering requirements where applicable.

Meeting the Hierarchy for heat flows

Operators must use the most accurate available data sources, these sources are set out in a hierarchy. The hierarchy for heat data is similar to other parameters the MMP requires to be monitored, but there is no reference to approved Monitoring Plans (because heat flows are not relevant for emissions monitoring under the MRR). The hierarchy can be seen in Table 1.

The highest level provided refers only to "readings of measuring instruments subject to National Legal Meteorological Control (NLMC) or measuring instruments compliant with the requirements the Measurement Instruments Directive (MID) or Non-Automatic-Weighing Instruments (NAWI) Directive for direct determination of a data set".

Heat meters in general are not subject to NLMC in the UK. Currently, the MID does not cover heat meters for steam. Therefore, this highest level cannot be reached for sites that have steam

networks. Where steam is used, we will not request a demonstration why the highest in the hierarchy cannot be met.

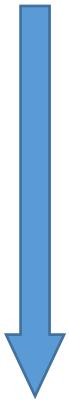
The MID does cover heat meters for use in fluid system (e.g. hot water, glycol, oil), therefore, it is possible to meet the highest in the hierarchy for such systems.

Set out below is the evidence that we would expect to see for metering to show compliance with point (a) and (b) in the hierarchy, since for steam metering, point (b) is the highest level that can be met.

There are two UK schemes which fulfil minimum standards for heat metering for all uses (liquid/steam) which might be applicable in ETS installation: The non-domestic renewable heat incentive(RHI) and the CHPQA scheme.

Highest in the Hierarchy

Moving down the Hierarchy = data sources of lower accuracy



	Hierarchy Method	Example of the type of monitoring
(a)	**Readings of measurement instruments subject to national legal meteorological control or measurement instruments compliant with the requirements of the Directive 2014/31/EU or Directive 2014/32/EU for direct determination of a data set;**	All the site heat consumption is solely for hot water and is monitored by heat meters that (may or may not be owned by the site). The meters comply with requirement of the Measuring Instruments Directive.
(b)	Readings of measuring instruments under the operator's control for direct determination of a data set not falling under point a;	The site has steam metering in place;
(c)	Readings of measuring instruments not under the operator's control for direct determination of a data set not falling under point a;	The site uses steam meters owned and operated by the heat producing facility but the heat consuming facility is in receipt of the allocation.
(d)	Readings of measuring instruments for indirect determination of a data set, provided that an appropriate correlation between the measurement and the data set in question is established in line with section 3.4 of the Annex VII FAR	The site monitors the heat in the product and correlates the amount of heat required to meet this temperature.
(e)	Calculation of a proxy for the determining net measurable heat in accordance with method 3 of section 7.2 of Annex VII	Using the amount of fuel consumed by the heat producing units multiplied by the measured efficiency of heat production from demonstrable evidence or 70%;
(f)	Other methods, in particular for historical data or where no other data source can be identified by the operator is available	Not generally expected to be used;

Table 1: Showing the measurement accuracy hierarchy for net measurable heat and example applications; the hierarchy comes from the Free Allocation Regulation Annex VII Section 4.5

What is measurable heat & what metering is required?

"Measurable heat" is defined in the Free Allocation Regulation FAR (Article 2(7)) as "a net heat flow transported through identifiable pipelines or ducts using a heat transfer medium, such as, in particular, steam, hot air, water, oil, liquid metals and salts, for which a heat meter is or could be installed". Due to the requirement that the heat flow must be determined as a "net" amount, monitoring has to take into account the enthalpy of the heat medium delivered from the heat production unit (boiler house, CHP unit, heat exchanger for heat recovery, etc.) to the heat consumer minus the enthalpy contained in the heat medium returned to the heat producer. A simple diagram of heat flow through a process is in Figure 1.

Therefore, a precise monitoring of heat requires the determination of several parameters:

- Flow rate of the heat medium (most appropriate is the mass flow) to the process
- State of the medium entering the heat consuming process; where "state" includes all parameters relevant for determining the specific enthalpy of the medium:
- Type of the medium (hot water, steam, molten salt or metal, solutions or dispersions of diverse materials, etc.);
- Temperature;
- Pressure (in case of steam or other gases);
- Information on saturation/super-heating in case of steam;
- Concentration for solutions; Etc.
- State of the medium leaving the heat consuming process;
- If the flow rate of the returned medium is different from the forward flow or unknown, suitable assumptions for its enthalpy are required.

Industrial installations sometimes have complex heat networks with several heat sources and a multitude of consumers. Therefore, demonstrating that the highest accuracy in the hierarchy is met is complex.

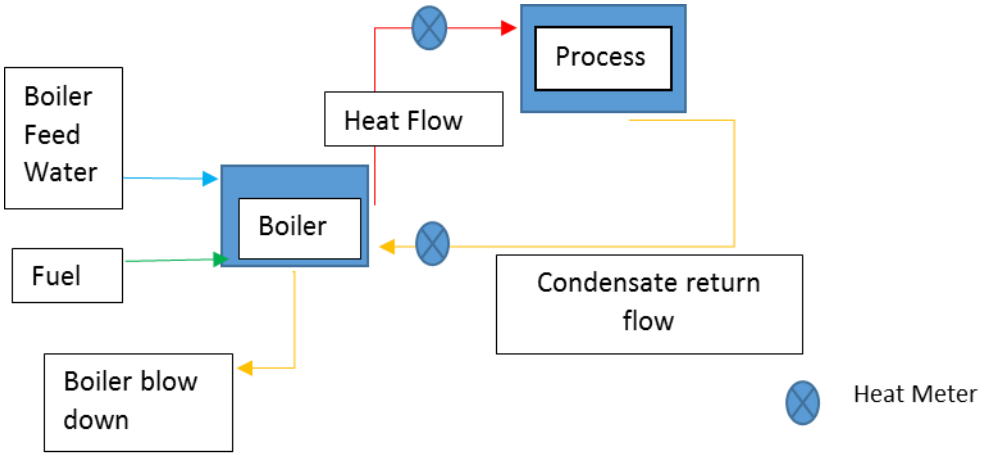


Figure 1: Simple schematic of heat flow through a boiler

Heat Metering – General

A heat meter is a device which measures thermal energy provided by a heat source such as a boiler and delivered to a heat sink such as a central heating system or process, by measuring the flow rate of the heat transfer fluid and the temperature (ΔT) between the outflow and return legs of the system. Heat meters consist of a flow sensor, a pair of temperature sensors, and a calculator (DECC 2016). Heat meters can be in a single meter set up or with multiple meters (see Figure 2).

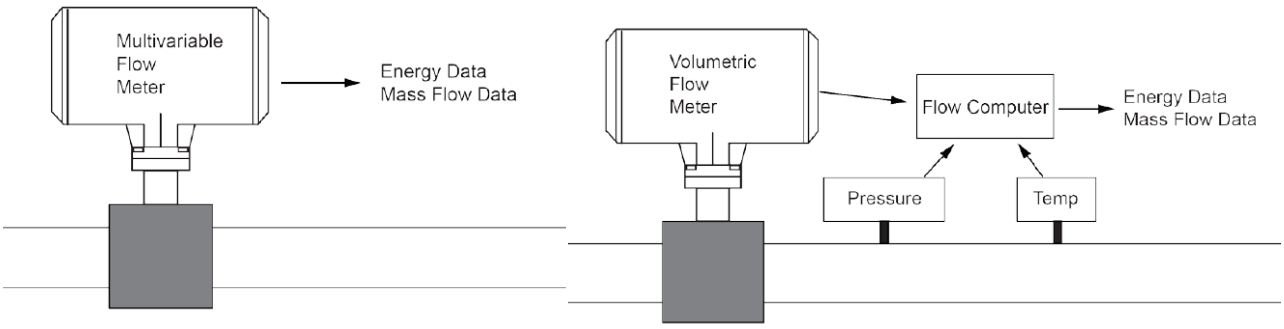


Figure 2 Simple Diagram showing difference between single instrument and multi instrument heat metering.

Annex MI-004 of the MID defines a heat meter as an instrument designed to measure the heat which, in a heat exchange circuit, is given up by a liquid called the heat-conveying liquid. The Directive further specifies that a heat meter can be either a complete instrument, or a combined instrument consisting of the sub-assemblies consisting of the flow sensor, the temperature sensor pair, and the calculator.

The flow rate can be measured by different types of meters, similar to use in other aspects of ETS fuel flow e.g. ultrasonic meters, turbine meters, electromagnetic meters, vortex meters, differential pressure (e.g. orifice plates). Further information on types of flow meters used for heat metering can be found here:

Heat Meter Accuracy – DECC (2016)

Temperature measurement is generally carried out using platinum resistance thermometers or digital temperature sensors. The main variances between different types of heat meters relate to the flow meter.

What are the minimum standards that could be applied?

Summary of RHI & CHPQA Metering requirements

The non-domestic RHI scheme regulations stipulate that heat metering must comply with the specific requirements listed in Annex MI-004 to the MID and fall within accuracy class 2 as defined in the Directive). For steam, the metering will need to comply with accuracy class 2.

The CHPQA schemes have 3 heat monitoring options

- Standalone commercially available heat meters (fully integrated heat meters) manufactured to metrological Class 3 or better as defined in BS EN 1434 –2018
- Heat metering by computation within control systems, i.e. BMS or DCS [use flow and return temperatures and measure flow rate] With an overall uncertainty of +/-2.0% of the value, except for heat outputs from Schemes with total power capacity (TPC) <2MWe where +/-5.0% of value is acceptable
- Schemes with TPC <2 MWe with a have a dump (or trim) cooler are permitted to calculate the heat output from the flow temperature and the return temperature before (upstream of) the dump cooler, with the assumption of a fixed circulation rate that is verifiable from test measurements. The test must show variation in flow is not greater than +/-5.0%.
- For measurement of steam mass flow and energy content, meters with an overall uncertainty of +/-2.0% of full-scale or +/-3.0% of actual readings are required. Where

appropriate, correction for steam pressure and temperature (superheated steam only) is required. The additional uncertainties associated with these corrections and other elements of the measuring system are included in the overall uncertainty.

If an installation is covered by either of these schemes; and the entire heat sub-installation is included within the boundaries of that scheme approval, the Operator can seek to demonstrate that the highest in the hierarchy is met by providing a certificate.

We will check that all the equipment listed in the heat sub-installation is included on this certificate (e.g., the site may have separate heat generating equipment).

Requirements for Heat Measurements to Meet Highest Accuracy at non-RHI/CHPQA Installations

If an installation is not covered by the non-domestic RHI or CHPQA for its measurable heat (or partially covered) then Table 2 contains the metering standard we will accept. This does not apply where the operator can provide an acceptable deviation in the form of unreasonable cost or some other acceptable deviation (see section below on deviation).

Heat Metering – Hot Water

A metering system can meet the highest in the hierarchy. See Table 2 for the evidence requirements:

Steam Metering

As there is no NLMC for steam metering the Operator can implement the next most accurate available data source in the hierarchy WITHOUT providing any evidence to justify deviation – it will be accepted as technically not feasible at the present time.

The installation should instead implement “readings of measuring instruments under the operator’s control for direct determination of the data set”.

SEPA may also consider an alternative proposal to the metering standards set out in Table 2 where it is justified by the operator that the method provides at least a similar level of accuracy.

Justifications for Deviations from the Hierarchy (further details in the MMP Approval Guidance)

Metering may not need to be installed if a justification can be provided under the following:

1. Technical feasibility:
2. Unreasonable Cost;
   The cost of implementing the metering is compared against the benefit.
   The benefit is calculated with a reference of 20Euros per allowance multiplied by an improvement factor:
   Improvement Factor = TJ heat per year* 62.3TJ (heat benchmark)*1%
3. Simplified Uncertainty Assessment

Where the costs are deemed unreasonable or it is technically infeasible to provide metering for the whole installation, we will ask for consideration to providing some level of metering at the installation. For example:

- installing metering for the largest heat consumer,
- installing metering only for selected heat consumers,

A tool to demonstrate unreasonable cost is on the SEPA website.

Table 2: Acceptable Metering for Non-RHI/CHPQA sites

Medium	Level in Hierarchy	Acceptable Metering	Evidence Required
Water	(a)	A standalone metering system that complies with the MID (Class 2 or better). Or By computation using a series of instruments where the overall uncertainty of +/-2% is achieved;	• Evidence of metering Class; or • Evidence of uncertainty achieved; • Installation by a suitably qualified technician; • metering is set up to provide heat consumption, discounting the non-eligible heat uses. For example heat losses (e.g. deaerators, make-up water and blow offs need to be discounted).
Other liquid: Hot Oil/Glycol	(a)	As above but provide evidence of the metering suitability for the application	As above but provide evidence of the metering suitability for the application
Steam	(b)	For measurement of steam mass flow and energy content, meters with an overall uncertainty of +/-2.0% of full-scale or +/-3.0% of actual readings are required. Where appropriate, correction for steam pressure and temperature (superheated steam only) is required. The additional uncertainties associated with these corrections and other elements of the measuring system are included in the overall uncertainty.	• Evidence of uncertainty achieved; • Installation by a suitably qualified technician; metering is set up to provide heat consumption, discounting the non-eligible heat uses. For example heat losses (e.g. deaerators, make-up water and blow offs need to be discounted).
Hot Air	(b)	Please consult SEPA	• Please consult SEPA

Heat Metering – control system

Article 11 of the FAR covers the control system. The MMP requires the operator to have carried out a risk assessment (similar to the MP) of the data gathering and reporting process. They must then establish, document and maintain a control system to ensure that the errors are minimised (preventing misstatements and ensure compliance with the MMP and regulations). Therefore, many of the established procedures for the MP will be applicable for the MMP; with the exception of some items such as heat.

Therefore, we will need evidence that the operator has established some form of control system for the purposes of net measurable heat that includes the following:

- Quality assurance of the relevant measuring equipment; ensuring all equipment is calibrated, adjusted and checked at regular intervals including prior to use and checked against measurements standards traceable to international measurement standards, where available, and proportionate to the risks identified.

For the installations covered by the CHPQA or non-domestic RHI; a calibration schedule will have been generated –; this should be referenced in the MMP at the relevant sections on control systems. We may ask to see this schedule.

For installations which are not covered by the scheme – the MMP must include a reference to such a procedure and a summary which we can ask to review.

Where new metering is being installed, you must ensure that the MMP is updated to include appropriate calibrations to recognised measurement standards.

Where a site is not using heat metering such procedures will not be applicable. E.g. where a proxy of fuel input for heat output is used.

Metering Design/Layout

Net measurable heat is taken to be the heat content of the heat flow transmitted to heat consuming process or external user minus the heat content of the return flow; this means that the metering arrangements must be placed to provide the quantities of heat consumed rather than the heat produced. Therefore, operators need to show that they have taken into consideration the operation of the heat production and distribution system which will result in heat losses (e.g. deaerators, make-up water and blow offs need to be discounted).

The CHPQA and non-domestic RHI require that metering arrangements are set up in such a way to discount non-eligible heat uses such as those described above (see Guidance notes 13 & 16 of CHPQA). Sites covered by these schemes do not require further checks on metering set ups but confirmation should be provided that it is the data provided to the CHPQA/non-domestic RHI for eligible heat use which is being used for ETS reporting purposes.

For other sites, confirmation is required that metering is set up to provide heat consumption, discounting the non-eligible heat uses. New metering systems must also be set up to provide the information discounting non-eligible heat use.

Further Reading:

SEPA Guidance on Monitoring Methodology Plan Approval:

https://www.sepa.org.uk/media/495168/mmp_interim_guidance_for_operators.pdf

CHPQA Guidance Notes specifically 13 and 16 on metering & Heat:

https://www.gov.uk/guidance/chpqa-guidance-notes

Heat Meter Accuracy Testing Report (DECC 2016):

https://www.gov.uk/government/publications/heat-meter-accuracy-testing

BRE report on heat metering (Same authors as DECC report):

https://www.bre.co.uk/heatmetering

RHI FAQ's:

https://www.ofgem.gov.uk/publications-and-updates/domestic-renewable-heat-incentive-frequently-asked-questions-faqs-applicants

Glossary of Terms:

BMS/DCS – Building Management System/Distributed Control System – computerised control system for metering;

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03000 99 66 99

Strathallan House, Castle Business Park, Stirling, FK9 4TZ