BESA HIU Technical Committee

Note on Space Heating Temperature Tolerance

Revision history

Version	Description	Author	Approved	Date
Rev001	Initial proposal accepted by BESA HIU Technical Committee.	FV	GJ	07/03/25
Rev002	Revised version subsequent to MEHNA statement and further BESA HIU Technical Committee sub-group meeting.	FV	GJ	24/04/25
Rev003	Revision post-Technical Committee feedback. Introduction of flow rate tolerance, awaiting feedback from test house.	FV	FV	08/05/25

Introduction

A query was received from an HIU manufacturer regarding approach to testing under the 2023 BESA UK Technical Standard for HIUs. In order to expedite the process of reviewing this query in the absence of an organised BESA HIU Technical Committee meeting, a sub-group of a small number of BESA HIU Technical Committee members met on 3 March 2025 to discuss the query in order to determine a suitable conclusion, as per the agreed process.

This conclusion was presented back to the BESA HIU Technical Committee, and no comments were received back, resulting in the proposal being deemed to be accepted.

Following the distribution of the proposed approach, MEHNA issued a letter to BESA noting that the proposed change had resulted in significant concern among the manufacturer community. As an outcome of a follow-up meeting between MEHNA and BESA, it was agreed that there would be a revised approach taken for technical queries of this form, with a recommendation being passed to MEHNA for comment, prior to taking a recommendation to the Steering Group for final approval.

Given the unexpected level of concern from manufacturers, it was concluded that the sub-group of the BESA HIU Technical Committee should meet again to re-investigate the issue, then issue an updated proposal, as per the newly agreed process.

The technical sub-group met again on 10 April 2025. The query and conclusions from that investigation are presented below.

Manufacturer query

Background to query

An HIU manufacturer that had undertaken twin-plate HIU testing under Modules 1, 2, 7, and 8 raised concerns regarding the test wording and stipulations for Modules 1 and 2 (space heating).

During the tests, it was observed that after the space heating flow temperature (t_{22}) was commissioned to a 4 kW load (for tests 1c and 1f), when the load was reduced to 1 kW and 0.5 kW, this caused the space heating flow temperature to increase beyond the allowed average temperature variation of ±0.5°C outlined in clauses M1.3.9 and M2.3.9. These clauses state that if the average value of t_{22} cannot be controlled to this allowed variation, then a VWART should not be calculated. This doesn't specifically state that the HIU would fail, but if a VWART cannot be calculated, then this implies that the HIU should fail the test.

The manufacturer highlighted that they thought that this clause would affect the ability for mechanically controlled space heating to pass, and proposed that removing, or relaxing this stipulation would mean that the HIUs would still be able to deliver the required output, and make it possible for other mechanically controlled HIUs to undergo and pass the testing.

The manufacturer acknowledged that this change would negatively impact their VWART calculation, so they were not seeking an advantage.

Investigation

Round robin test

As part of the launch of the new HIU Test Standard, round robin testing was undertaken at Enertek in order to demonstrate that their testing procedure was able to meet the requirements of the HIU Test Standard in terms of test rig control, as well as to confirm that the tests were able to be repeated to the same standard, i.e. that an HIU would achieve the same testing results if it was tested again. Typically this exercise would be done across more than one test house, however as there is only a single test house that are able to carry out the required tests, intra-test house testing was undertaken to confirm that the same results would be achieved for an HIU under repeat testing.

As part of this round robin testing, two HIUs were tested under Modules 1, 2, 7 and 8 – an electronically controlled HIU and a mechanically controlled HIU.

There were queries put to the BESA HIU Technical Committee as to why the temperature controllability clauses weren't flagged as a concern during the round robin testing, if it was deemed challenging for mechanically controlled HIUs to meet this requirement.

However, during the round robin testing of Modules 1 and 2 for the mechanically controlled HIU, the space heating flow temperature during tests 1a to 1f was seemingly controlled within the allowed average temperature variation of ±0.5°C outlined in clauses M1.3.9 and M2.3.9. Given that the HIU tested was able to meet this condition and was successful at meeting the control tolerances of the test, the potential difficulty of this clause was not questioned and no queries raised.

Since the testing, the manufacturer in question has flagged that they would not expect any mechanically controlled HIU to be able to control to the required tolerance. This was raised with Enertek who have stated that the round robin test was undertaken correctly, the HIU not altered in between tests, and that the HIU was able to meet the required control tolerances.

Mechanical HIU test results from previous testing

During this investigation, results from mechanically controlled HIUs from the previous version of the HIU Test Standard were assessed. Whilst it is noted that the testing temperatures, space heating loads and primary differential pressures have changed, conclusions can still be made from analysing the previous test results and it is believed that testing at a lower primary flow temperature and a lower space heating load would put more stress on the control valves and may lead to increased levels of expected fluctuation.

Parameter	High/low temperature test	2018 version	2023 version
Primary flow temperature	High	70°C	70°C
Space heating flow temperature	High	60°C	55°C
Space heating return temperature	High	40°C	35°C
Primary flow temperature	Low	60°C	55°C
Space heating flow temperature	Low	45°C	45°C
Space heating return temperature	Low	35°C	35°C
Space heating loads	High & Low	1 kW, 2 kW, 4 kW	0.5 kW, 1 kW, 4 kW
Primary differential pressure	High & Low	50 kPa for all tests	50 kPa for 0.5 kW and 4 kW tests 200 kPa for 1 kW test

Table 1: Comparisons between the space heating tests within the 2018 and 2023 versions of the HIU Test Standard

A total of six mechanically controlled HIUs were tested under the 2018 version of the testing regime (where a similar space heating flow temperature clause is present). A summary of these tests can be seen in the table below, and further detail can be found in the appendix. For clarity, tests 1a and 1d are carried out at 1 kW, tests 1b and 1e are carried out at 2 kW and tests 1c and 1f are carried out at 4 kW.

Manufacturer	Model	Year of test	Achieved space heat flow temperature test parameter for all three heating tests?	
			High temp regime	Low temp regime
Heat Products	Compact VX1-1	2019	No Tests 1a and 1b over by c.2.0-3.2°C	No Tests 1d and 1e over by c.0.9-1.7°C
Herz	Guildford	2019	Yes	No Tests 1d and 1e over by c.0.7°C
SAV	VVX-IV 1-5 RAD	2022	No Test 1b under by c.0.8°C	No Tests 1d and 1e over by c.0.9-2.4°C
Vital Energi	Vtherm	2019	No Test 1a over by c.1.8°C	No Tests 1d and 1e over by c.1.5-2.0°C

Wilson Energy / Uponor	Combi Port PRO XU	2019	No Test 1a over by c.1.6°C	No Tests 1d and 1e over by c.0.9-1.9°C
YGHP	50/10 HIU	2021	No Tests 1a and 1b over by c.1.1°C	No Tests 1d and 1e over by c.0.6-0.8°C

Table 2: Summary of results obtained from mechanically controlled HIUs from the space heating tests within the 2018 version of the HIU Test Standard

These results demonstrate that in the previous version of the HIU Test Standard, mechanically controlled HIUs were unable to meet the ±0.5°C average space heating flow temperature tolerance across all space heating tests for both high and low temperature regime. However, in all instances, the HIUs were able to deliver the required space heating load outputs as required by the tests, as the secondary flow rates were adjusted to suit, therefore the impact on resident comfort would not be impacted.

Previously, the elevated space heating average temperatures will not have prevented the HIU from having their results published, whereas the current wording of the HIU Test Standard will result in a subset of the HIU market from not being able to meet stipulated control requirements, therefore not being able to have their VWARTs published and therefore not being able to have their space heating results published.

Proposed approach

There has been acknowledgment from the BESA HIU Technical Committee that the current stipulation creates challenges for mechanically controlled units, which was not the original intention.

There was also acknowledgement that HIU manufacturers have committed resources to improving the controllability and performance of their HIUs and components within those units, in order to meet the tolerances set out by the HIU Test Standard, and appreciation of the concern that could be raised with relation to changes to the standard.

As such, it was noted that if changes were made to the standard, this commitment should be rewarded.

It was noted that the test standard was to be updated in September / October this year, with a shift to a new version number, and that the intention had always been to make modifications to the standard, based on feedback from the market.

It was felt by the sub-group that a modification should be made to the standard as part of that process, as: (a) there is ambiguity with regards to whether or not the tolerance is a pass/fail requirement; and (b) there is concern that the tolerance is an artifact of the test standard itself, rather than resulting in significantly better consumer outcomes, and concern that it could differentially impact a particular typology of HIUs, with no valid basis for doing so.

However, the concern raised by MEHNA that this could be seen as a dilution of the test standard was acknowledged, and it was agreed that any change made should be accompanied by an improvement in actual performance requirements.

The following is proposed by the BESA HIU Technical Committee as an update to the HIU Test Standard wording, for the 2025 version:

- The average t_{22} value tolerance across the space heating tests will remain at ±0.5°C for the 4 kW tests, which would set the target temperature for commissioning the HIU at the start of the heating tests.

- For the 1 kW and 0.5 kW tests, a revised tolerance of the average t_{22} will be -0.5°C and +2°C. This is to protect against under-delivery of heat during operation, but allow for some variance in the upper end, but not too much as to impact the operation of safety thermostats typically used in UFH applications to protect damage to floor screed, as well as not introducing too much leniency into the test.
- The revised tolerance will be introduced as an explicit pass/fail criteria,
  - This will not affect pass/fail conditions for HIUs with results published to date under the 2023 regime.
- A new Best Practice condition will be introduced, reflecting the original test tolerance, i.e. if the average value of t_{22} taken over the duration of the test is within ±0.5°C of the required set point for all space heating tests within a module.
  - All HIUs with results published to date (as of the date of issue of this document) will have met this threshold and achieved Best Practice.
- The test house control requirement for the average space heating return temperature (t_{21}) across the test will still be retained at 35±0.5°C for both M1 and M2.
- The test house control requirement for average space heating power (H2) across the test (i.e. 0.5, 1 or 4 kW ± 10% or 250 W, whichever is smaller) will be removed. Test houses should control the space heating circuit to provide the flow rate which would correspond to the required load at the required dT (20°C for M1, 10°C for M2), whilst also controlling to the required t_{21}. This would not impact on VWART calculations, given the approach to calculating VWART is based on the average power observed. A tolerance will be introduced around the flow rate control which is to be determined based on feedback from the test house.

Secondary load, H_2 (kW)	Secondary flow rate, q_2 (l/s)	Tolerance on secondary flow rate
High temperature module, M1		
4	0.048	TBD
1	0.024	TBD
0.5	0.006	TBD
Low temperature module, M2		
4	0.096	TBD
1	0.024	TBD
0.5	0.012	TBD

Table 3: Space heating loads and flow rates, with tolerances to be inputted subsequent to feedback from the test house

- In order to ensure that the BESA HIU Test Standard continues to push the performance standard of HIUs on the market, the space heating VWART for both M1 and M2 will be lowered to the current Best Practice threshold of 37°C, with the Best Practice threshold being lowered to 36°C.
  - All HIUs with results published to date (as of the date of issue of this document) will have met the pass/fail condition, with one exception on

one module. This HIU would still be able to have results published on the website as meeting all criteria and passing the 2023 version of the HIU Test Standard.

  - Several HIUs with results published to date (as of the date of issue of this document) will have met this threshold and achieved Best Practice.

- Further investigation will be undertaken to determine if a ±5°C maximum allowed t_{22} variation could be introduced in the future, in order to prevent poor space heating flow temperature control.
- This adjustment will apply to all HIUs, not just mechanically controlled units.
- This adjustment would not affect the requirements for M3 and M4 (direct space heating with no temperature mix-down), however the impact on M5 and M6 (direct space heating with temperature mix-down) will be discussed in a future BESA HIU Technical Committee meeting

It was determined that given the changes to pass/fail and Best Practice criteria, this should be included in a formalised update to the HIU Test Standard (as opposed to a minor addendum). This update is planned for release in September / October 2025 and will become the regime that HIUs are tested to, however all 2023 results will remain published on the website and still be valid until a subsequent version is published.

Until the point where the new HIU Test Standard is published in September 2025, no change to the current test regime or results thresholds will be made.

Appendix

Test results for mechanically controlled HIUs for space heating tests 1a – 1f, tested under the 2018 version of the BESA HIU Test Standard

For each of the below HIUs, the results tables have been taken from the reports published on the BESA website. Instances where the average space heating flow temperature across the duration of the test does not meet the required tolerance of ±0.5°C have been highlighted in yellow.

Heat Products, Compact VX1-1, 2019

Test	District Heating Circuit				Space Heating Circuit				
	t_{11} (°C)	t_{12} (°C)	q_1 (l/s)	P_1 (kW)	T_{21} (°C)	T_{22} (°C)	q_2 (l/s)	Δp_2 (kPa)	P_2 (kW)
1a	70.06	39.73	0.008	1.01	40.00	62.02	0.011	0.02	1.01
1b	70.17	42.28	0.017	1.98	40.03	63.22	0.020	0.25	1.94
1c	69.98	41.43	0.034	4.06	40.12	60.28	0.048	1.53	4.05
1d	59.93	34.82	0.010	1.05	35.00	46.69	0.020	0.32	0.98
1e	60.00	35.17	0.019	1.97	35.07	45.93	0.043	1.40	1.95
Uncertainty	±0.019	±0.018	±0.0006	±0.07	±0.02	±0.02	±0.0006	±0.054	±0.06
1f	60.03	35.20	0.039	4.05	35.05	44.99	0.096	5.82	3.99
Uncertainty	±0.018	±0.018	±0.0006	±0.07	±0.02	±0.02	±0.0012	±0.055	±0.05

Herz, Guildford, 2019

Test	Primary circuit				Secondary circuit				
	t_{11} (°C)	t_{12} (°C)	q_1 (l/s)	P_1 (kW)	T_{21} (°C)	T_{22} (°C)	q_2 (l/s)	Δp_2 (kPa)	P_2 (kW)
1a	69.99	39.73	0.009	1.13	40.08	60.14	0.012	0.41	1.00
1b	70.00	40.15	0.017	2.11	40.02	60.23	0.024	1.08	2.01
1c	69.92	40.72	0.034	4.12	40.02	59.95	0.048	3.41	3.97
1d	60.00	34.57	0.010	1.06	34.97	45.68	0.022	0.90	0.98
1e	60.07	34.80	0.020	2.10	35.06	45.67	0.046	3.16	2.03
Uncertainty	±0.019	±0.018	±0.0006	±0.07	±0.02	±0.02	±0.0006	±0.054	±0.06
1f	60.00	34.97	0.040	4.16	35.13	44.93	0.099	12.46	4.03
Uncertainty	±0.018	±0.018	±0.0006	±0.07	±0.02	±0.02	±0.0012	±0.055	±0.05

SAV, VVX-IV 1-5 RAD, 2022

Test	District Heating Circuit					Space Heating Circuit			
	t_{11} (°C)	t_{12} (°C)	q_1 (l/s)	Δp_1 (kPa)	P_1 (kW)	T_{21} (°C)	T_{22} (°C)	q_2 (l/s)	P_2 (kW)
1a	70.29	39.64	0.009	50.39	1.14	39.99	59.89	0.012	0.98
1b	70.00	40.13	0.017	50.15	2.08	40.04	59.21	0.025	1.97
1c	70.04	40.40	0.034	50.62	4.18	40.03	59.95	0.049	4.01
1d	60.03	34.81	0.011	50.05	1.15	35.02	47.43	0.020	1.03
1e	59.93	34.88	0.021	50.15	2.19	34.99	45.90	0.046	2.08
1f	60.07	35.00	0.041	50.31	4.27	35.09	44.93	0.100	4.07

Vital Energi, Vtherm, 2019

Test	Description	Primary					Secondary				
		Flow Temperature $[t_{11}]$ [°C]	*Return Temperature* $[t_{12}]$ [°C]	*Flow Rate* $[q_1]$ $[Ls^{-1}]$	*Differential Pressure* $[\Delta p_1]$ [kPa]	*Heat Load* $[P_1]$ [W]	*Return Temperature* $[t_{21}]$ [°C]	*Flow Temperature* $[t_{22}]$ [°C]	*Flow Rate* $[q_2]$ $[Ls^{-1}]$	*Differential Pressure* $[\Delta p_2]$ [kPa]	*Heat Load* $[P_2]$ [W]
1a	- 1 kW Space Heating (DH 70 °C flow)	70.0	38.8	0.010	53.5	1302	40.3	61.8	0.012	-0.8	1081
1b	- 2 kW Space Heating (DH 70 °C flow)	70.1	39.7	0.017	51.7	2141	39.9	60.3	0.012	0.8	2007
1c	- 4 kW Space Heating (DH 70 °C flow)	70.5	40.0	0.032	50.2	4079	39.8	59.5	0.048	-0.5	3959
1d	- Space Heating 1 kW (DH 60 °C flow)	59.6	34.5	0.012	52.7	1275	35.0	47.0	0.024	1.1	1183
1e	- Space Heating 2 kW (DH 60 °C flow)	60.0	34.9	0.022	51.3	2346	35.2	46.5	0.024	-0.1	2253
1f	- Space Heating 4 kW (DH 60 °C flow)	60.5	35.0	0.038	52.7	4103	35.1	45.1	0.097	-4.9	4039

Wilson Energy/Uponor, Combi Port PRO XU, 2019

Test point	Primary				Secondary				
	t_{11} [°C]	t_{12} [°C]	q_1 [l/s]	P_1 [kW]	t_{21} [°C]	t_{22} [°C]	q_2 [l/s]	Δp_2 [kPa]	P_2 [kW]
1a	69.8	40.3	0.012	1.5	40.0	61.6	0.012	0.3	1.0
1b	69.9	40.9	0.019	2.2	40.0	60.3	0.025	0.8	2.1
1c	69.9	41.6	0.036	4.2	39.9	59.9	0.048	2.2	3.9
1d	60.2	34.9*	0.018	1.9	35.1	46.9	0.021	0.6	1.0
1e	60.2	35.2	0.022	2.3	35.0	45.9	0.048	2.2	2.1
1f	60.3	35.3	0.040	4.1	34.9	44.8	0.096	7.4	3.9

YGHP, 50/10 HIU, 2021

Test		Description	Primary					Secondary				
			t_{11} °C	t_{12} °C	q_1 l/s	Δp_1 kPa	P_1 W	t_{21} °C	t_{22} °C	q_2 l/s	Δp_2 kPa	P_2 W
1a	-	1 kW Space Heating (DH 70 °C flow)	69.6	40.7	0.010	54.5	1174	40.0	61.1	0.011	3.8	971
1b	-	2 kW Space Heating (DH 70 °C flow)	69.9	40.9	0.018	52.5	2184	39.6	61.1	0.024	7.9	2007
1c	-	4 kW Space Heating (DH 70 °C flow)	70.1	42.1	0.035	48.7	4162	40.2	60.2	0.047	26.3	3977
1d	-	Space Heating 1 kW (DH 60 °C flow)	60.4	34.9	0.011	52.4	1121	35.0	45.6	0.024	-0.6	1058
1e	-	Space Heating 2 kW (DH 60 °C flow)	60.3	35.2	0.021	49.5	2182	35.2	45.8	0.047	26.2	2103
1f	-	Space Heating 4 kW (DH 60 °C flow)	59.7	35.2	0.039	49.8	3979	34.8	44.8	0.095	18.3	3959