

Test Module 5

Space Heating, High Temperature, Direct, Including Mix Down
HEATING MODULE 5–DH70 Direct, Including Mix Down

HM5–DH70C

Our Mission Statement: “To improve the performance of residential HIUs across the UK.”

Revision History

Revision number	Comments	Author	Approver	Date
VI-Rev001	Final version of test module for publication alongside the third edition of the Technical Standard for UK HIU Test Regime	Technical Committee	Steering Group	01/09/2023

1. INTRODUCTION

This document forms part of the UK Test Standard for Heat Interface Units that has been developed to assess the role and performance of HIUs in UK heat networks.

BESA Technical Standard for UK HIU Test Regime (2023) sets out the overall Test Standard requirements. In order to avoid having to repeat successful tests, the tests have been bundled into ‘modules’. This sub document covers MODULE 5 that comprises a series of tests, as set out below. Readers should refer to the main test document to understand how the tests and modules fit together within the overall Test Standard.

2. SCOPE

MODULE 5, covering HIUs supplying Space Heating at High Temperature, Directly, Including Mix Down.

The module code is:

HM5–DH70C – HEATING MODULE 5–DH70 Direct, Including Mix Down.

This module only applies to HIUs:

TYPE 3 HD–MD /HWI

TYPE 7 HD–MD

Pass/fail and best practice thresholds for these HIUs are shown below.

This module can be combined with DHW modules M7 or M9 for TYPE 3 HIUs.

3. TESTS TO BE CARRIED OUT

The following tests shall be carried out in this module.

M5.3.1 **Objective:** Perform static/steady state testing in order to investigate the performance characteristics of the HIU when meeting a specified space heating load.

M5.3.2 The primary differential pressure shall vary between 50 kPa and 200 kPa. The test rig shall control primary differential pressure to the set point $\pm 4\%$.

Note that in all plotting of graphs when reporting, dP will be converted into MPa to ensure that dP has a similar magnitude to flow rate values (in l/s) and can therefore share the same axis, with temperature on a separate axis.

Note: The static tests data shall be recorded for a minimum of 300 seconds once HIU and test rig operation has stabilised. The results shall then be presented in table form derived from the mean average over the test period, as well as a plot of the key metrics for the same time period.

All tests shall include the following:

M5.3.3 **Parameter recording** – there are several sensors across the test rig as well as instantaneous power values that shall be calculated from these sensor recordings. Only some of these will be required to be reported and plotted in graphs (see Reporting box at the end of the test module sections). However all sensors and calculated values shall be recorded for the duration of all tests and made available to the Technical Lead for analysis.

M5.3.4 **Electrical consumption** – the maximum and average electrical consumption shall be measured throughout the test (in Watts $\pm 1\%$) along with the derived electrical losses. Electrical elements and other components not within the standard definition of a HIU shall be recorded in the HIU list of components and recorded as an extra line item of measured electrical consumption. The electrical consumption values will not be reported on but will be made available to the Technical Lead for analysis.

Tests 03a, 03b & 03c – Direct heating HIU, including mix down, space heating circuit capacity (High Primary Temperature)

03a	DH/70C, Space Heating Direct, Including Mix Down 0.5 kW, 55/35°C tertiary
03b	DH/70C, Space Heating Direct, Including Mix Down 1 kW, 55/35°C tertiary
03c	DH/70C, Space Heating Direct, Including Mix Down 4 kW, 55/35°C tertiary

M5.3.5 **Objective** – To perform static testing in order to investigate the performance characteristics of the HIU when **directly** meeting a space heating load with **tertiary temperature control** (i.e. via a mixing valve), given a 55°C/35°C tertiary heating circuit and 70°C primary flow temperature.

Note: The static tests data shall be recorded for a minimum of 300 seconds once the HIU and test rig operation has stabilised. The test shall be performed with modulating dP on the primary side while flow rate, flow temperature, return temperature and dP are recorded on both primary and tertiary side of the HIU

M5.3.6 The **scope** of this test includes HIUs that directly supply water from the primary heat network to the apartment heating circuit with a tertiary temperature control achieved by mixing primary flow water with tertiary return water. This type of HIU shall include a pump. The HIU shall have means of controlling the dP reaching the tertiary circuit, protecting it from the changes in primary dP, and shall also control the tertiary temperature.

M5.3.7 The test shall be performed supplying the HIU with 70°C on the primary inlet and 55°C on the tertiary outlet. The resulting temperatures shall be recorded.

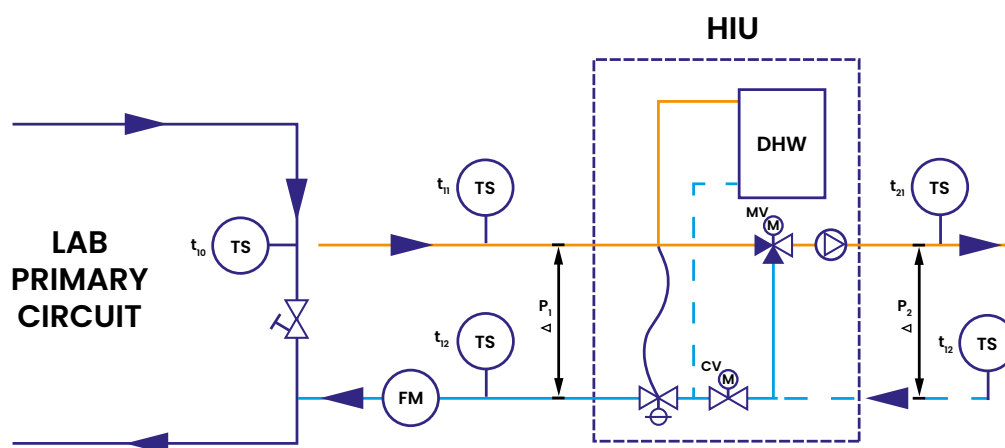
M5.3.8 The space heating test represents the HIU performing at the following design conditions shown in Table 1:

Test	kW	Primary flow temperature (°C)	Tertiary temperature profile (°C)	Flow rate (l/s)
03a	0.5	70	55/35	0.0060
03b	1	70	55/35	0.012
03c	4	70	55/35	0.048

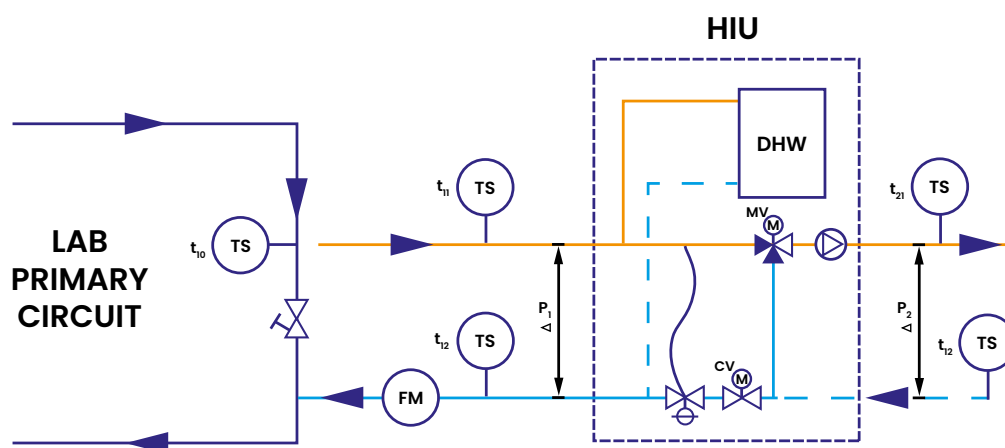
M5 Table 1 – Design conditions for tests 3a, 3b and 3c

M5.3.9 There are two types of direct HIU, depending on the dP control:

1. HIUs that include a **common dP control for DHW and heating** service on the primary (as shown in Figure 1). This HIU heating test is directly linked to a setting that affects DHW performance. Heating tests for this type of HIU shall be carried out with the same DPCV setting that is used on DHW tests. Therefore, once commissioned for one test, it shall not be modified for the remaining tests. These HIU dP settings shall be set in accordance with the manufacturer's instructions.
2. HIUs that include a **separate dP control for DHW and heating** (as shown in Figure 2). The heating DPCV setting in these HIUs does not affect DHW performance and their DHW and heating test modules are independent. Commissioning of the DPCV in these units is detailed in M5.3.10 as it will need to be carried out in tandem with commissioning the DRV at the start of the 4 kW test.



M5 Figure 1 – Direct heating HIU with common DHW and heating dP control and with heating mix down

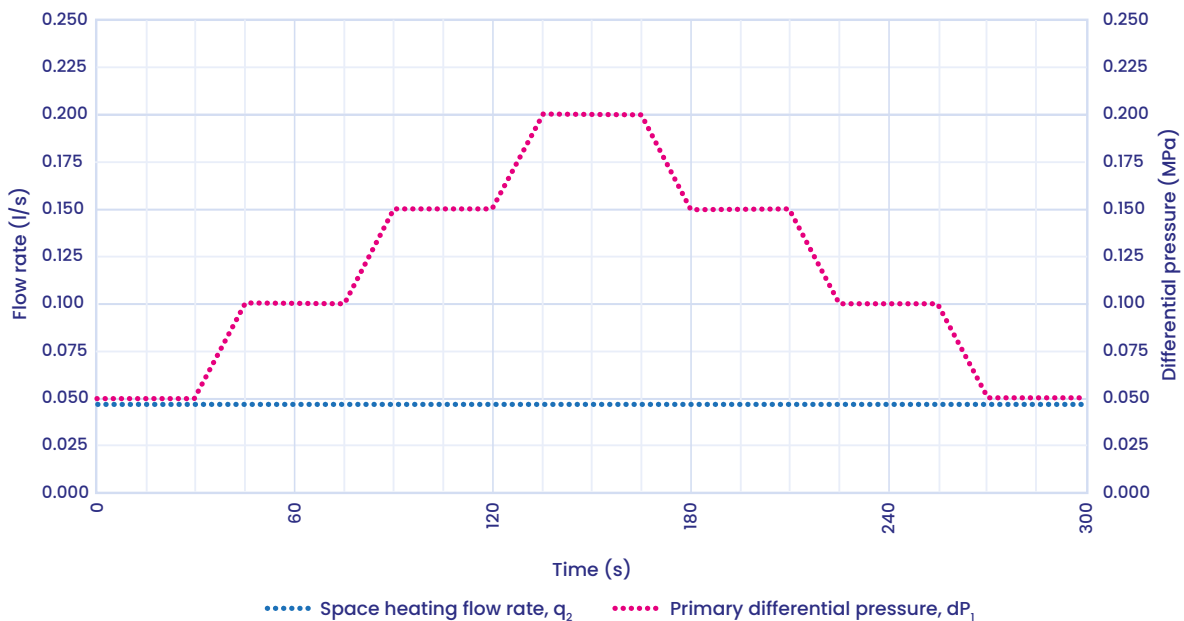


M5 Figure 2 – Direct heating HIU with independent heating dP control and with heating mix down

M5.3.10 The test rig shall include a DRV that shall simulate the pressure drop of the tertiary circuits. The commissioning of this shall be as follows, starting with the 4 kW heating test (test 03c) for both of the above configurations of HIU:

- For HIUs with a common DPCV, the DPCV shall be commissioned during the hot water tests and the DRV shall be adjusted to achieve the flow corresponding to a 4 kW demand (0.048 l/s), with 50 ± 2 kPa on the primary side and the HIU pump switched on. The DPCV shall not be touched during this.
- For HIUs with an independent heating DPCV, the DPCV shall be commissioned to achieve 20 kPa on the tertiary side, with 50 ± 2 kPa on the primary side and the HIU pump switched on. The test rig DRV shall be adjusted at this condition to achieve the flow corresponding to a 4 kW demand (0.048 l/s). This process might follow some interactions between HIU DPCV commissioning and the test rig DRV commissioning. Once the conditions are achieved then the HIU DPCV shall not be touched again.
- Following the 4 kW test, the 1 kW (test 03b) and 0.5 kW (test 03a) tests shall follow, not necessarily in that order. Before each of these, the test rig DRV shall be commissioned to achieve the corresponding test flow rates (0.012 l/s and 0.0060 l/s) with 50 ± 2 kPa on the primary side and the HIU pump switched on

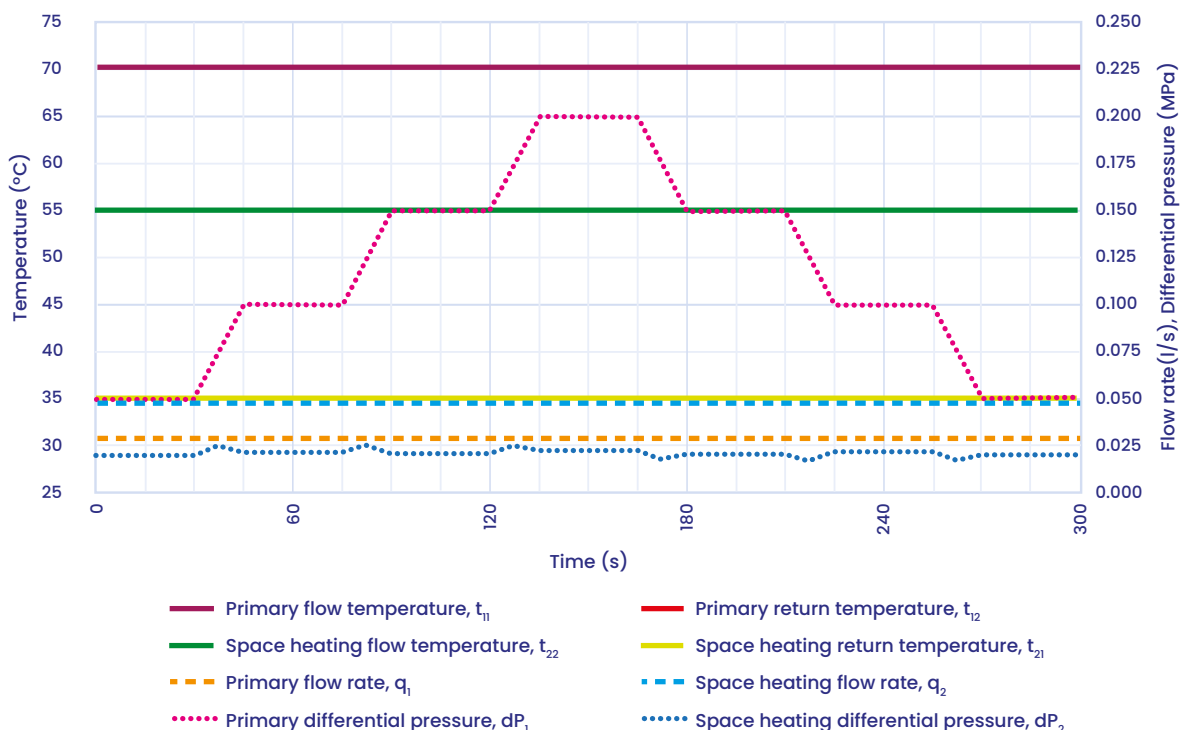
M5.3.11 Once the flow conditions are achieved with the test DRV, the test shall start with 50 kPa and shall increase in steps of 50 kPa up to 2 bar, and then drop back to 50 kPa in 50 kPa steps. Each step shall last 30 seconds at the set point and the dP transition shall last 15 seconds, as per the example profile shown in Figure 3.



M5 Figure 3 – Differential pressure test profile, also displaying primary flow rate (note that the primary flow rate shown is for demonstration purposes only as it displays the primary flow rate for Test 03c)

M5.3.12 Results shall be presented in two forms:

- A table including mean average values of t_{11} , t_{12} , q_1 , H_1 , t_{21} , t_{22} , q_2 , dP_2 , H_2 over the duration of each test, plus maximum and minimum t_{22} , dP_2 . The table shall also show percentage values of the maximum dP_2 variation from initial setting, and the percentage deviation of the design q_2 flow values in Table 1.
- A graph over time including t_{11} , t_{12} , q_1 , dP_1 , t_{21} , t_{22} , q_2 , dP_2 , similar to the example profile in Figure 4.



M5 Figure 4 – Example test output (note that the primary flow rate shown is for demonstration purposes only as it displays the primary flow rate for Test 03c)

M5.3.13 The HIU will fail if the tertiary dP drops below 10 kPa or rises above 60 kPa at any point in the test.

M5.3.14 The HIU will fail if space heating temperatures at t_{22} are not maintained at 55°C \pm 5.0°C (to one decimal place) for more than 1 second.

M5.3.15 If the HIU passes the test, then a 35°C primary return temperature and the design flow rates shall be used in the space heating VWARD calculations.

The HIU outer case shall be in place for these tests.

No DHW shall be drawn off during these tests.

Pass/Fail Criteria

TEST 03 – Direct heating HIU, including mix down, static testing of space heating circuit capacity

Fail if the space heating flow temperature, $t_{22'}$, is not maintained at $55^{\circ}\text{C} \pm 5.0^{\circ}\text{C}$ (to one decimal place) for more than one second.

Fail if the heating differential pressure, $dP_{2'}$, drops below 10 kPa or rises above 60 kPa (to one decimal place) at any point in the test.

Best Practice Criteria

TEST 03 – Direct heating HIU, including mix down, static testing of space heating circuit capacity

Best practice if the tertiary flow temperature is maintained at $55^{\circ}\text{C} \pm 3.0^{\circ}\text{C}$ (to one decimal place).

These values do not constitute part of the formal test registration process. However, they do provide targets for manufacturers and purchasers seeking to achieve the highest possible performance in the sector.

4. TEST OUTPUTS

M5.4.1 A test report shall be prepared using the standardised BESA output template shown in the main test document. The test will provide the following outputs:

Reporting

TEST 03 – Direct heating HIU, including mix down, static testing of space heating circuit capacity

Report on the following values for each test:

A table including mean average values of t_{11} , t_{12} , q_1 , H_1 , t_{21} , t_{22} , q_2 , dP_2 , H_2 over the duration of each test.

Maximum and minimum values of t_{22} , dP_2 .

Percentage values of the maximum dP_2 variation from initial setting, and the percentage deviation of the design q_2 flow values in Table 1

Plot graph of following key metrics for each test:

t_{11} , t_{12} , q_1 , dP_1 , t_{21} , t_{22} , q_2 , dP_2 over the duration of each test.

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First edition 2016, Second edition 2018, Third edition 2023.

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