HEAT METER INSPECTION INSTRUCTION

1. PURPOSE AND SCOPE

This instruction defines the process required for the measurement inspection of heat meters and the evaluation of whether they are within the MIH values in line with the Ministry of Industry and Technology's Heat Meters Inspection Regulation dated 06.07.2018 and numbered 30470.

It covers the measurement inspection of all heat meters from DN15 to DN40.

2. DEFINITIONS

Heat meter; It is a measuring instrument designed to measure the heat in the heat exchange circuit by means of a liquid called heat conductor.

The heat meter can be a complete meter or a combined or hybrid meter consisting of a combination of flow sensor, dual temperature sensors and calculator.

Complete heat meter: A heat meter that is not subdivided into subgroups such as flow sensor, dual temperature sensors and calculator.

Combined heat meter: A heat meter consisting of a flow sensor, dual temperature sensors and a calculator or a combination thereof, which can be subdivided into these subgroups.

Mixed (Compact) heat meter: A heat meter that can be subdivided into subgroups such as a combined heat meter for type approval and initial inspection, but cannot be subdivided into subgroups after initial inspection.

3. RESPONSIBILITIES

The Inspection Manager is responsible for checking the inspection results and approving the reports,

Heat Meter Inspection Personnel are responsible for conducting inspections, forming reports, submitting them for approval, and stamping the appropriate meters.

4. APPLICATION

4..1 GENERAL

Before starting the inspection, necessary checks of the Test Table are made. The necessary adjustments, operation and inspections of the Test Table are made according to **MT.02 Test Table Operation and Maintenance Instruction**.

1. Inspection of the complete heat meter

1. The accuracy class, $\Delta\Theta_{min}$, $\Delta\Theta_{max}$, q_i and q_p values are read from the meter and the meter is subjected to inspection at each of the following intervals.

For heating applications:

a) $\Delta\Theta_{min} \leq \Delta\Theta \leq 1{,}2\ \Delta\Theta_{min}$ and $0{,}9\ q_p \leq q \leq 1{,}1\ q_p$

b) $10\ K \leq \Delta\Theta \leq 20\ K$ and $0{,}1\ q_p \leq q \leq 0{,}11\ q_p$

c) $\Delta\Theta_{max} - 5K \leq \Delta\Theta \leq \Delta\Theta_{max}$ ve $q_i \leq q \leq 1{,}2\ q_i$

For cooling applications:

a) $\Delta\Theta_{min} \leq \Delta\Theta \leq 1{,}2\ \Delta\Theta_{min}$ and $0{,}9\ q_p \leq q \leq 1{,}1\ q_p$

b) $0{,}8\ \Delta\Theta_{max} \leq \Delta\Theta \leq \Delta\Theta_{max}$ and $0{,}1\ q_p \leq q \leq 0{,}11\ q_p$

c) $0{,}8\ \Delta\Theta_{max} \leq \Delta\Theta \leq \Delta\Theta_{max}$ and $q_i \leq q \leq 1{,}2\ q_i$

2. The temperature of the bath in which the outlet line temperature sensor is to be immersed must be within a temperature range of (50 ± 5) °C for heating applications and (15 ± 5) °C for cooling applications.

3. The temperature of the bath in which the inlet line temperature sensor will be immersed must be $\Delta\Theta$ higher than the temperature of the other bath.

4. The stamped sensor on the meter is removed and both temperature sensors are immersed in the baths prepared at the temperatures specified above in such a way that they are not less than the smallest immersion depth and remain in water.

5. Calibrated etalon thermometers are placed in the temperature baths.

6. The meter is connected to the repair and adjustment station according to the flow direction and put into test mode.

7. The MIH value for each inspection point is calculated as follows.

– Class 1: $E_f = \pm (1 + 0{,}01\ q_p / q)$ not more than ± 5%,
– Class 2: $E_f = \pm (2 + 0{,}02\ q_p / q)$ not more than ± 5%,
– Class 3: $E_f = \pm (3 + 0{,}05\ q_p / q)$ not more than ± 5%.,

$E_t = \pm (0{,}5 + 3\ \Delta\Theta_{min} / \Delta\Theta)$

$E_c = \pm (0{,}5 + \Delta\Theta_{min} / \Delta\Theta)$

$E = E_f + E_t + E_c$

8. When all the necessary conditions are met, the examination begins.

9. Water is passed through the meter at the flow rates specified above for a certain period of time. Then the water flow is terminated and the energy value written on the meter is read.

10. The actual energy value is calculated by taking the actual amount of water passing through the meter and the temperature values read from the etalon thermometers in the water baths. By comparing this calculated value with the energy value read from the meter, the percentage (%) error value is calculated according to the formula below.

$$E_b = \frac{Q_s - Q_e}{Q_e} \times 100$$

Q_s: Energy value read from the meter

Q_e: Actual energy value

E_b: Energy error of the meter

11. It is checked whether the energy error of the meter is within the MIH limits. If the error value is within the MIH limits, the meter is considered to be working correctly. If it is outside the limits of the MIH, the inspection is repeated two more times in the same way. If the inspection results meet the following two conditions, the meter is considered to be working correctly.

– Arithmetic average of the three examination results and
– At least two of the examination results are within the limits of MIH.

12. The above-mentioned inspection steps are repeated for other temperature difference and flow rate ranges specified in the first article of this section.

2. Inspection of the combined heat meter

2.1. In the inspection of the combined heat meter; temperature sensors, flow sensor and calculator are subject to separate inspection.

2.1.1. Flow Sensor Inspection

1. The accuracy class, q_i and q_p values are read from the meter and the meter is subjected to inspection at each of the following flow intervals.

a) $q_i \leq q \leq 1,2\ q_i$
b) $0,1\ q_p \leq q \leq 0,11\ q_p$
c) $0,9\ q_p \leq q \leq 1,1\ q_p$

2. The temperature of the water used in the repair and adjustment station must be in the range of (50 ± 5)°C for heating applications and (15 ± 5)°C for cooling applications. However, if permitted in the type approval certificate, this inspection can also be carried out with cold water.

3. The meter is connected to the repair and adjustment station according to the flow direction and put into test mode.

4. The flow sensor MIH value is calculated according to the class of the meter as follows.

– Class 1: $E_f = \pm (1 + 0,01\ q_p / q)$ not more than ± 5%,
– Class 2: $E_f = \pm (2 + 0,02\ q_p / q)$ not more than ± 5%,
– Class 3: $E_f = \pm (3 + 0,05\ q_p / q)$ not more than ± 5%,

5. When all the necessary conditions are met, the examination begins.

6. Water is passed through the meter at the flow rates specified above for a certain period of time. Then the water flow is terminated and the volume value written on the meter is read.

7. The percentage (%) error value of the flow sensor is calculated according to the formula below by comparing the volume value read on the meter with the volume value read on the etalon device.

$$E_b = \frac{V_s - V_e}{V_e} \times 100$$

V_s : Volume read from the meter

V_e : Volume read from the etalon

E_b : Error of the flow sensor

8. It is checked whether the error value of the flow sensor is within the MIH limits. If the error value is within the MIH limits, the flow sensor is considered to be working correctly. If the error value is outside the limits, the inspection is repeated two more times in the same way. If the inspection results meet the following two conditions, the flow sensor is considered to be working correctly.

– Arithmetic average of the three examination results and
– At least two of the examination results are within the limits of MIH.

9. The above-mentioned inspection steps are repeated at other flow ranges specified in the first article of this section.

2.1.2. Inspection of Temperature Sensors

1. Θ_{min} and Θ_{max} values are read from the meter and the sensor pair is subjected to inspection in the following temperature ranges..

Inspection Temperature Value	Inspection Temperature Range	
Θ_1	From Θ_{min} to (Θ_{min} +10K)	
Θ_2	($\Theta_1 + \Theta_3$) / 2 ± 5K	
Θ_3	$\Theta_{max} \leq 150$ °C	From Θ_{max} -10K to Θ_{max}
	$\Theta_{max} > 150$ °C	From Θ_{max} -20K to Θ_{max} (Not exceeding 140 °C)
Note: Variation of the temperature range is permitted if specified in the Type Approval certificate.		

2. The temperature bath is set to the temperature value specified above.

3. The stamped sensor on the meter is removed and both temperature sensors are immersed in the temperature bath in such a way that they are not less than the smallest immersion depth and remain in water.

4. A calibrated etalon thermometer is placed in the temperature bath.

5. The meter is put into test mode and the inspection is started.

6. When the temperature of the bath reaches the desired value, the temperature value of each temperature sensor is read.

7. By comparing the temperature readings with the reading from the etalon thermometer in the hot water bath, the percentage (%) error value of each temperature sensor is calculated according to the formula below.

$$E_b = \frac{t_s - t_e}{t_e} \times 100$$

t_s= Temperature value read from the temperature sensor

t_e= Temperature reading from the hot water bath

E_b= Error value of the temperature sensor

8. The temperature sensor MIH value is calculated as follows.

$E_t = \pm\ (0,5 + 3\ \Delta\Theta_{min} / \Delta\Theta)$

9. It is checked whether the error value of the temperature sensor is within the MIH limits. If the error value is within the MIH limits, the temperature sensor is considered to be working correctly. If the error value is outside the limits, the inspection is repeated two more times in the same way. If the inspection results meet the following two conditions, the temperature sensor is considered to be working correctly.

- Arithmetic average of the three examination results and
- At least two of the examination results are within the limits of MIH.

10. The above-mentioned inspection steps are repeated at other flow ranges specified in the first article of this section.

2.1.3 Inspection of the Calculator

1. The accuracy class, $\Delta\Theta_{min}$ and $\Delta\Theta_{max}$ values are read from the meter and the calculator is subjected to inspection in each of the following temperature ranges.

For heating applications:

a) $\Delta\Theta_{min} \leq \Delta\Theta \leq 1{,}2\ \Delta\Theta_{min}$

b) $10\ K \leq \Delta\Theta \leq 20\ K$

c) $\Delta\Theta_{max} - 5K \leq \Delta\Theta \leq \Delta\Theta_{max}$

For cooling applications:

a) $\Delta\Theta_{min} \leq \Delta\Theta \leq 1{,}2\ \Delta\Theta_{min}$

b) $0{,}8\ \Delta\Theta_{max} \leq \Delta\Theta \leq \Delta\Theta_{max}$

2. The temperature of the bath in which the outlet line temperature sensor is to be immersed must be within a temperature range of (50 ± 5) °C for heating applications and (15 ± 5) °C for cooling applications.

3. The temperature of the bath in which the inlet line temperature sensor will be immersed must be $\Delta\Theta$ higher than the temperature of the other bath.

4. The stamped sensor on the meter is removed and both temperature sensors are immersed in the baths prepared at the temperatures specified above in such a way that they are not less than the smallest immersion depth and remain in water.

5. Calibrated etalon thermometers are placed in the temperature baths.

6. The meter is put into test mode. During the inspection, the flow rate desired to pass through the meters is applied with the simulated signal. Then the simulated flow signal is stopped. Energy value is read from the meter display.

7. The MIH value for each inspection point is calculated as follows.

$E_c = (0{,}5 + \Delta\Theta_{min} / \Delta\Theta)$

8. By comparing the energy value read from the meter display with the energy value calculated from the etalon, the percentage (%) error value of the calculator is found according to the formula below.

$E_b = \frac{Q_s - Q_e}{Q_e} \times 100$

Q_s: Energy value read from the meter display

Q_e: Energy value calculated from the etalon

E_b: Error of the calculator

9. It is checked whether the error value of the calculator is within the MIH limits. If the error value is within the MIH limits, the calculator is considered to be working correctly. If the error value is outside the MIH limits, the inspection is repeated two more times in the same way. If the results of the inspection meet the following two conditions, the calculator is considered to be working correctly.

– Arithmetic average of the three examination results and
– At least two of the examination results are within the limits of MIH.

10. The above-mentioned inspection steps are repeated at other temperature ranges specified in the first article of this section.

3. Mixed (Compact) heat meter Inspection

The inspection of the mixed heat meter is carried out as the inspection of the complete heat meter specified in Article 1. However, if the meter is to be subjected to the first inspection after operations such as repair, maintenance and adjustment, it is inspected like the combined heat meter specified in Article 2.

Measurement inspection results;

Heat Meters are recorded in the **MF.04 Measurement Record Form.**

MF.05 Heat Meter Test Report and **MF.06 Heat Meter Inspection Report** are created.

The meters that are periodically inspected are recorded in the **MF.07 Periodic Inspection Record Book Form**.