

Model:

Serial Number:

Year of manufacture:

Test carried out by

On:

Reference:

NOTE: The VWART accuracy is in the range +/-2°C

	HIGH TEMP	LOW TEMP
	VWART °C	VWART °C
DHW		
Keep-warm		
Space heating		
Overall with keep warm		

Pressure test		
No HIU damage		

Dynamic DHW operation	2a	
DHW not exceed 65°C		

Low flow test at BESA flow rate of 0.02l/s	3a	3b
DHW not exceed 65°C		
DHW temperature at set point +/- 3°C		

Low flow test at manufacturer declared flow rate	3c	3d
Declared minimum flow rate (l/sec)		
Not exceed 65°C		
DHW temperature at set point +/- 3°C		

Keep-warm test	4a	4b
Standby heat consumption - average (Watts)		
Standby electricity consumption - average (Watts)		
Total HIU heat loss (DH + electrical input) (Watts)		
Standby flow rate (the average flow rate) (l/hr)		

DHW Response time test	5a	5b
DHW response time (Seconds)		
Peak electrical heat during test (Watts)		
Output		
DHW temperature not exceed 65°C for more than 10 secs		
DHW reaches 45°C with 15 secs		

Scaling risk assessment as defined in 2.26	If any of the factors below occur then the risk of scaling of the DHW PHE in hard water areas increases		
HIU has a TMV or TRV on the DHW			
Test	2a	3a	3c
t32 above 60°C for more than 5 secs			
t12 exceeds 55°C at any point of the test			
Test	4a		4b
t12 exceeds 50°C at any time			

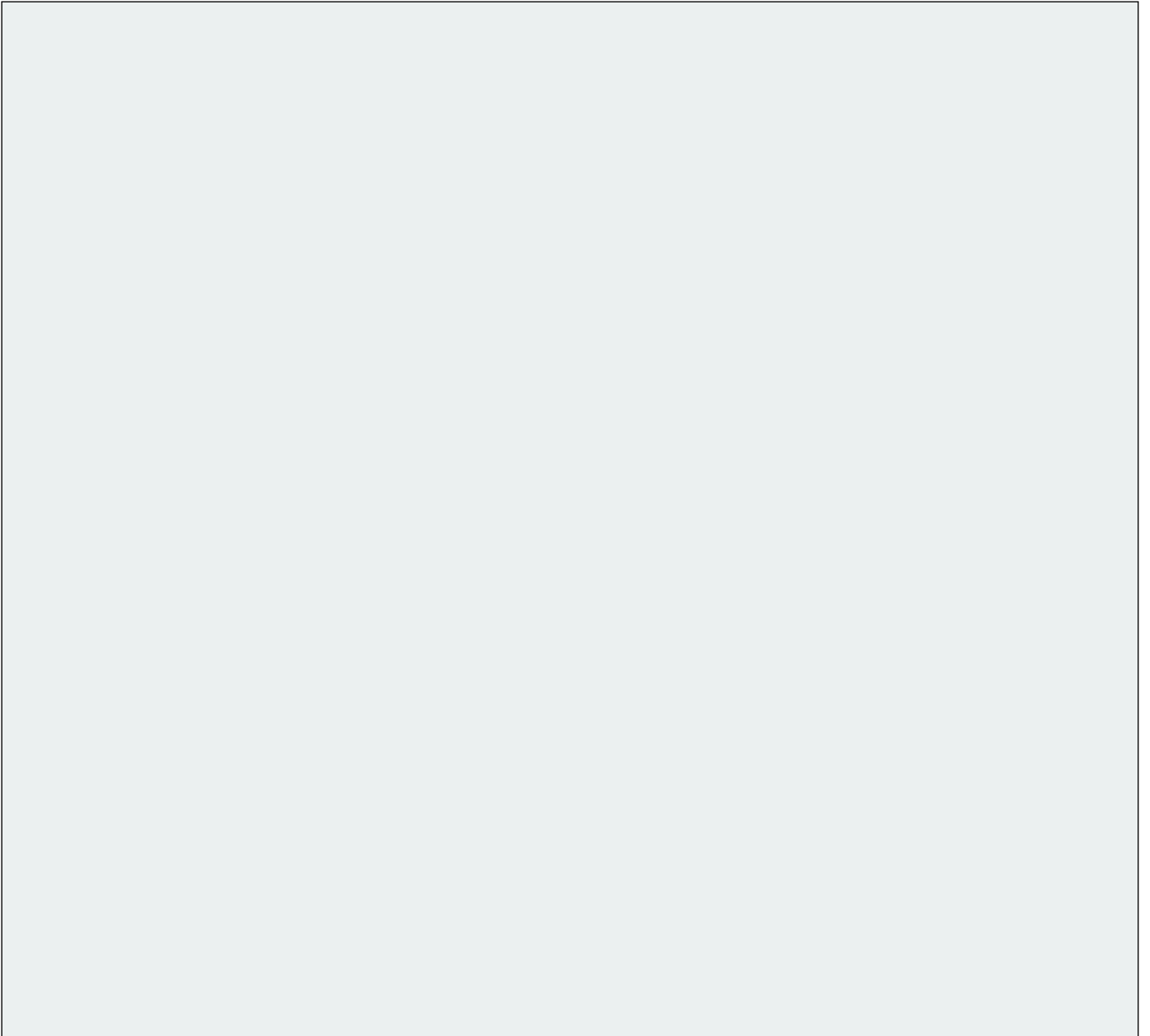


Photo of HIU being tested with the cover off.

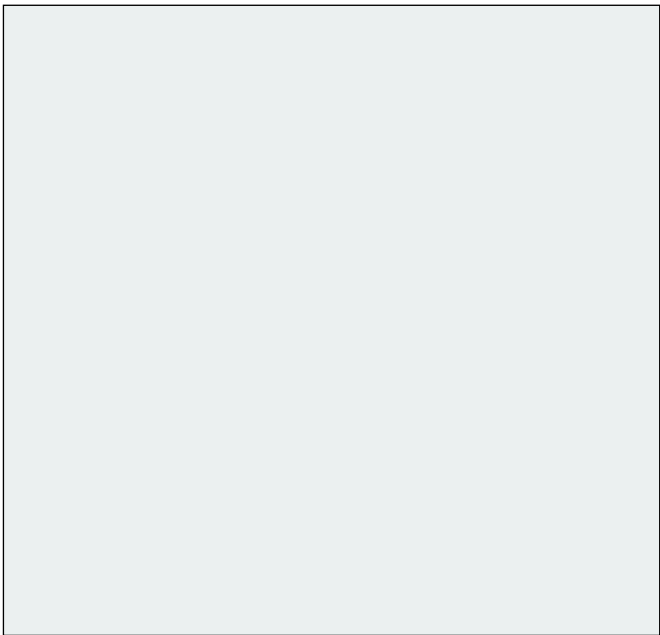


Photo of HIU being tested with the cover on.

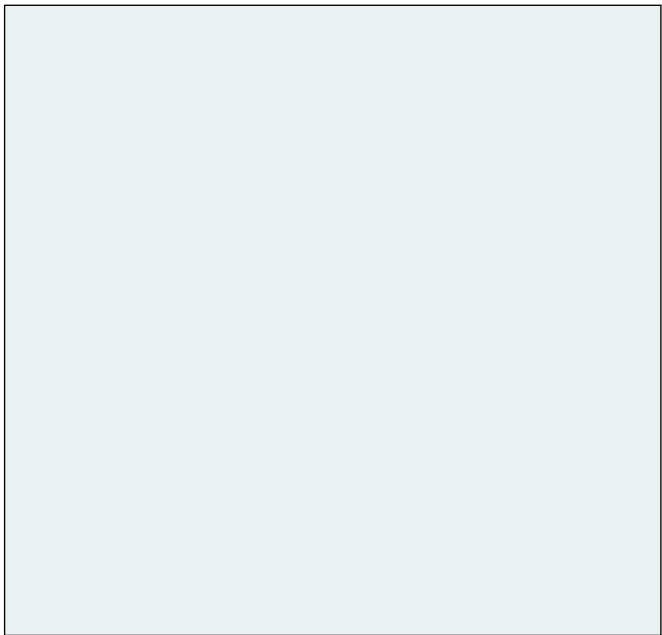


Photo of Manufacturers label and serial number.

COMPONENT DATA AND DOCUMENTATION

[illegible]

Schematic diagram and drawing showing the structure and arrangement of the HIU with dimensions and weight		
Technical specification for electronic components including version of software		
Installation guide		
Commissioning guide		
Operation guide with a function description/ description of operations and care instructions as suited to the intended user category		
Declaration of Conformity for CE-marked HIUs		
Full parameter list for electronically controlled HIUs		

HIU Marking	Comment	Info present
Model name and type no.		
Serial no.		

HIU MANUFACTURERS' DECLARED INFORMATION (TO BE COMPLETED BY THE MANUFACTURER)

HIU Model	
Part No.	
Software version	
Test Date:	
Test No.	

DIMENSIONAL INFORMATION	
Dimensions with casing (HxDxW) (mm)	
Primary connections top/bottom	
Secondary HTG connections top/bottom	
Secondary BCW/DHW connections top/bottom	
Connection sizes Prim/Sec DHW/Sec HTG (mm)	
Empty weight kg** (Kg)	
Operating weight kg** (Kg)	

ELECTRICAL INFORMATION	
Power supply (230V 1 phase)	230V 1~
Maximum power (Watts)	
Standby power demand (Watts)	

HYDRAULIC INFORMATION	
Maximum primary pressure (Bar g)	
Maximum primary temperature (°C)	
Primary water volume (l)	
Maximum secondary DHW pressure (Bar g)	
Maximum secondary DHW temperature (°C)	
Secondary DHW water volume (l)	
Maximum secondary HTG pressure (Bar g)	
Maximum secondary HTG temperature (°C)	
Primary operating DP range min/max (kPa)	

DECLARED MAXIMUM PERFORMANCE LT TEST CONDITIONS	
DHW	
Maximum DHW production at 70°C (kW)	
Primary flow temperature (°C)	70
Primary return temperature (°C)	
Primary flow (m ³ /h)	
Primary ΔP^* (kPa)	
Secondary in/out temperature (°C)	10/55
Secondary ΔP (bar)	
HTG	
Maximum HTG production (kW)	
Primary flow temperature (°C)	70
Primary return temperature (°C)	
Primary ΔP^* (bar)	
Secondary in/out temperature (°C)	40/60
Secondary available DP at the output of HIU	

DECLARED MAXIMUM PERFORMANCE LT TEST CONDITIONS	
DHW	
Maximum DHW production at 60°C (kW)	
Primary flow temperature (°C)	60
Primary return temperature (°C)	
Primary flow (m³/h)	
Primary ΔP^* (kPa)	
Secondary in/out temperature (°C)	10/50
Secondary ΔP (bar)	
HTG	
Maximum HTG production (kW)	
Primary flow temperature (°C)	60
Primary return temperature (°C)	
Primary ΔP^* (bar)	
Secondary in/out temperature (°C)	35/45
Secondary available DP at the output of the HIU (kPa)	
HIU P&ID supplied by manufacturer with a legend for the components	

*DP pressure not to include HM. Designers must add HM pressure drop.

** Including HIU, casing and wall hung bracket

The information included in this page is for the specific model of HIU detailed in this test report. It is additional information voluntarily provided by the manufacturer who is solely accountable for the details submitted.

MANUFACTURERS' DECLARATION

This is to confirm that the information supplied by
accurate representation of the product listed on the BESA HIU Register.

relates to the specific HIU tested and is an

Signed

Position

Company

COMMENTS/HISTORY

BESA HIU TEST REPORT
KFFR-1230722.FI.16.0 HIU**Client: Kodsan**

Project Number: E4657 Report Issue: 2

13 May 2022

Prepared By:



Simon Broxham - Project Engineer

Approved By:



Howard Ruston – Director of Operations



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BESA SUMMARY SHEET

This test summary, downloaded from the BESA website, indicates that the HIU listed below has been tested against the criteria of the BESA HIU Test Regime.



Model: KFFR-61-722.FI.16.0

Serial Number: 012103-0001

Year of manufacture: 2021

Test carried out by Enertek Int-S.Broxham On: 1/5/22

Reference: E4657

	HIGH TEMP	LOW TEMP
	VWART °C	VWART °C
DHW	14	17
Keep-warm	53	52
Space heating	44	40
Overall with keep warm	45	46

NOTE: The VWART accuracy is in the range +/- 2°C

Pressure test		
No HIU damage	Pass	Pass

Dynamic DHW operation	2a	
DHW not exceed 65°C	Pass	Pass

Low flow test at BESA flow rate of 0.02l/s	3a	3b
DHW not exceed 65°C	Pass	Pass
DHW temperature at set point +/- 3°C	Pass	Pass

Low flow test at manufacturer declared flow rate	3c	3d
Declared minimum flow rate (l/sec)		
Not exceed 65°C	n/a	n/a
DHW temperature at set point +/- 3°C	n/a	n/a

Keep-warm test	4a	4b
Standby heat consumption - average (Watts)	105	91
Standby electricity consumption - average (Watts)	0	0
Total HIU heat loss (DH + electrical input) (Watts)	105	91
Standby flow rate (the average flow rate) (l/hr)	11.9	18.0

DHW Response time test	5a	5b
DHW response time (Seconds)	6	5
Peak electrical heat during test (Watts)		
Output		
DHW temperature not exceed 65°C for more than 10 secs	Pass	Pass
DHW reaches 45°C with 15 secs	Pass	Pass

Scaling risk assessment as defined in 2.26	If any of the factors below occur then the risk of scaling of the DHW PHE in hard water areas increases		
HIU has a TMV or TRV on the DHW	No		
Test	2a	3a	3c
t32 above 60°C for more than 5 secs	No	No	n/a
t12 exceeds 55°C at any point of the test	No	No	n/a
Test	4a		4b
t12 exceeds 50°C at any time	Yes		Yes

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1 BRIEF

- 1.1.1 Enertek International Limited (EIL), were contracted to receive, install, and commission a production sample, of the Kodsan KFFR-123-722.FI.16.0 HIU.
- 1.1.2 To carry out the work involved to evaluate the performance of Domestic Hot Water (DHW) and Space Heating (SH) in accordance with the BESA UK HIU Test Regime Technical Specification, Rev-009 October 2018, a publicly available online Test Regime. This is here-on referred to as the Test Regime throughout this document.
- 1.1.3 To provide a report detailing the tests carried out and generated results in accordance with the Test Regime criteria, including calculations for Volume Weighted Average Return Temperatures (VWART).

2 DEFINITIONS

2.1.1 The following definitions and abbreviations which have been used within this report can be found in Table 2.1 below:

Table 2.1 – Definitions and Abbreviations

Symbol	Description	Unit
P_1	Power, Primary Side	kW
P_2	Power, Space Heating side	kW
P_3	Power, Domestic Hot Water	kW
t_{11}	Temperature, Primary Side Supply Connection	°C
t_{12}	Temperature, Primary Side Return Connection	°C
t_{21}	Temperature, Space Heating Side Return Connection	°C
t_{22}	Temperature, Space Heating System Supply Connection	°C
t_{31}	Temperature, Cold Water Supply	°C
t_{32}	Temperature, Domestic Hot Water Output from HIU	°C
q_1	Volume Flow, Primary Side	L/s
q_2	Volume Flow, Space Heating Side	L/s
q_3	Volume Flow, Domestic Hot Water	L/s
Δp_1	Primary Pressure Drop Across Entire HIU Unit	kPa
Δp_2	Pressure Drop, Space Heating System Across HIU	kPa
Δp_3	Pressure Drop, Domestic Hot Water Across HIU	kPa
$VWART_{DHW}$	DHW Volume Weighted Return Temperature	°C
$VWART_{SH}$	Space Heating Volume Weighted Return Temperature	°C
$VWART_{KWH}$	Keep Warm Volume Weighted Return Temperature	°C
$VWART_{HEAT}$	Annual Volume Weighted Return Temperature for Heating Period	°C
$VWART_{NONHEAT}$	Annual Volume Weighted Return Temperature for Non-Heating	°C
$VWART_{HIU}$	Total Annual Volume Weighted Return Temperature	°C
DHW	Domestic Hot Water	—
HIU	Heat Interface Unit	—
SH	Space Heating	—
TMV	Thermostatic Mixing Valve	—

3 TEST OBJECT

3.1 Appliance Details

- 3.1.1 Details of the HIU Kodsan KFFR-123-722.FI.16.0 appliance are given in Table 3.1. Photograph of the installed appliance is given in Figure 9.2.

Table 3.1 – Appliance Details

Item	Description
Manufacturer	Kodsan
Model	KFFR-123-722.FI.16.0
Serial Number	012111-0001
Year of Manufacture	2021
DHW Priority	Yes

3.2 Appliance Design Pressures

- 3.2.1 The maximum design pressures of the Kodsan KFFR-123-722.FI.16.0 appliance for the primary and secondary sides for both Space Heating and DHW are given in Table 3.2.

Table 3.2 – Appliance Design Pressures

Item	Value	Unit
Primary Side	16	Bar
Secondary Side space Heating	3	Bar
Secondary Side DHW	10	Bar

3.3 Appliance Design Temperatures

- 3.3.1 The maximum design temperatures of the Kodsan KFFR-123-722.FI.16.0 appliance for the primary and secondary sides for both Space Heating and DHW are given in Table 3.3.

Table 3.3 – Appliance Design Temperatures

Item	Value	Unit
Primary Side	95	°C
Secondary Side space Heating	70	°C
Secondary Side DHW	70	°C

4 TEST METHOD

4.1 Installation of Appliance

- 4.1.1 The appliance was installed and commissioned (as received) and as defined in the product literature provided. Testing was carried out without further adjustment other than disabling the internal space heating pump and adjusting the setting of the SH and DHW set points through the user interface on the HIU controller to suit the conditions of the HIU test rig. The HIU rig schematic is given in Figure 4.1.

4.2 Test Regime

- 4.2.1 The testing described in this report was carried out in accordance with the BESA Test Regime. The Test Regime outlines a series of static and dynamic tests to determine the performance of a HIU's DHW and SH functions. The Regime outlines the test method including the reporting of the results, the performance requirements and the VWART calculations.
- 4.2.2 The setup of the BESA tests is reproduced in Table 4.1. The basis of reporting the performance of the HIU from the BESA Test Regime is reproduced in Table 4.2.
- 4.2.3 The Test Regime specifies the testing of two different test temperature packages. The first is the high temperature package, with a district primary supply of 70 °C and the second is the 'low temperature' package, with a district primary supply temperature of 60 °C.
- 1.1.1 As the Kodsan HIU is suitable for both high and low temperature operation, both test packages were carried out and results recorded within this report.

4.3 Measurement & Uncertainties

- 4.3.1 All measurements and uncertainties adhere to the requirements stipulated in the BESA Test Regime. All measurements were sampled at a rate of 1 Hz for all tests.
- 4.3.2 The BESA uncertainties of measurement requirements are as follows: Differential Pressure, ± 1 kPa; Temperature, ± 0.1 °C; Volume Flow, ± 1.5 %. Note: the time constant for the temperature sensors is less than 1.5 s.
- 4.3.3 EIL's reported uncertainty is based on a standard uncertainty by a coverage factor $K=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements. The EIL equipment list and uncertainties are given in Table 9.2, Appendix B.

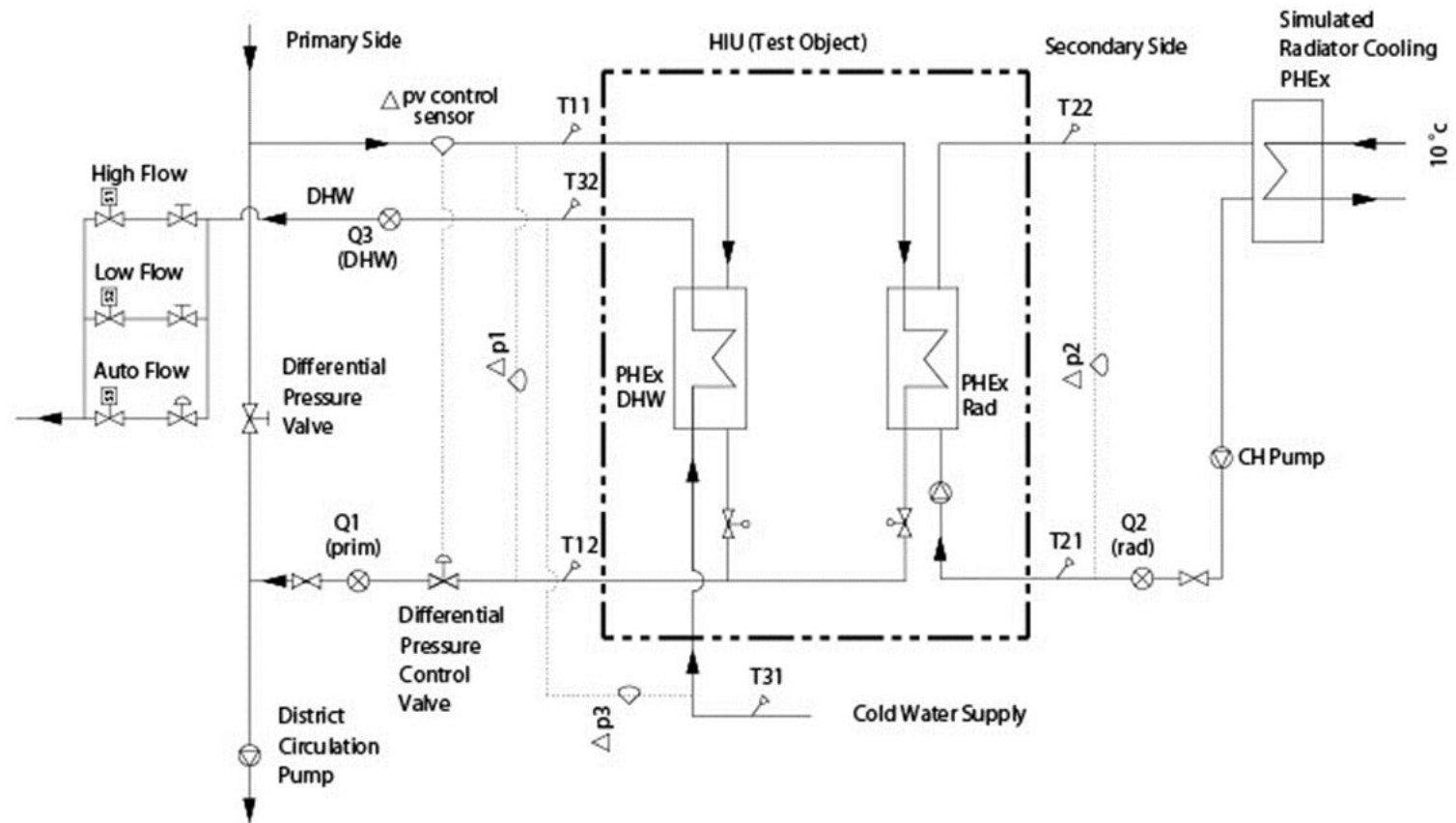


Figure 4.1 – EIL's HIU Test Rig Schematic

Table 4.1 – Setup of Tests (Based on BESA Test Regime, Table 1: Test Schedule)

		District Circuit			Domestic Hot Water			Space Heating		
		Static Pressure	Differential Pressure	Flow Temperature	Temperature Set Point	Flow Rate	Heat Load	Flow Temperature	Return Temperature	Heat Load
<i>Symbol</i>		$[p_1]$	$[\Delta p_1]$	$[t_{11}]$	$[t_{32}]$	$[q_3]$	$[P_3]$	$[t_{22}]$	$[t_{21}]$	$[P_2]$
<i>Units</i>		$[kPa]$	$[kPa]$	$[^{\circ}C]$	$[^{\circ}C]$	$[Ls^{-1}]$	$[kW]$	$[^{\circ}C]$	$[^{\circ}C]$	$[kW]$
Static Tests										
0a	District Pressure Test	1.43 X Claimed Value	-	-	-	-	-	-	-	-
1a	1kW Space Heating	3.0	0.5	70	-	-	-	60	40	1
1b	2kW Space Heating	3.0	0.5	70	-	-	-	60	40	2
1c	4kW Space Heating	3.0	0.5	70	-	-	-	60	40	4
1d	1kW Space Heating	3.0	0.5	60	-	-	-	45	35	1
1e	2kW Space Heating	3.0	0.5	60	-	-	-	45	35	2
1f	4kW Space Heating	3.0	0.5	60	-	-	-	45	35	4
Dynamic Tests										
2a	Dynamic Tapping	3.0	0.5	70	55	See Test Profile	See Test Profile	-	-	-
2b	Dynamic Tapping	3.0	0.5	60	50			-	-	-
3a	Low Flow	3.0	0.5	70	55	0.02	Record Value.	-	-	-
3b	Low Flow	3.0	0.5	60	50	0.02	Record Value.	-	-	-
4a	Keep-Warm	3.0	0.5	70	55	0.00	0	-	-	-
4b	Keep-Warm	3.0	0.5	60	50	0.00	0	-	-	-
5a	DHW Response	3.0	0.5	70	55	0.13	Record Value.	-	-	-
5b	DHW Response	3.0	0.5	60	50	0.13	Record Value.	-	-	-

Table 4.2 – Test Reporting, (Adapted from BESA Test Regime, Table 5)

Test Designation		Reporting
0	District Pressure Test.	Pass/Fail as to whether HIU manages pressure test without leaks or damage.
1a	Space Heating 1 kW, 60/40 °C Secondary.	t_{11} – Primary flow temperature. t_{12} – Primary return temperature.
1b	Space Heating 2 kW, 60/40 °C Secondary.	Plot of key metrics over duration of test.
1c	Space Heating 4 kW, 60/40 °C Secondary.	Note: Outputs used as input data to ‘High Temperature’ Space Heating Volume Weighted Average Return Temperature calculation.
1d	Space Heating 1 kW, 45/35 °C Secondary.	t_{11} – Primary flow temperature. t_{12} – Primary return temperature.
1e	Space Heating 2 kW, 45/35 °C Secondary.	Plot of key metrics over duration of test.
1f	Space Heating 4 kW, 45/35 °C Secondary.	Note: Outputs used as input data to ‘Low Temperature’ Space Heating Volume Weighted Average Return Temperature calculation.
2a	DHW Only, DH 70 °C Flow, 55 °C DHW.	Pass/Fail on DHW (at t_{32}) exceeding 65.0 °C (to 1 decimal point) for more than 10 consecutive seconds. State the maximum and minimum DHW temperatures over the period of the test when there is a DHW flow. Assessment of scaling risk as per the criteria detailed in 2.26. Note: Outputs used as input data to ‘High Temperature’ Space Heating Volume Weighted Average Return Temperature calculation. Plot t_{32} , t_{31} , q_3 , t_{12} , q_1
2b	DHW Only, DH 60 °C Flow, 50 °C DHW.	State the maximum and minimum DHW temperatures over the period of the test when there is a DHW flow. Note: Outputs used as input data to ‘Low Temperature’ Domestic Hot Water Volume Weighted Average Return Temperature calculation. Plot q_1 , q_3 , dp_1 , dp_3
3a	Low Flow DHW, DH 70 °C Flow, 55 °C DHW.	Pass/Fail on DHW (at t_{32}) exceeding 65.0 °C (1 decimal place) for more than 10 consecutive seconds. Comment on ability to deliver DHW at low flow based on DHW temperature reaching at least 45.0 °C (1 decimal place) at the end of the 180 second period of low flow DHW. Comment on the ability to deliver stable DHW flow temperature (at t_{32}), defined as ability to maintain 55.0 +/- 3.0 °C (1 decimal place) during the last 60 seconds of the test. Maximum temperature achieved and +/- °C variance around 55.0 °C (1 decimal place) to be stated. Plot of key metrics for 60 seconds of 0.13 l/s flow and the subsequent 180 seconds of 0.02 l/s DHW flow. Assessment of scaling risk as per criteria detailed in 2.26.
3b	Low Flow DHW, DH 60 °C Flow, 50 °C DHW.	Comment on the ability to deliver DHW at low flow rate based on DHW temperature reaching at least 45 °C (1 decimal place) at the end of the 180 second period of low flow DHW. Comment on the ability to deliver stable DHW flow temperature (at t_{32}), defined as ability to maintain 50.0 +/- 3 °C (1 decimal place) to be stated. Maximum temperature achieved and +/- °C variance around 50.0 °C (1 decimal place) to be stated. Plot of key metrics for 60 seconds of 0.13 l/s flow and the subsequent 180 seconds of 0.02 l/s DHW flow.

Test Designation		Reporting
4a	Keep-Warm, DH 70 °C Flow, 55 °C DHW.	<p>Assessment of whether valid keep-warm operation, based on 5a response time criteria: Pass/Fail.</p> <p>Comment on HIU keep-warm controls options.</p> <p>Assessment of scaling risk based on duration of temperatures in excess of 55.0 °C (1 decimal place).</p> <p>State average heat load for the duration of the test.</p> <p>State the average primary flow rate for the duration of the test.</p> <p>Note: Outputs used as input data to 'High Temperature' Keep-warm Volume Weighted Average Return Temperature calculation.</p> <p>Plot of key metrics over duration of test.</p>
4b	Keep-Warm, DH 60 °C Flow, 50 °C DHW.	<p>Assessment of whether valid keep-warm operation, based on 5a response time criteria: Pass/Fail.</p> <p>Observation on the operation of the HIU during keep-warm. Comment on HIU keep-warm controls options.</p> <p>Assessment of scaling risk based on extent and duration of temperatures in excess of 55.0 °C (1 decimal place).</p> <p>State average heat load for the duration of the test.</p> <p>State the average primary flowrate for the duration of the test.</p> <p>Note: Outputs used as input data to 'Low Temperature' Keep-warm Volume Weighted Average Return Temperature calculation.</p> <p>Plot of key metrics over duration of test.</p>
5a	DHW Response Time, DH 70 °C Flow, 55 °C DHW.	<p>Pass/Fail on DHW (at t_{32}) exceeding 65.0 °C (1 decimal place) for more than 10 consecutive seconds.</p> <p>State time to achieve 45.0 °C (1 decimal place) and not subsequently drop below 42.0 °C (1 decimal place).</p> <p>Plot t_{32}, t_{31}, t_{12}, q_1 over duration of test.</p>
5b	DHW Response Time, DH 60 °C Flow, 50 °C DHW.	<p>State time to achieve a DHW temperature 45.0 °C (1 decimal place) and not subsequently drop below 42.0 °C (1 decimal place).</p> <p>Comment on stability of DHW temperature.</p> <p>Plot t_{32}, t_{31}, t_{12}, q_1 over duration of the test.</p>

5 TEST RESULTS

5.1 Test 0 – Pressure Test

- 5.1.1 The appliance has passed the requirements of the static pressure test, Test 0 of the BESA Test Regime as:
- 5.1.2 There was No damage observed during the static pressure test, with the primary flow pressurised to 22.88 bar (1.43 times the rated value), and,
- 5.1.3 There were No leaks observed during the static pressure test, with the primary flow pressurised to 22.88 bar (1.43 times the rated value).

5.2 Test 1a to 1f – Space Heating 1-4 kW at 70 and 60°C

- 5.2.1 The plot of the key metrics of Tests 1a-1f for the space heating 1 - 4 kW at both 70 and 60 °C are displayed in Figure 7.1 to Figure 7.6 respectively. See Table 5.1 for summarised test results including the average primary return temperature, t_{12} .

Table 5.1 - Test Results for Space Heating Tests 1a to 1f

Test No & Description	Primary					Secondary				
	Flow Temperature	Return Temperature	Flow Rate	Differential Pressure	Heat Load	Return Temperature	Flow Temperature	Flow Rate	Differential Pressure	Heat Load
	$[t_{11}]$ [°C]	$[t_{12}]$ [°C]	$[q_1]$ [Ls ⁻¹]	$[\Delta p_1]$ [kPa]	$[P_1]$ [W]	$[t_{21}]$ [°C]	$[t_{22}]$ [°C]	$[q_2]$ [Ls ⁻¹]	$[\Delta p_2]$ [kPa]	$[P_2]$ [W]
1a - 1 kW Space Heating (DH 70 °C flow)	69.5	45.4	0.014	60.2	1322	40.0	59.9	0.013	1.1	1099
1b - 2 kW Space Heating (DH 70 °C flow)	69.6	43.8	0.022	62.4	2271	39.7	60.2	0.023	1.8	2019
1c - 4 kW Space Heating (DH 70 °C flow)	69.8	44.3	0.043	50.2	4442	39.9	60.5	0.048	9.0	4093
1d - Space Heating 1 kW (DH 60 °C flow)	59.6	40.1	0.017	62.8	1334	34.5	47.2	0.021	1.8	1100
1e - Space Heating 2 kW (DH 60 °C flow)	59.8	40.8	0.029	57.3	2293	34.8	46.8	0.042	8.0	2100
1f - Space Heating 4 kW (DH 60 °C flow)	59.9	38.6	0.051	49.7	4554	34.8	45.4	0.096	35.7	4290

5.3 Test 2a – DHW Dynamic Tapping at 70 °C

- 5.3.1 The appliance has passed the requirements of the DHW only at 70 °C, Test 2a of the BESA Test Regime as:
- 5.3.2 The domestic hot water output temperature, t_{32} did not exceed 65 °C for more than 10 seconds.
- 5.3.3 The maximum and minimum temperatures of t_{32} were 59.6 °C and 52.4 °C respectively.
- 5.3.4 The plot of the key metrics of the duration of Test 2a is displayed in Figure 7.7, Appendix A.

5.4 Test 2b – DHW Dynamic Tapping at 60 °C

- 5.4.1 The maximum and minimum temperatures of t_{32} were 57.0 °C and 48.0 °C respectively.
- 5.4.2 The plot of the key metrics of the duration of Test 2b is displayed in Figure 7.8, Appendix A.

5.5 Test 3a – Low Flow DHW at 70 °C

- 5.5.1 The appliance has passed the requirements of the Low Flow at 70 °C, Test 3a of the BESA Test Regime as:
- 5.5.2 The domestic hot water output temperature, t_{32} did NOT exceed 65 °C for more than 10 seconds, and,
- 5.5.3 The appliance did maintain the DHW output temperature, t_{32} at 55 ± 3 °C during the last 60 seconds of the test.
- 5.5.4 The maximum and minimum temperatures of t_{32} were 59.0 °C and 54.6 °C respectively.
- 5.5.5 The plot of the key metrics of the duration of Test 3a is displayed in Figure 7.9, Appendix A.

5.6 Test 3b – Low Flow DHW at 60 °C

- 5.6.1 The appliance did maintain stable flow temperatures during Low Flow at 60 °C, Test 3b of the BESA Test Regime.
- 5.6.2 The plot of the key metrics of the duration of Test 3b is displayed in Figure 7.10, Appendix A.

5.7 Test 4a – Keep-Warm at 70 °C

- 5.7.1 The appliance has passed the requirements of the Keep-warm at 70 °C, Test 4a of the BESA Test Regime as:
- 5.7.2 This is a valid keep warm operation based on 5a response time criteria, see 5.9.3.
- 5.7.3 The appliance is not performing keep-warm cycling as the primary flow temperature, t_{11} does not vary by more than ± 3 °C during the final 3 hours of the test. Please see BESA HIU Standard technical note TN-018 Version 1 for a more detailed definition of cyclical data.
- 5.7.4 The average heat load on the primary side P_1 is 105 W.
- 5.7.5 The average electrical consumption was 0 W.
- 5.7.6 The average primary flow q_1 over the 8 hours test was 11.9 l/hr.
- 5.7.7 The HIU has no option to turn a keep-warm setting on.
- 5.7.8 The plot of the key metrics of the duration of Test 4a is displayed in Figure 7.11, Appendix A.

5.8 Test 4b – Keep-Warm at 60 °C

- 5.8.1 The appliance has passed the requirements of the Keep-warm at 60 °C, Test 4b of the BESA Test Regime as:
- 5.8.2 This is a valid keep warm operation based on 5b response time criteria, see 5.10.1.
- 5.8.3 The appliance is not performing keep-warm cycling as the primary flow temperature, t_{11} does not vary by more than ± 3 °C during the final 3 hours of the test.
- 5.8.4 The average heat load on the primary side P_1 is 91 W.
- 5.8.5 The average primary flow q_1 over the 8 hours test was 18.0 l/hr.
- 5.8.6 The average electrical consumption was 0 W.
- 5.8.7 The HIU has no option to turn a keep-warm setting on.
- 5.8.8 The plot of the key metrics of the duration of Test 4b is displayed in Figure 7.12 Appendix A.

5.9 Test 5a – DHW Response Time at 70 °C

- 5.9.1 The appliance has passed the requirements of DHW Response Time at 70 °C, Test 5a of the BESA Test Regime as:
- 5.9.2 The domestic hot water output temperature, t_{32} did not exceed 65 °C for more than 10 seconds.
- 5.9.3 The DHW response time for t_{32} to reach 45 °C (and not subsequently drop below 42 °C) was 6 seconds; therefore this is a valid keep warm.
- 5.9.4 The plot of the key metrics of the duration of Test 5a is displayed in Figure 7.13, Appendix A.

5.10 Test 5b – DHW Response Time at 60 °C

- 5.10.1 The DHW response time for t_{32} to reach 45 °C (and not subsequently drop below 42 °C) was 5 seconds; therefore this is a valid keep warm.
- 5.10.2 The plot of the key metrics of the duration of Test 5b is displayed in Figure 7.14, Appendix A.

5.11 Overall Scaling Risk Assessment

- 5.11.1 If any of the below factors occur, then the risk of scaling of the DHW plate in hard water areas increases.

Table 5.2 - Overall Scaling Risk Assessment

<i>HIU has a TMV or TRV on the output of the DHW plate heat exchanger.</i>	No	
Test Designation	2a	3a
<i>t_{32} above 60°C for more than 5 seconds</i>	No	No
<i>t_{12} exceeds 55°C at any point of the test</i>	No	No
Test Designation	4a	4b
<i>t_{12} exceeds 50°C at any time</i>	Yes	Yes

5.12 VWART Calculations

- 5.12.1 The Volume Weighted Average Return Temperatures (VWART) have been calculated as stipulated in the BESA UK HIU Test Regime document. The calculated VWART values for both the high temperature and low temperature tests described in this report are given below in Table 5.3 and Table 5.4 respectively.

Table 5.3 – High Temperature VWART Calculations

Description	Symbol	Value	Unit
Annual Heating Period Percentage	SH _{PROP}	7.0	%
Annual Non-Heating Period Percentage	NSH _{PROP}	93.0	%
Space Heating Volume Weighted Return Temperature	VWART _{SH}	44	°C
DHW Volume Weighted Return Temperature	VWART _{DHW}	14	°C
Keep Warm Volume Weighed Return Temperature	VWART _{KWM}	53	°C
Annual Volume Weighted Return Temperature for Heating Period	VWART _{HEAT}	44	°C
Annual Volume Weighted Return Temperature for Non-Heating	VWART _{NONHEAT}	45	°C
Total Annual Volume Weighted Return Temperature	VWART _{OVERALL}	45	°C

Table 5.4 – Low Temperature VWART Calculations

Description	Symbol	Value	Unit
Annual Heating Period Percentage	SH _{PROP}	6.7	%
Annual Non-Heating Period Percentage	NSH _{PROP}	93.3	%
Space Heating Volume Weighted Return Temperature	VWART _{SH}	40	°C
DHW Volume Weighted Return Temperature	VWART _{DHW}	17	°C
Keep Warm Volume Weighed Return Temperature	VWART _{KWM}	52	°C
Annual Volume Weighted Return Temperature for Heating Period	VWART _{HEAT}	41	°C
Annual Volume Weighted Return Temperature for Non-Heating	VWART _{NONHEAT}	46	°C
Total Annual Volume Weighted Return Temperature	VWART _{OVERALL}	46	°C

6 CONCLUSIONS

6.1.1 The appliance has passed the performance requirements of the BESA HIU Test Regime.

7 APPENDIX A

7.1 Key Metric Plots

- 7.1.1 The graphical plots of the key metrics of the tests described in this report are given in this section.

GRAPHICAL PLOTS START ON NEXT PAGE

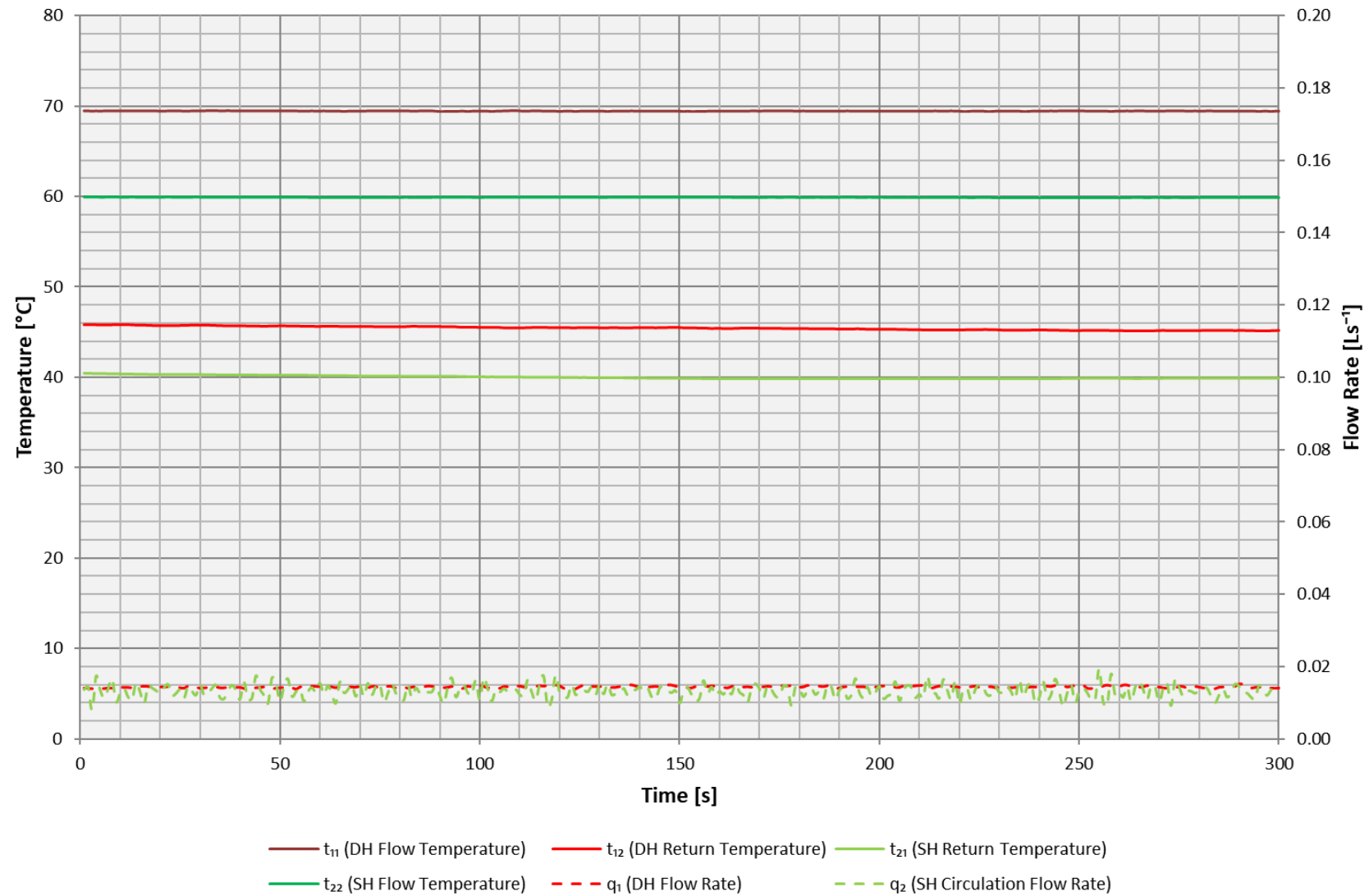


Figure 7.1 - Test 1a – Space Heating 1 kW at 70 °C

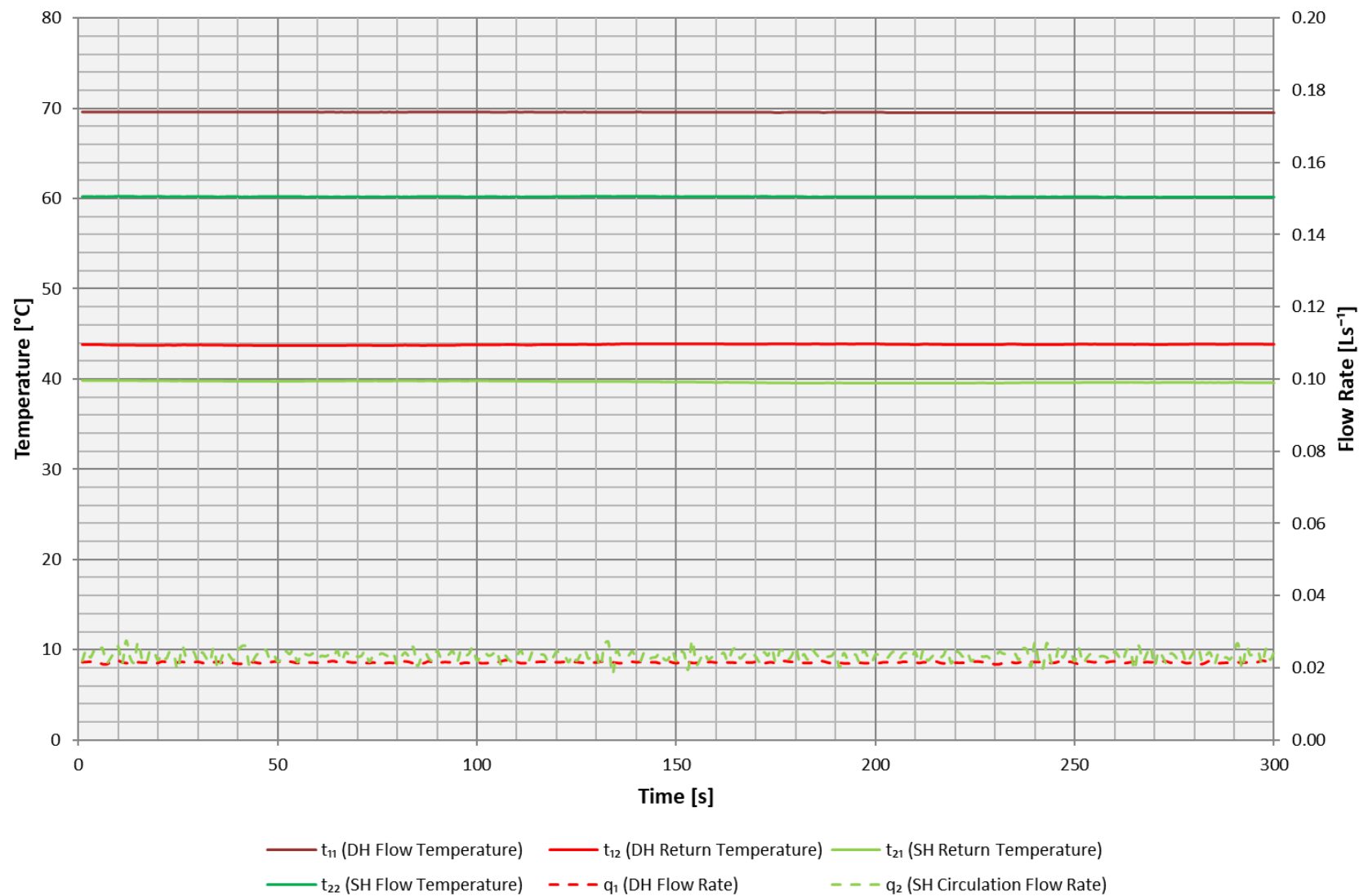


Figure 7.2 - Test 1b – Space Heating 2 kW at 70 °C

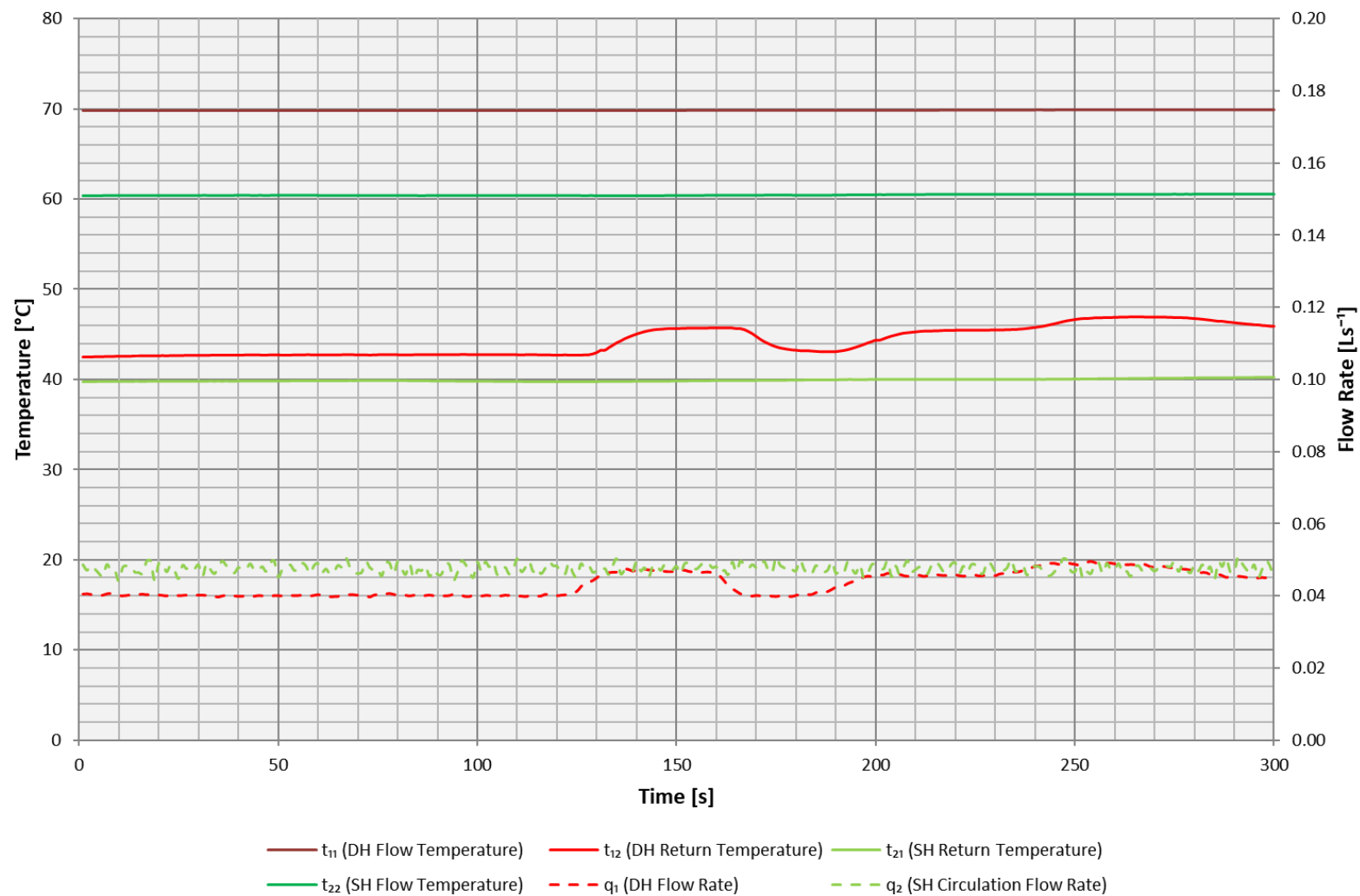


Figure 7.3 - Test 1c – Space Heating 4 kW at 70 °C

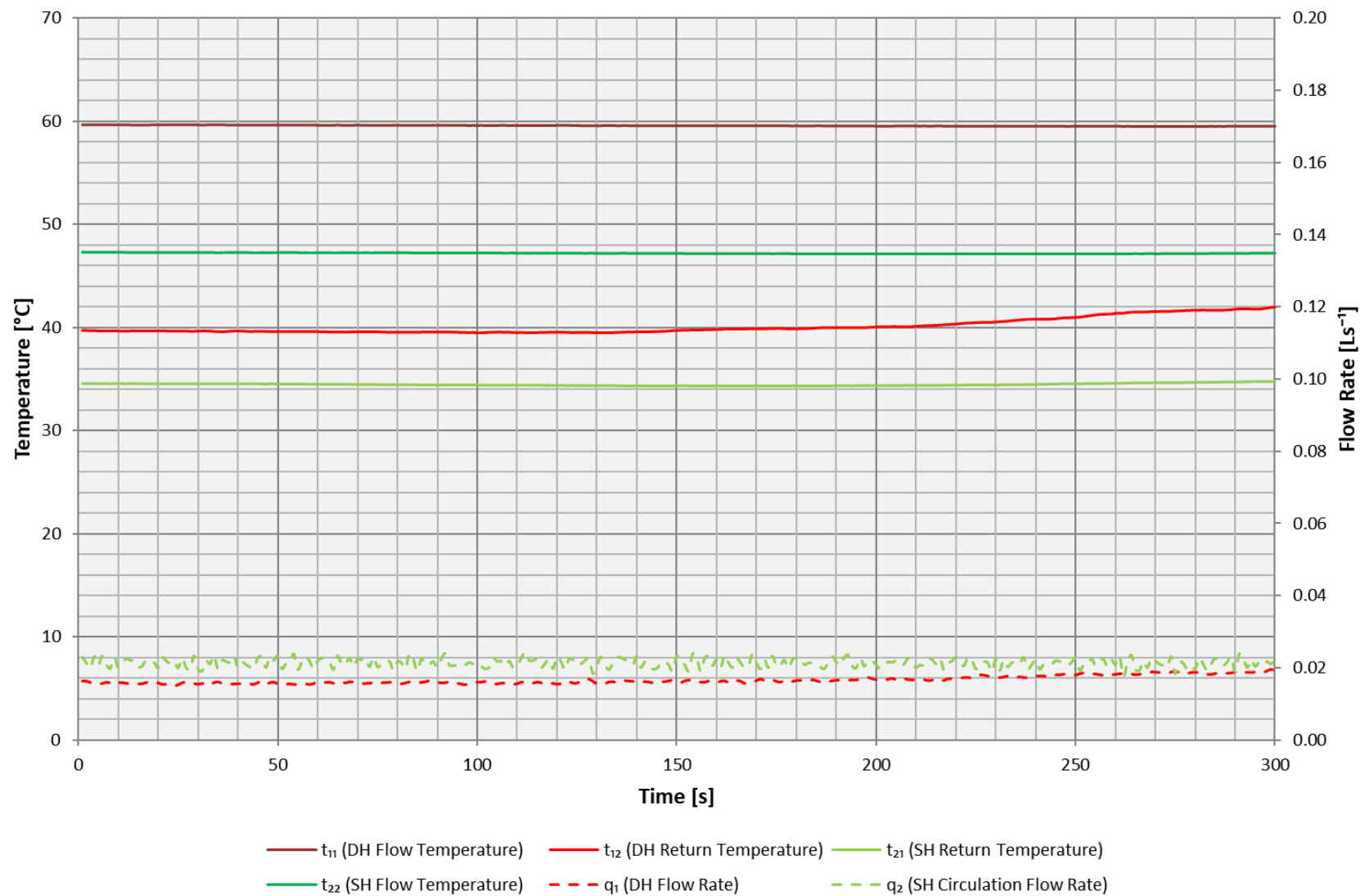


Figure 7.4 - Test 1d – Space Heating 1 kW at 60 °C

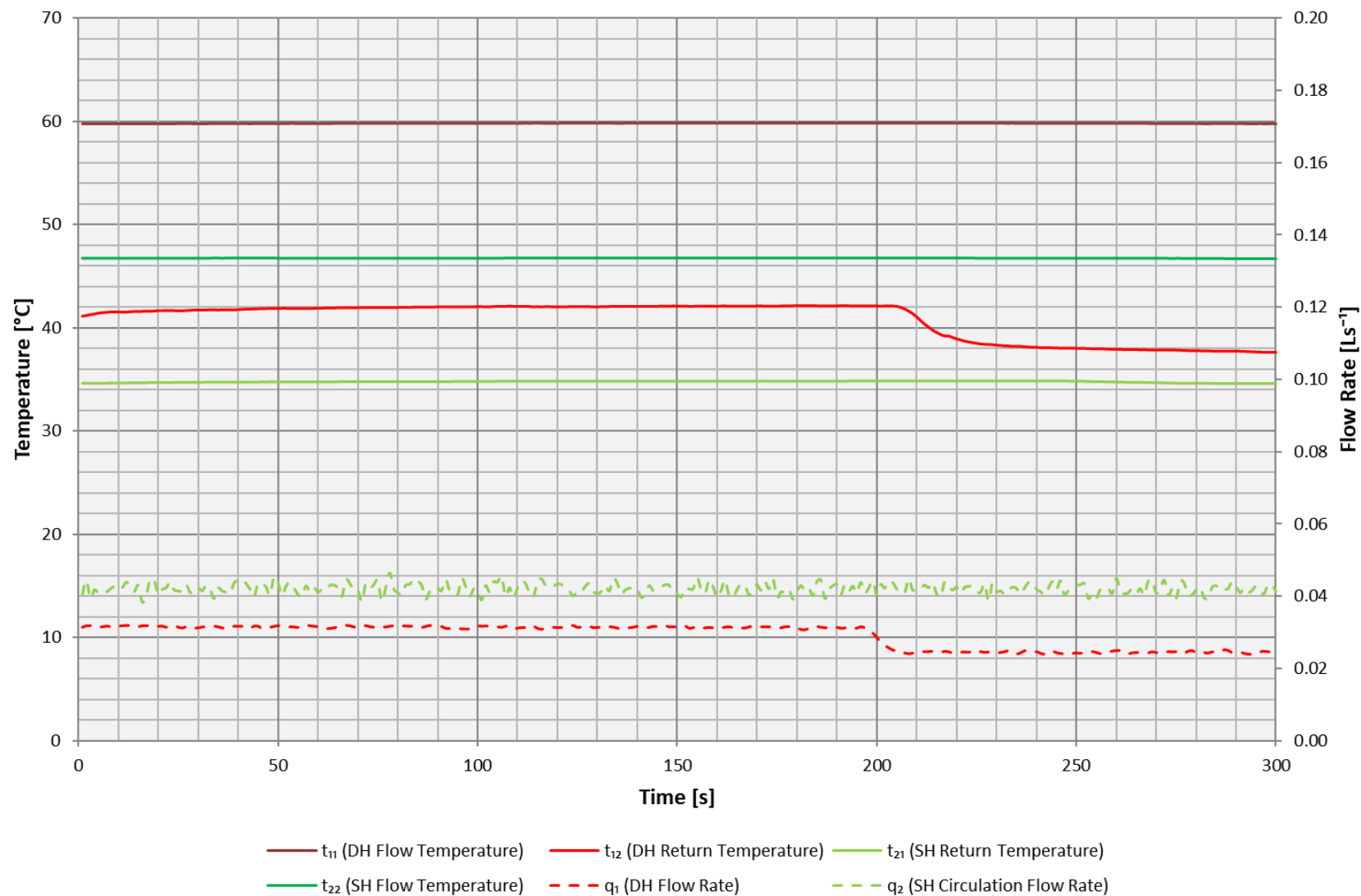


Figure 7.5 - Test 1e – Space Heating 2 kW at 60 °C

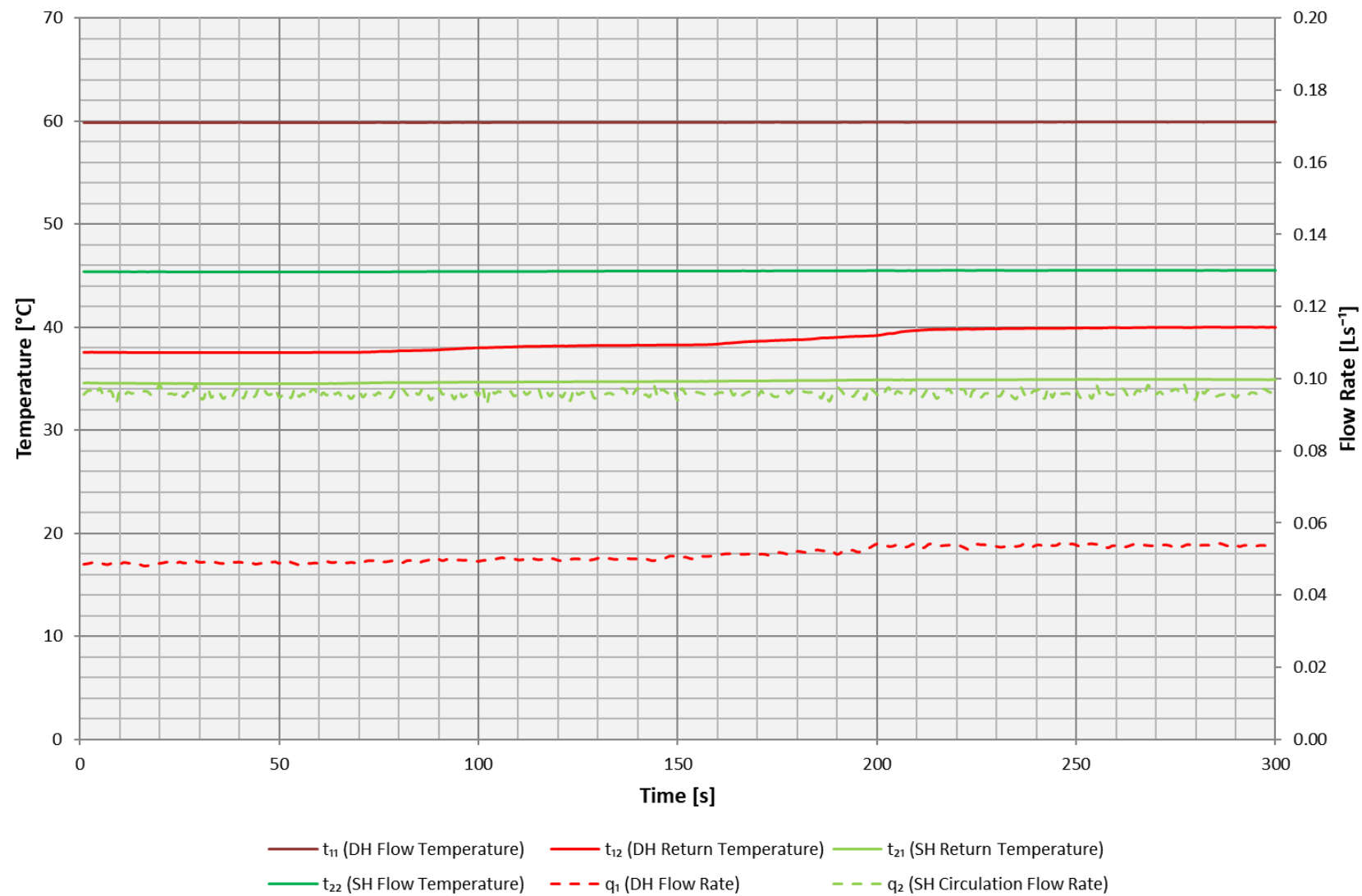


Figure 7.6 - Test 1f – Space Heating 4 kW at 60 °C

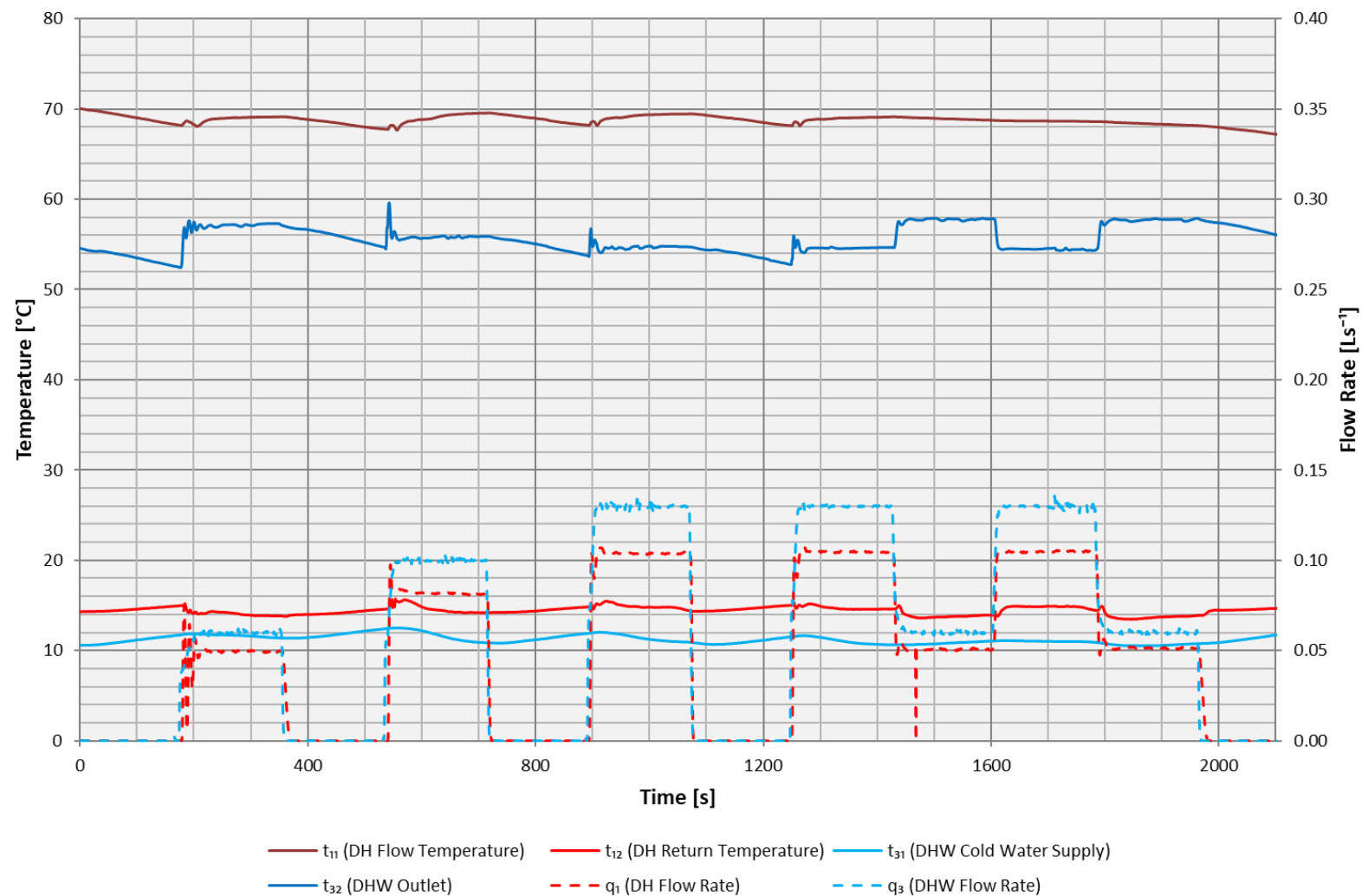


Figure 7.7 - Test 2a – DHW Only at 70 °C

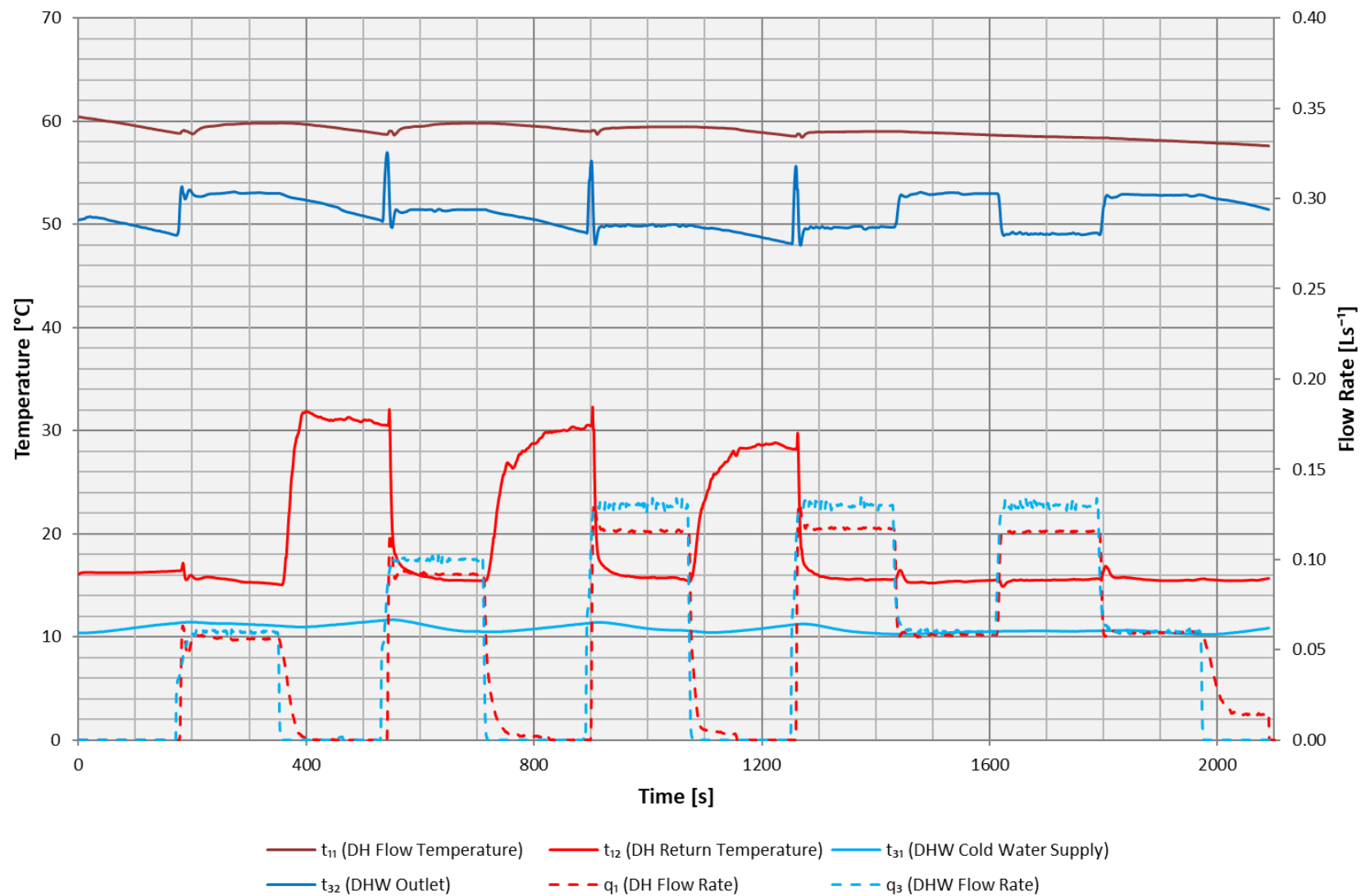


Figure 7.8 - Test 2b – DHW Only at 60 °C

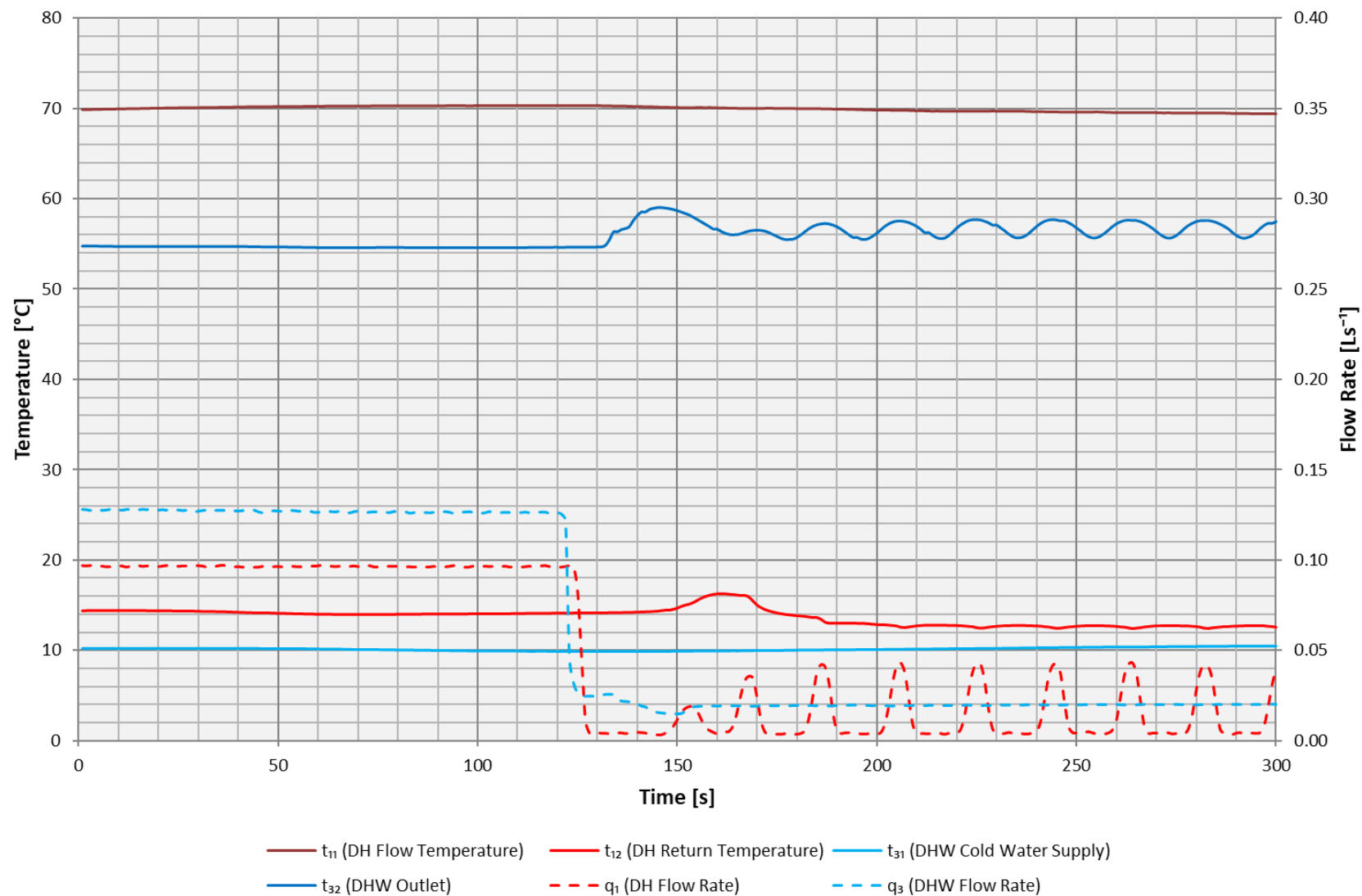


Figure 7.9 - Test 3a – Low Flow DHW at 70 °C

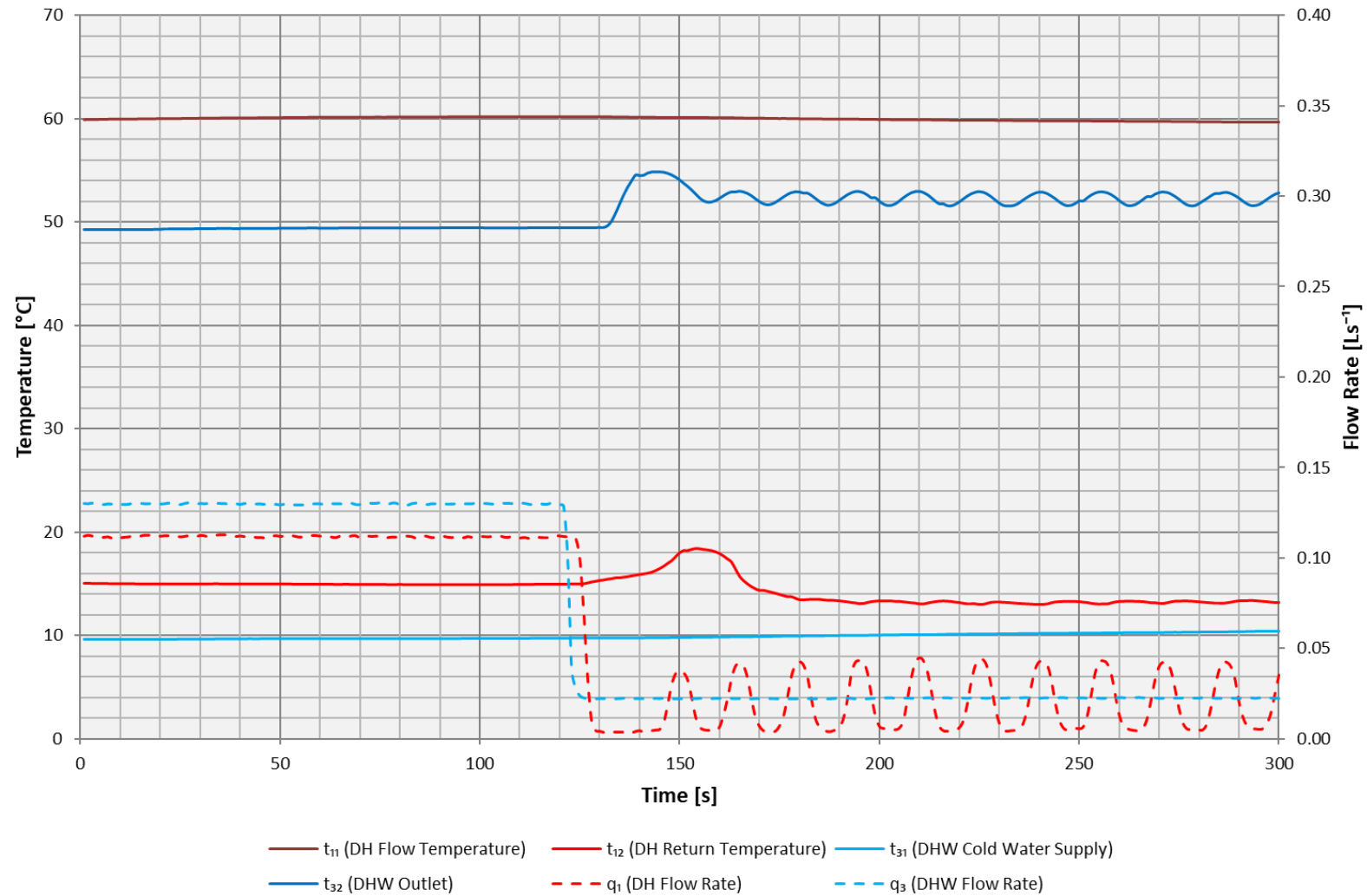


Figure 7.10 - Test 3b – Low Flow DHW at 60 °C

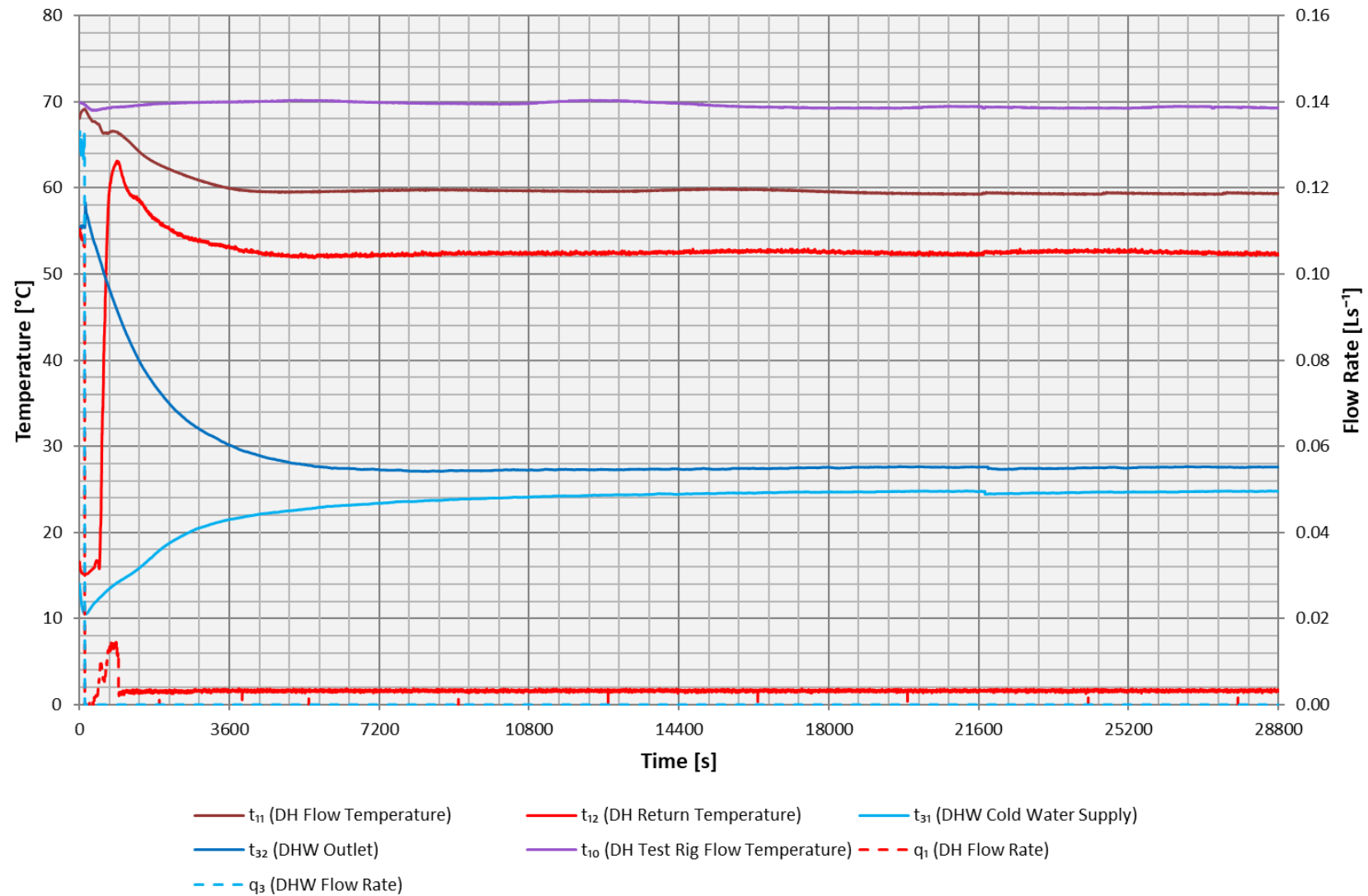


Figure 7.11 - Test 4a – Keep-Warm at 70 °C

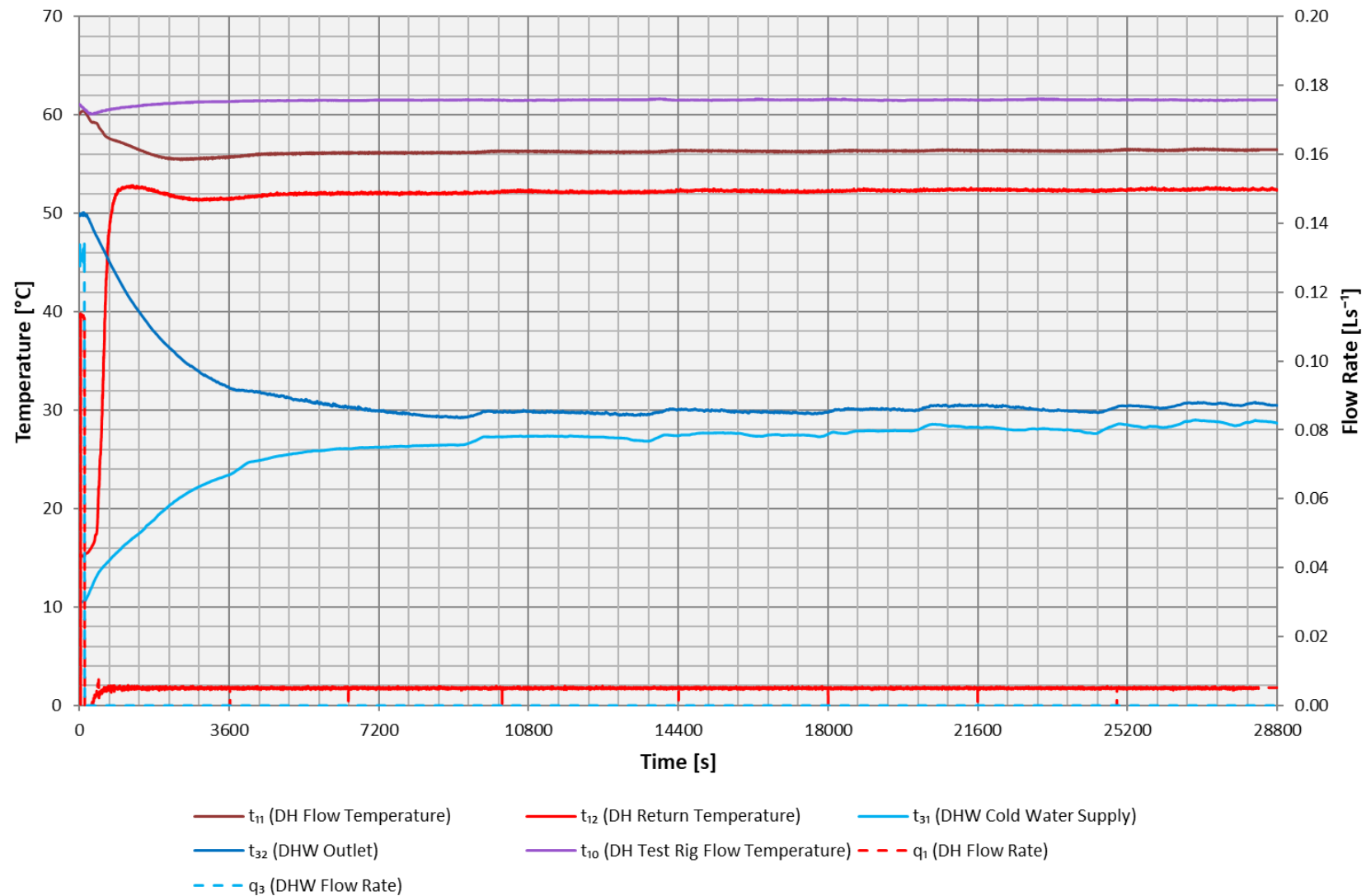


Figure 7.12 - Test 4b – Keep-Warm at 60 °C

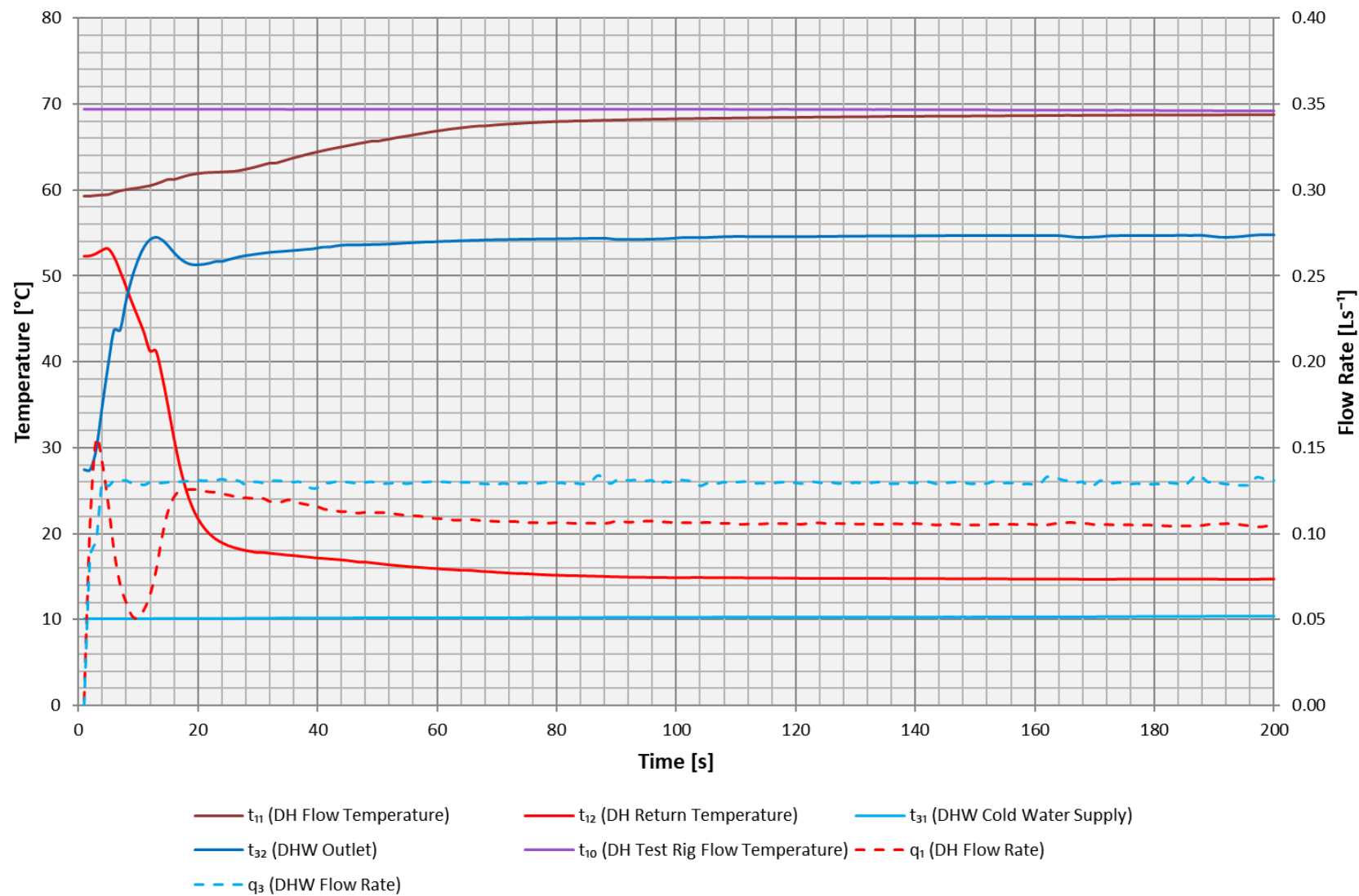


Figure 7.13 - Test 5a – DHW Response Time at 70 °C

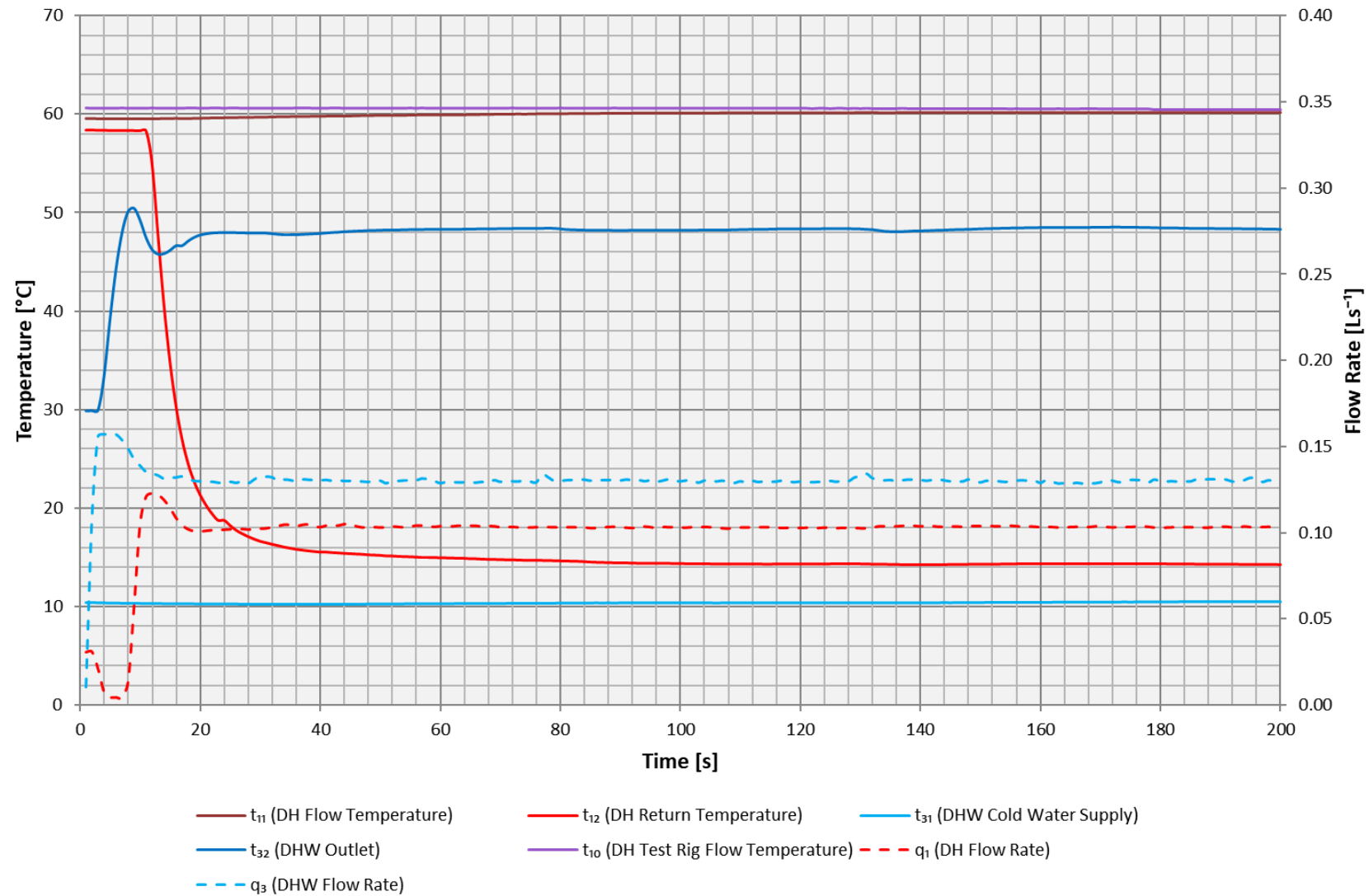


Figure 7.14 - Test 5b – DHW Response Time at 60 °C

7.2 Key Metric and VWARD Summary

- 7.2.1 The summary tables of the key metrics and VWARDS of the tests described in this report are given in this section.

SUMMARY TABLES START ON NEXT PAGE



VWART Calculation with Keep Warm

Test carried out by Enertek International for High Temperature BESA Tests

Manufacturer: Kodsan

Model: KFFR-123-722

Serial number: 012111-0001

Calculation performed by S.Broxham of Enertek on: 05/01/2022

Primary Flow Temperature: 70°C

DHW Setpoint: 55°C

Space Heating Temperature: 60/40°C

	VWART (°C)	Volume (m3)
DHW	14	23.2
Standby	53	95.9
Space Heating	44	56.4

	VWART with keep warm active	
Period	VWART (°C)	% Time
No Heating	45	93%
Heating	44	7%
Overall	45	

Test Results									
		Power (p1) [W]	Primary flow [m³/hr]	VWART [°C]	Energy Used [kWh]	Annual Operation [Hours]	Volume [m³]	Events [Per Year]	Average duration [Seconds]
1kW Space Heating	1a	1322	0.052	45	118	89.2	4.63	-	-
2kW Space Heating	1b	2271	0.078	44	885	389.8	30.23	-	-
4kW Space Heating	1c	4442	0.156	44	613	138.0	21.57	-	-
DHW Low Flow Rate	2a	10979	0.171	14	724	66.4	11.35	-	-
DHW Medium Flow Rate	2a	17728	0.279	15	295	16.8	4.67	-	-
DHW High Flow Rate	2a	22841	0.361	15	443	19.4	7.02	-	-
DHW Post Low Flow Rate	2a	-	0.006	14	-	-	0.14	10000	30
DHW Post Medium Flow Rate	2a	-	0.000	14	-	-	0.00	660	70
DHW Post High Flow Rate	2a	-	0.000	0	-	-	0.00	300	145
DHW Keep Warm Standby	4a	-	0.012	53	-	8040.4	95.86	-	-

Table 7.1 - Key Metrics of High Temperature Package



VWART Calculation with Keep Warm

Test carried out by Enertek International for Low Temperature BESA Tests

Manufacturer: Kodsan

Model: KFFR-123-722

Serial number: 012111-0001

Calculation performed by S.Broxham of Enertek on: 05/01/2022

Primary Flow Temperature: 60°C

DHW Setpoint: 50°C

Space Heating Temperature: 45/35°C

	VWART (°C)	Volume (m3)
DHW	17	27.8
Standby	52	145.2
Space Heating	40	68.5

	VWART with keep warm active	
Period	VWART (°C)	% Time
No Heating	46	93%
Heating	41	7%
Overall	46	

Test Results									
		Power (p1) [W]	Primary flow [m³/hr]	VWART [°C]	Energy Used [kWh]	Annual Operation [Hours]	Volume [m³]	Events [Per Year]	Average duration [Seconds]
1kW Space Heating	1d	1334	0.060	40	115	86.1	5.13	-	-
2kW Space Heating	1e	2293	0.105	41	855	373.1	39.05	-	-
4kW Space Heating	1f	4554	0.185	39	600	131.8	24.33	-	-
DHW Low Flow Rate	2b	8716	0.161	18	652	83.6	13.48	-	-
DHW Medium Flow Rate	2b	16373	0.310	17	280	18.1	5.62	-	-
DHW High Flow Rate	2b	20673	0.394	17	420	21.5	8.45	-	-
DHW Post Low Flow Rate	2b	-	0.000	0	-	-	0.00	10000	30
DHW Post Medium Flow Rate	2b	-	0.035	21	-	-	0.12	660	70
DHW Post High Flow Rate	2b	-	0.021	24	-	-	0.12	300	145
DHW Keep Warm Standby	4b	-	0.018	52	-	8045.7	145.21	-	-

Table 7.2 - Key Metrics of Low Temperature Package

8 APPENDIX B

8.1 Appliance Documentation

8.1.1 The details of the appliance documentation are given in Table 8.1 below.

Table 8.1 – Documentation Supplied

	Component:	Document Submitted (Y/N):	Manufacturer and Type:
1	Space Heating Heat Exchanger	Y	E8lasw-Nx20 SWEP
2	Domestic Hot Water Heat Exchanger	Y	E8LASW-Nx40 SWEP
3	Controller for Space Heating – Thermostatic Valve	Y	Kodsan-WU A2/tf36 20/70c
4	Controller for DHW – Thermostatic Valve	Y	Kodsan-WU A2/tf36 20/70c
5	Differential pressure control valve	Y	Frese PV compact 5-30kPa
6	Heat Meter	Y	MINO, MINOCAL C5-IUF
7	Mini Ball Valve	Y	GPD
8	Strainer Primer Side	Y	Kodsan
9	Manual air vent space heating and DHW	Y	CALEFFI
10	Analogue Manometer	Y	Pakkens
11	Analogue Thermometer	Y	Pakkens
12	Expansion Vessel	Y	ONAYSAN RFA0700
13	Circulating pump	Y	Grundfos UPM3 98938540
14	Safety relief valve	Y	CASE
15	Zone Control Valve	Y	Siemens Acvatix SUA2 1/3
16	Ball valve	Y	RBM
17	Non-return Valve	Y	Kodsan
18	Terminal Cable box	Y	Kodsan
19	Pipes	Y	Kodsan
20	Fittings	Y	Kodsan
21	Gaskets	Y	Kodsan
22	Pipe Insulation	Y	Kodsan
A1	Case Insulation	Y	Kodsan
A3	Operation Guides with a Function Description / Description of Operation and Care Instructions as Suited to the Intended User Category	Y	Kodsan HIU Manual
A4	Declaration of Conformity for CE-Marked HIUs	Y	
A5	Full Parameter List for Electrically Controlled HIUs	Y	
A6	Maximum Primary Static Operating Differential Pressure	Y	
A7	Deactivation Procedure of the Internal SH Pump	Y	
	Model Name and Type Number	Y	KFFR-61-722.FI.16.0
	Software Version / Date of Issue	Y	N/A – Mechanical HIU
	Serial Number	Y	012103-0001

8.2 Appliance Photographs



Figure 8.1 – Photograph of Appliance [Case Fitted]



Figure 8.2 – Photograph of Appliance [Case Removed]

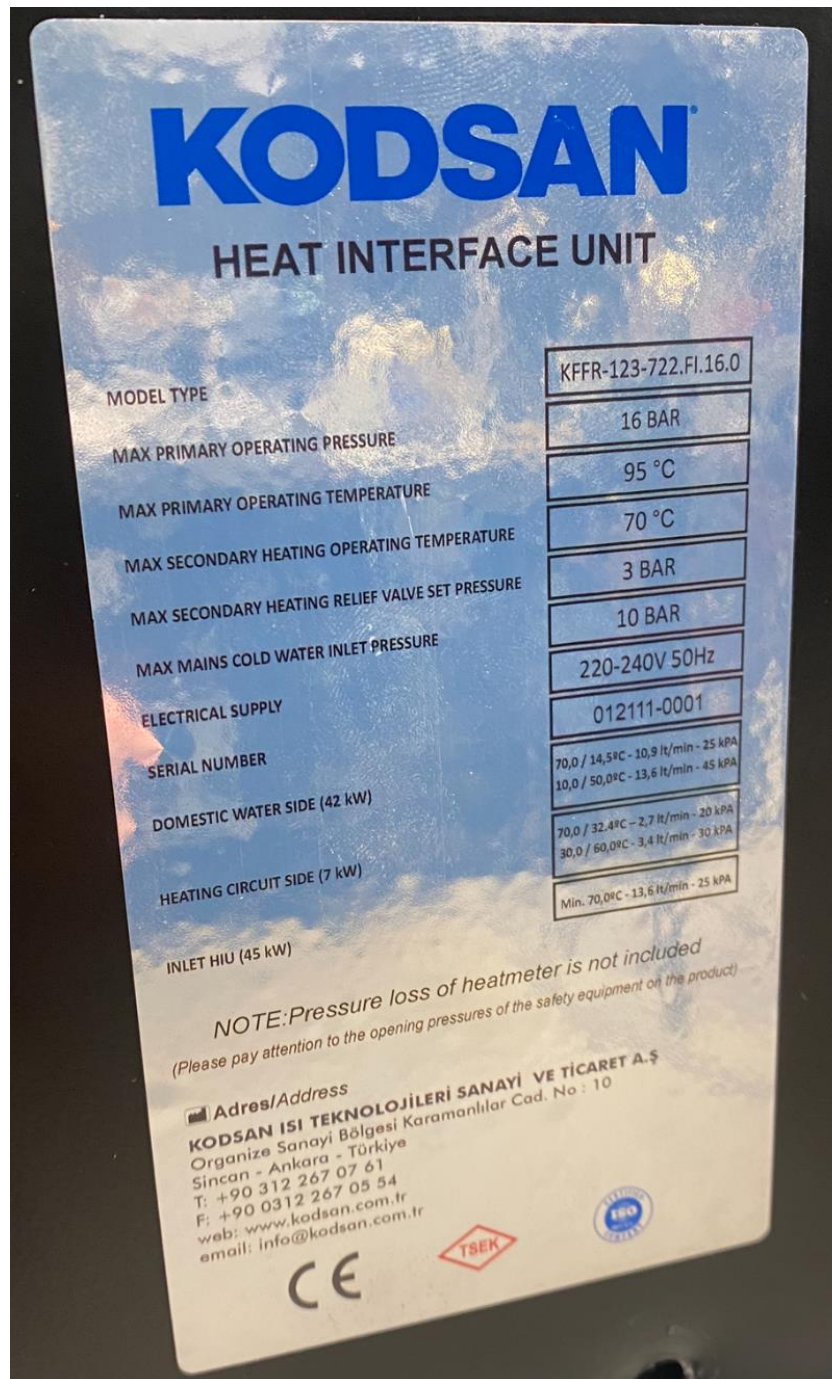


Figure 8.3 – Appliance Data Label

8.3 Calibrations and Uncertainties

8.3.1 A list of equipment, their calibrations and uncertainties are given in Table 8.2 below.

Table 8.2 - EIL Equipment Calibration and Uncertainties

Equipment Name	ID Number	Calibration Certificate	Measurement Uncertainty $K=2 \frac{U}{\sqrt{20}}$	Units	Calibration Date	Calibration Due
Flow Meter [Primary Flow Rate]	FM 601	K48376FW1S2	±0.0004	l/s	07/07/2021	07/2022
Flow Meter [DHW Flow Rate]	FM 602	K48378FW	±0.00305	l/s	07/07/2021	07/2022
Flow Meter [SH Flow Rate]	FM 603	K48377FW	±0.04871	l/s	06/07/2021	07/2022
Flow Meter [DHW Flow Rate]	FM 605	K48375FW	±0.00576	l/s	05/07/2021	07/2022
Pressure Transducer [Primary Supply]	PT 086	K48379P	±6.91	kPa	05/07/2021	07/2022
Pressure Transducer [Primary Return]	PT 085	K48384P	±8.54	kPa	05/07/2021	07/2022
Pressure Transducer [DHW Output Pressure]	PT 083	K48380P	±21.27	kPa	05/07/2021	07/2022
Pressure Transducer [DHW Cold Water Supply]	PT 084	K48383P2	±9.21	kPa	20/07/2021	07/2022
Pressure Transducer [SH Flow]	PT 087	K48382P	±7.10	kPa	05/07/2021	07/2022
Pressure Transducer [SH Return]	PT 088	K48381P	±15.24	kPa	05/07/2021	07/2022
PRT Probe [Primary Supply Temp]	PRT 4709	443851	±0.6	°C	10/07/2021	07/2022
PRT Probe [Primary Return Temp]	PRT 4708	443851	±0.6	°C	10/07/2021	07/2022
PRT Probe [DHW Output Temp]	PRT 4711	443852	±0.6	°C	10/07/2021	07/2022
PRT Probe [Cold Water Supply Temp]	PRT 4710	443852	±1.91	°C	10/07/2021	07/2022
PRT Probe [SH Supply Temp]	PRT 4707	443851	±0.57	°C	10/07/2021	07/2022

Equipment Name	ID Number	Calibration Certificate	Measurement Uncertainty $K=2 \frac{U}{\sqrt{20}}$	Units	Calibration Date	Calibration Due
PRT Probe [SH Return Temp]	PRT 4706	443851	±1.06	°C	10/07/2021	07/2022
Pressure Transducer [Static Pressure Test]	PT 090	U100553-19	±50	kPa	21/11/2019	20/11/2021
Power Meter [Electrical Consumption]	PM1022	U103585-20	±1.03	W	28/07/2021	09/2021
Software	VERSION – LabVIEW, Version 5, Service pack 1					

Report Issue No	Reason for Report Update
1	Original Issue 18/01/2022
2	Graphs updated. 13/06/2022

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