Enertek International

International Consultants In Product Research, Design, Development & Certification

Project Number:	E4501
Project Title:	BESA testing for George Fischer HPTP Indirect HIU
Client:	George Fischer Sales
Client Address	Paradise way Coventry CV2 2ST
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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 George Fischer HPTP Heat Interface unit on behalf of George Fischer Sales.

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 requirements, 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 have been used within this report:

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 Weighed 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 HPTP Indirect Heat Interface Unit appliance are given in Table 3.1. Photograph of the installed appliance is given in Figure 8.2.

Table 3.1 – Appliance Details

Item	Description
Manufacturer	George Fischer Sales
Model	HPTP Indirect Heat Interface Unit
Serial number	GF21020001
Year of manufacture	2020
DHW priority	Yes

3.2 Appliance Design Pressures

3.2.1 The maximum design pressures of the HPTP Indirect Heat Interface Unit appliance for the primary side and the secondary side 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 HPTP Indirect Heat Interface Unit appliance for the primary side and the secondary side 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	85	°C
Secondary Side DHW	65	°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[1]. 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.

4.2.4 As the George Fischer Sales, HPTP Indirect Heat Interface Unit 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 8.2, Appendix B.

[1] UK HIU Test Regime Technical Specification, Rev-009 requirements, issued by the Building Engineering Services Association (BESA)

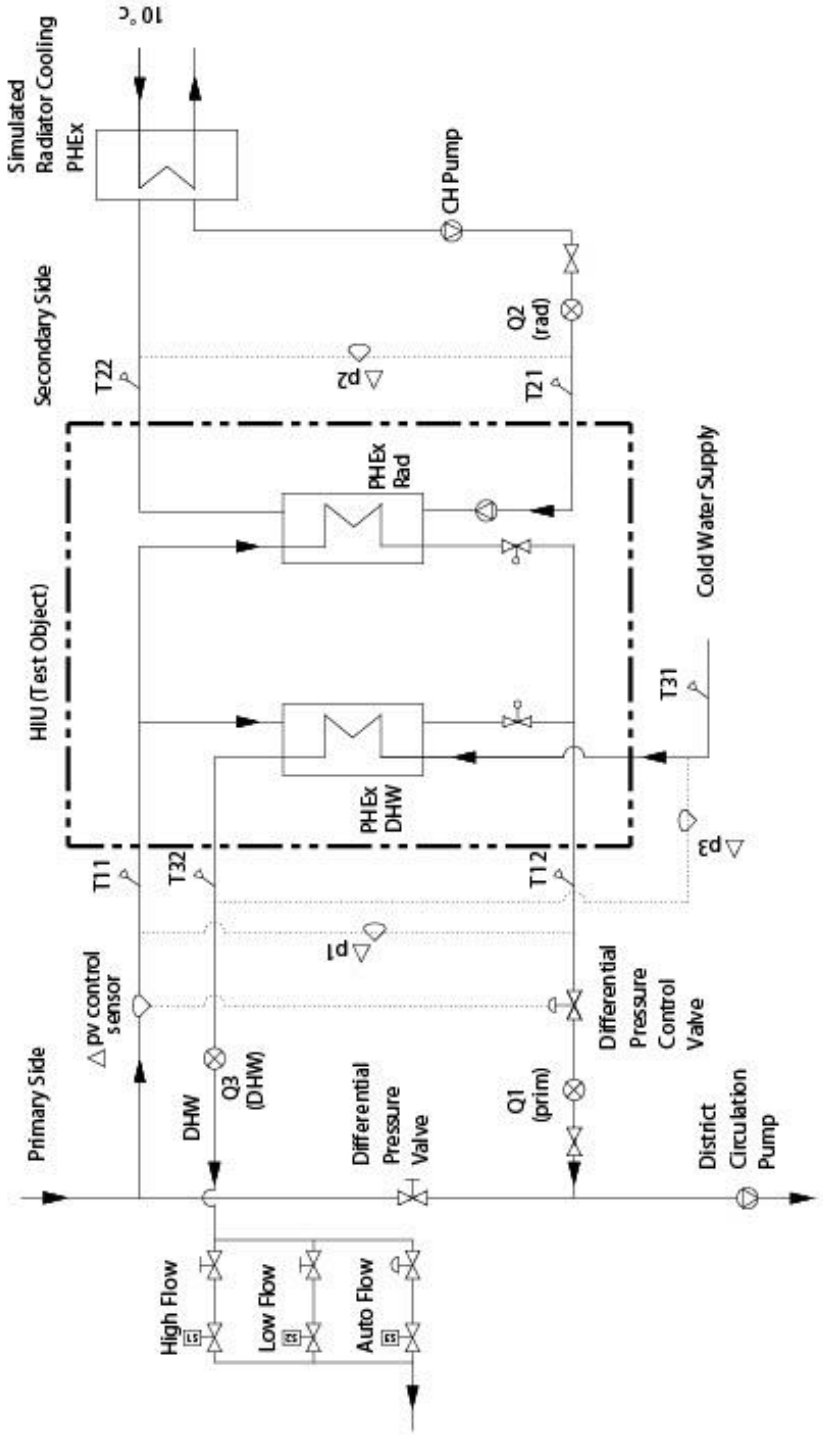

Figure 4.1 – EIL's HIU Test Rig schematic

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
Symbol		*[p_1]*	*[Δp_1]*	*[t_{11}]*	*[t_{32}]*	*[q_3]*	*[P_3]*	*[t_{22}]*	*[t_{21}]*	*[P_2]*
Units		*[kPa]*	*[kPa]*	*[°C]*	*[°C]*	*[Ls^{-1}]*	*[kW]*	*[°C]*	*[°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. Plot of key metrics over duration of test. **Note**: Outputs used as input data to 'High Temperature' Space Heating Volume Weighted Average Return Temperature calculation.
1b	Space heating 2 kW, 60/40 °C secondary.	
1c	Space heating 4 kW, 60/40 °C secondary.	
1d	Space heating 1 kW, 45/35 °C secondary.	t_{11} – Primary flow temperature. t_{12} – Primary return temperature. Plot of key metrics over duration of test. **Note**: Outputs used as input data to 'Low Temperature' Space Heating Volume Weighted Average Return Temperature calculation.
1e	Space heating 2 kW, 45/35 °C secondary.	
1f	Space heating 4 kW, 45/35 °C secondary.	
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.	Assessment of whether valid keep-warm operation, based on 5a response time criteria: Pass/Fail. Comment on HIU keep-warm controls options. Assessment of scaling risk based on duration of temperatures in excess of 55.0 °C (1 decimal place). State average heat load for the duration of the test. State the average primary flow rate for the duration of the test. Note: Outputs used as input data to 'High Temperature' Keep-warm Volume Weighted Average Return Temperature calculation. Plot of key metrics over duration of test.
4b	Keep-warm, DH 60 °C flow; 50 °C DHW.	Assessment of whether valid keep-warm operation, based on 5a response time criteria: Pass/Fail. Observation on the operation of the HIU during keep-warm. Comment on HIU keep-warm controls options. Assessment of scaling risk based on extent and duration of temperatures in excess of 55.0 °C (1 decimal place). State average heat load for the duration of the test. State the average primary flowrate for the duration of the test. **Note:** Outputs used as input data to 'Low Temperature' Keep-warm Volume Weighted Average Return Temperature calculation. Plot of key metrics over duration of test.
5a	DHW response time, 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. State time to achieve 45.0 °C (1 decimal place) and not subsequently drop below 42.0 °C (1 decimal place). Plot t_{32}, t_{31}, t_{12}, q_1 over duration of test.
5b	DHW response time, DH 60 °C flow; 50 °C DHW.	State time to achieve a DHW temperature 45.0 °C (1 decimal place) and not subsequently drop below 42.0 °C (1 decimal place). Comment on stability of DHW temperature. Plot t_{32}, t_{31}, t_{12}, q_1 over duration of test.

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	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)	70.2	44.2	0.010	50.9	1129	39.9	58.8	0.013	1.4	1038
1b	- 2 kW Space Heating (DH 70 °C flow)	70.2	43.4	0.018	50.0	1964	40.1	58.5	0.025	2.0	1923
1c	- 4 kW Space Heating (DH 70 °C flow)	70.2	45.1	0.038	51.5	3970	39.9	59.9	0.048	1.7	4034
1d	- Space Heating 1 kW (DH 60 °C flow)	59.9	35.9	0.011	53.7	1057	35.4	44.7	0.025	1.1	985
1e	- Space Heating 2 kW (DH 60 °C flow)	60.2	35.8	0.020	52.7	2030	35.0	44.6	0.049	0.4	1970
1f	- Space Heating 4 kW (DH 60 °C flow)	59.9	36.5	0.041	48.5	4051	34.9	44.8	0.096	4.7	3990

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 58.9°C and 45.39°C respectively.

5.3.4 The plot of the key metrics of the duration of Test 2a is displayed in Figure 7.7, Appendix.

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

5.4.1 The maximum and minimum temperatures of t_{32} were 53.7°C and 43.3°C respectively.

5.4.2 The plot of the key metrics of the duration of Test 2b is displayed in Figure 7.8, Appendix.

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 did 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 58.2°C and 47.5°C respectively.

5.5.5 The plot of the key metrics of the duration of Test 3a is displayed in Figure 7.9, Appendix.

5.6 Test 3b – Low Flow DHW at 60 °C

5.6.1 The appliance has passed the requirements of the Low Flow at 60 °C, Test 3b of the BESA Test Regime as:

5.6.2 The maximum and minimum temperatures of t_{32} were 51.3°C and 45.3°C respectively.

5.6.3 The plot of the key metrics of the duration of Test 3b is displayed in Figure 7.10, Appendix.

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.

5.7.4 The average heat load on the primary side P_1 is 48 W.

5.7.5 The average electrical consumption was 1.87W.

5.7.6 The average primary flow q_1 over the 8 hours test was 2.7 l/hr.

5.7.7 The Keep-warm control was set to on.

5.7.8 The plot of the key metrics of the duration of Test 4a is displayed in Figure 7.11, Appendix.

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} varies 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 47 W.

5.8.5 The average primary flow q_1 over the 8 hours test was 3.9 l/hr.

5.8.6 The average electrical consumption was 1.87 W.

5.8.7 The Keep-warm control was set to on.

5.8.8 The plot of the key metrics of the duration of Test 4b is displayed in Figure 7.12, Appendix.

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 ≤15 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.

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 ≤15 seconds; therefore this is not 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.

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

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

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	%
Annual Non-Heating Period percentage	NSH_{PROP}	93	%
Space Heating Volume Weighted Return Temperature	$VWART_{SH}$	44	°C
DHW Volume Weighted Return Temperature	$VWART_{DHW}$	21	°C
Keep Warm Volume Weighted Return Temperature	$VWART_{KWM}$	40	°C
Annual Volume Weighted Return Temperature for Heating Period	$VWART_{HEAT}$	43	°C
Annual Volume Weighted Return Temperature for Non-Heating	$VWART_{NONHEAT}$	28	°C
Total Annual Volume Weighted Return Temperature	$VWART_{OVERALL}$	29	°C

Table 5.4 – Low Temperature VWART Calculations

Description	Symbol	Value	Unit
Annual Heating Period percentage	SH_{PROP}	7	%
Annual Non-Heating Period percentage	NSH_{PROP}	93	%
Space Heating Volume Weighted Return Temperature	$VWART_{SH}$	36	°C
DHW Volume Weighted Return Temperature	$VWART_{DHW}$	25	°C
Keep Warm Volume Weighed Return Temperature	$VWART_{KWM}$	40	°C
Annual Volume Weighted Return Temperature for Heating Period	$VWART_{HEAT}$	36	°C
Annual Volume Weighted Return Temperature for Non-Heating	$VWART_{NONHEAT}$	31	°C
Total Annual Volume Weighted Return Temperature	$VWART_{OVERALL}$	32	°C

6 CONCLUSIONS

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

All conclusions, opinions and interpretations indicated in this report are outside the scope of Enertek's UKAS accreditation.

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

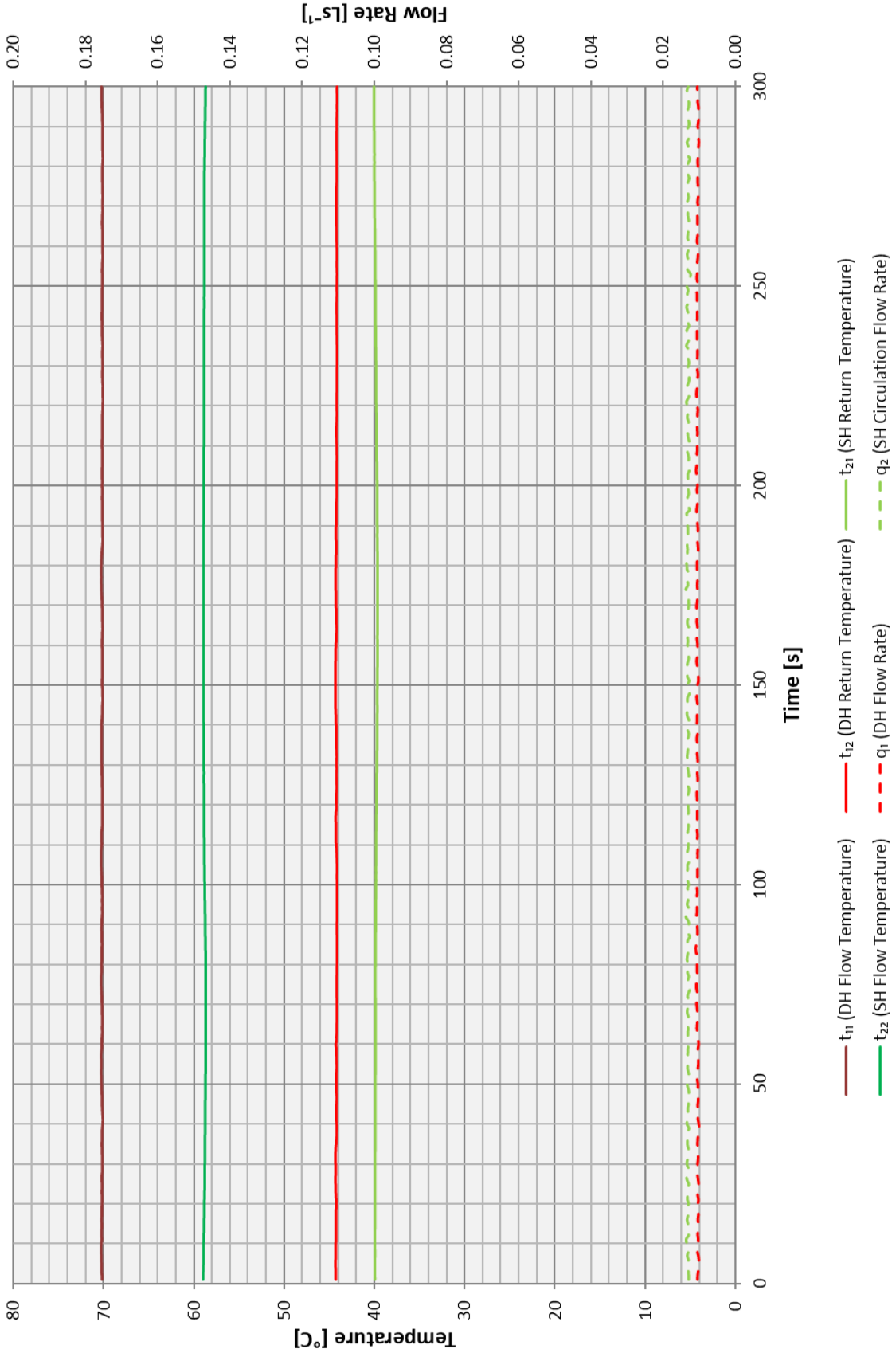

Figure 7.1 - Test 1a – Space Heating 1 kW at 70 °C

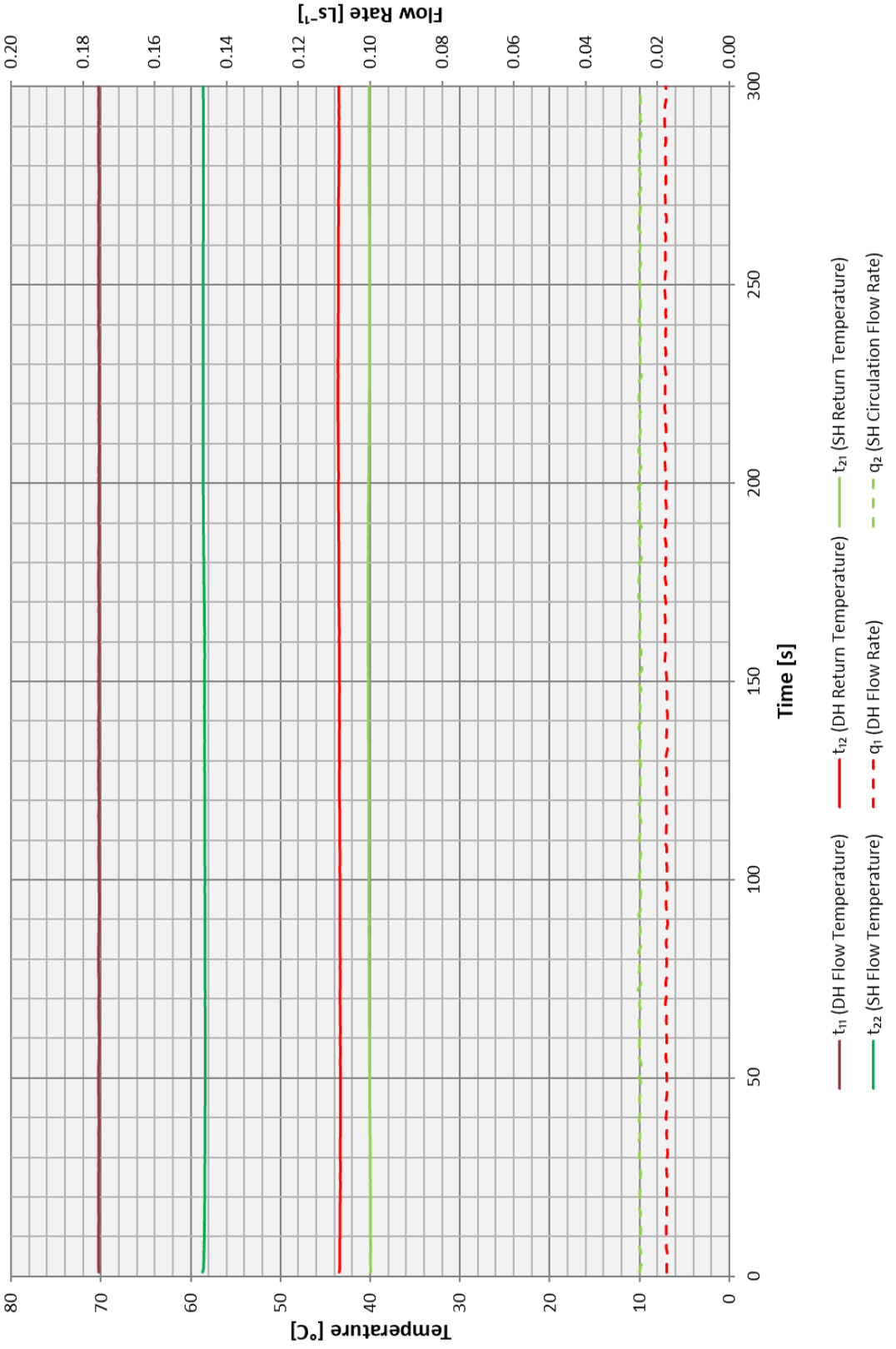

Figure 7.2 - Test 1b – Space Heating 2 kW at 70 °C

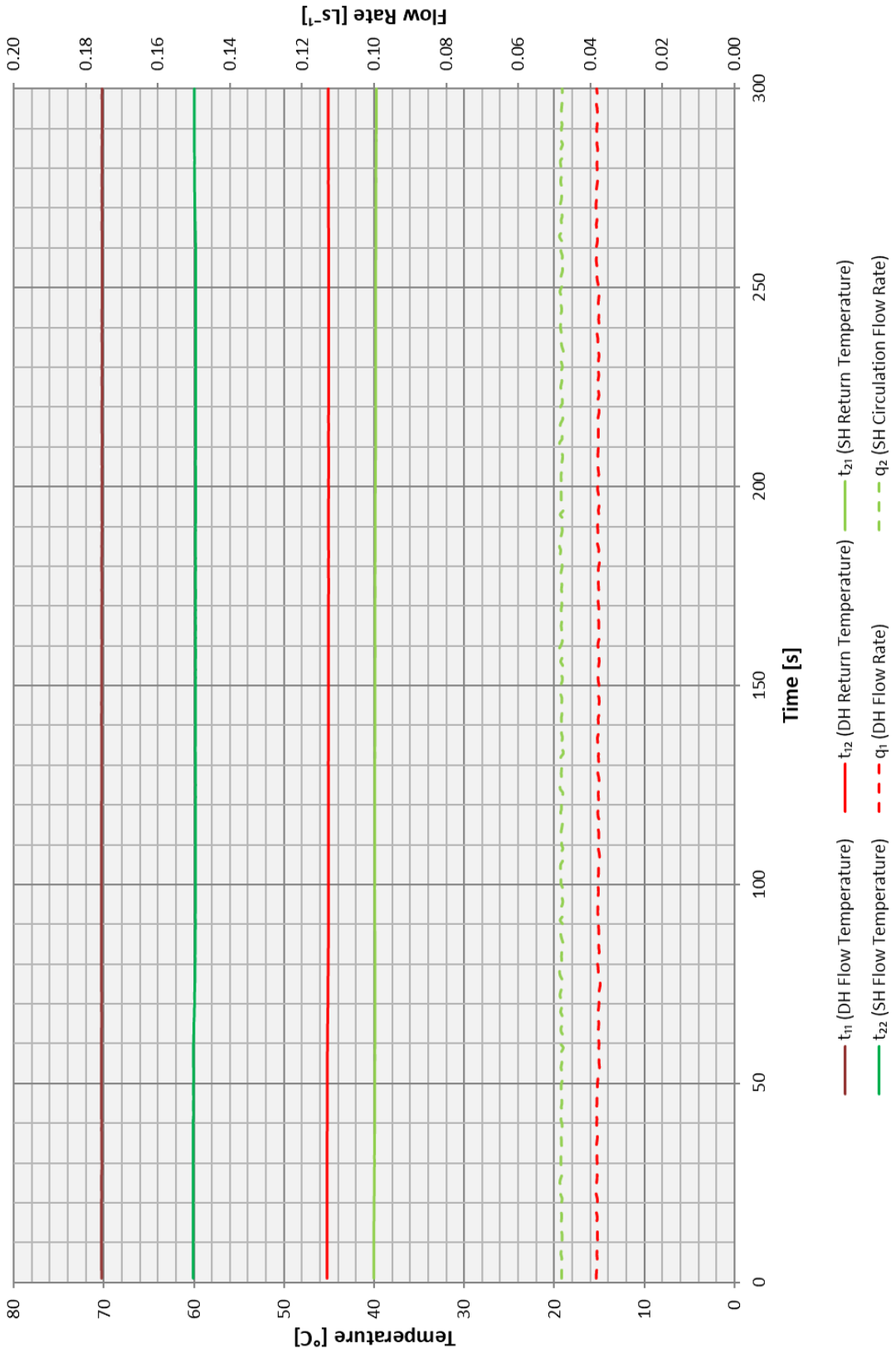

Figure 7.3 - Test 1c – Space Heating 4 kW at 70 °C

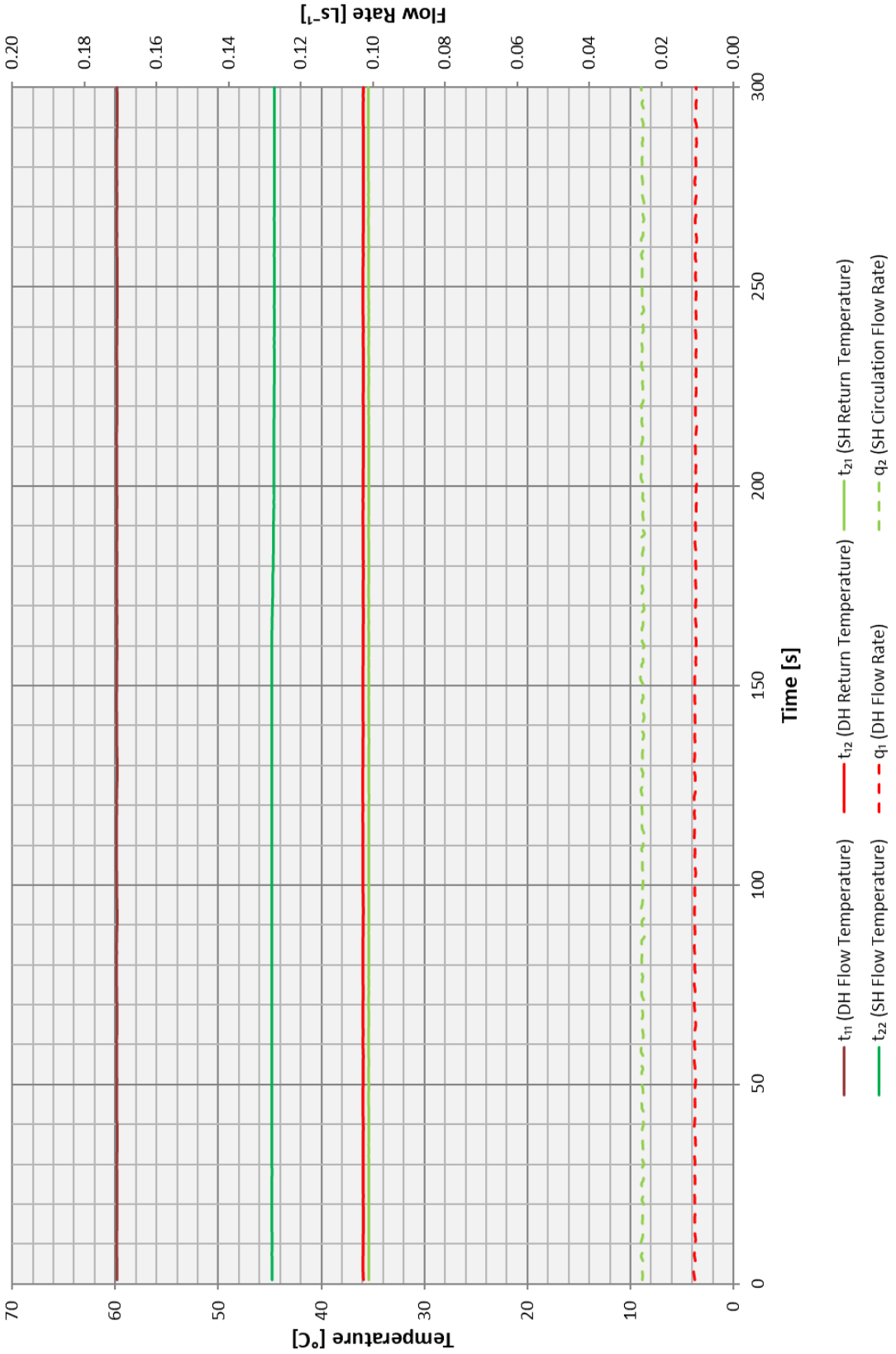

Figure 7.4 - Test 1d – Space Heating 1 kW at 60 °C

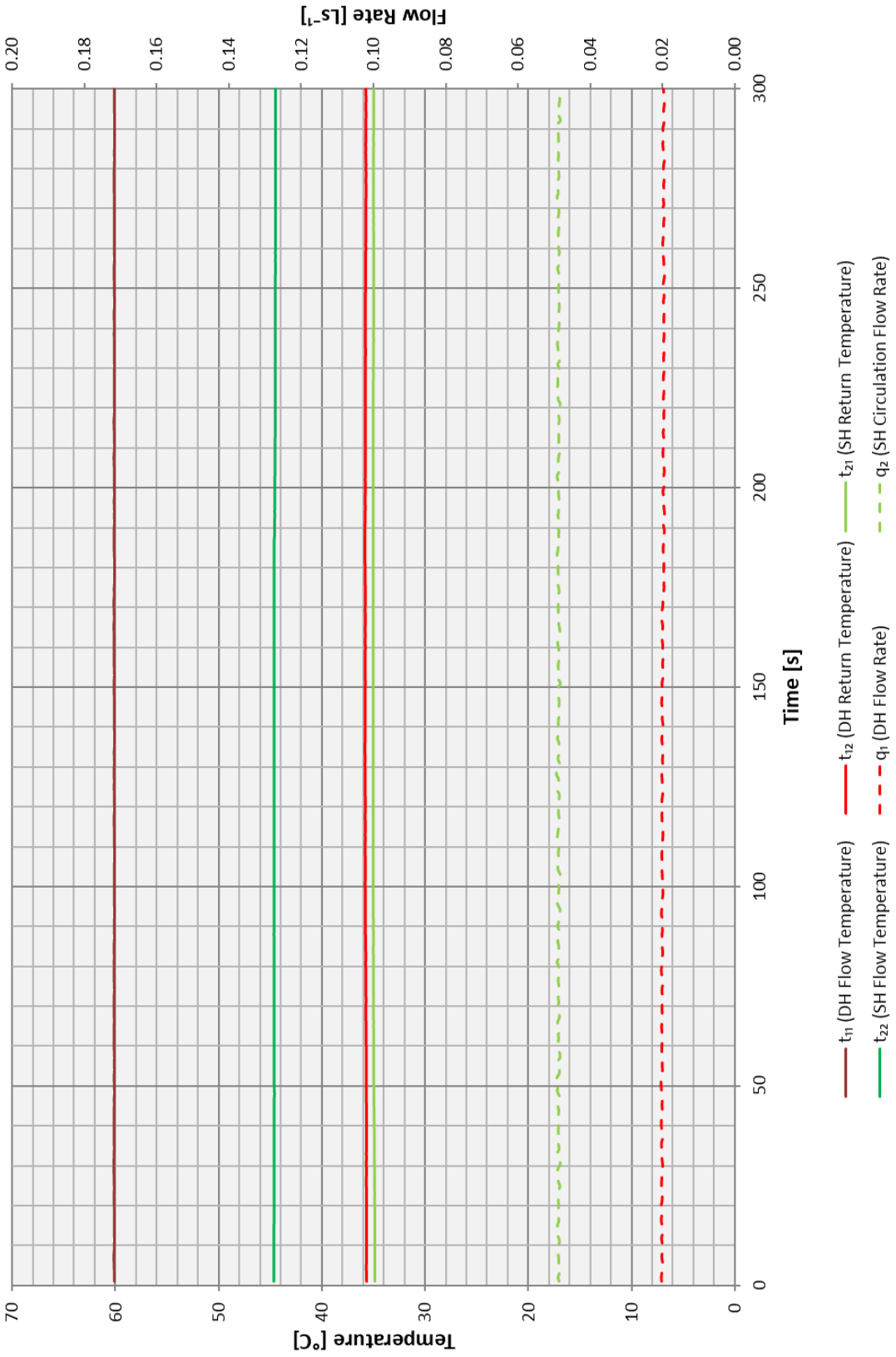

Figure 7.5 - Test 1e – Space Heating 2 kW at 60 °C

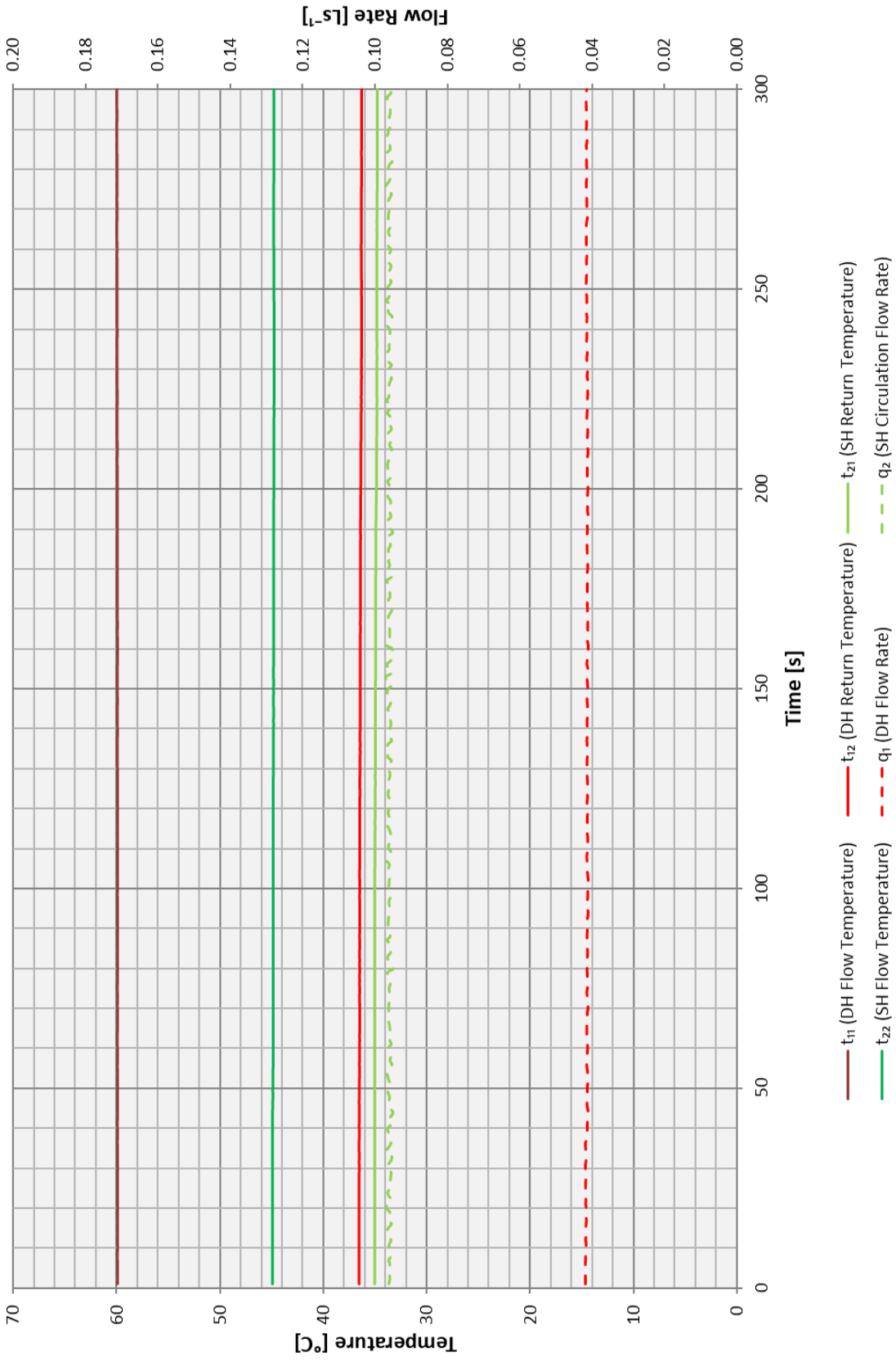

Figure 7.6 - Test 1f – Space Heating 4 kW at 60 °C

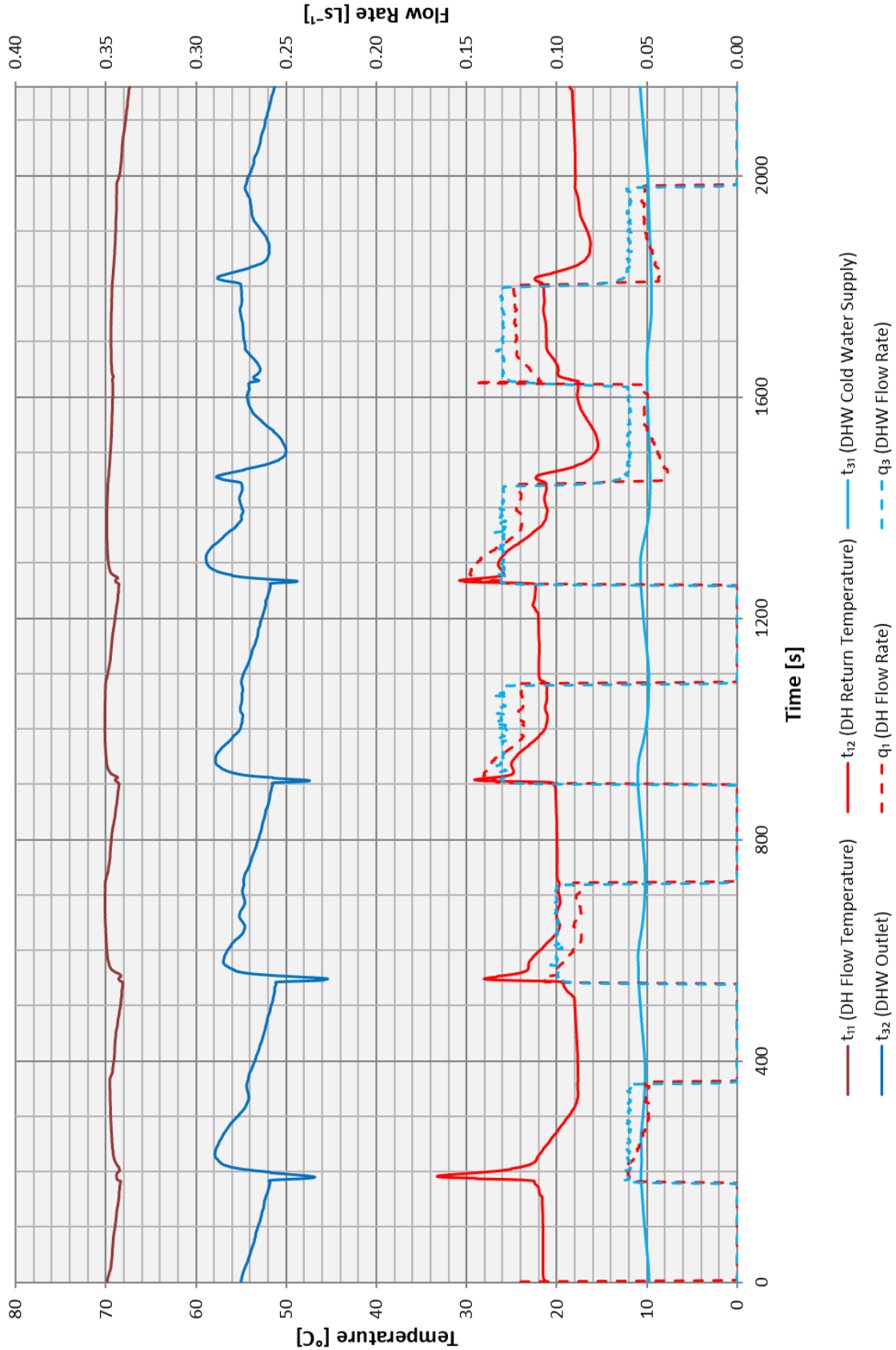

Figure 7.7 - Test 2a – DHW only at 70 °C

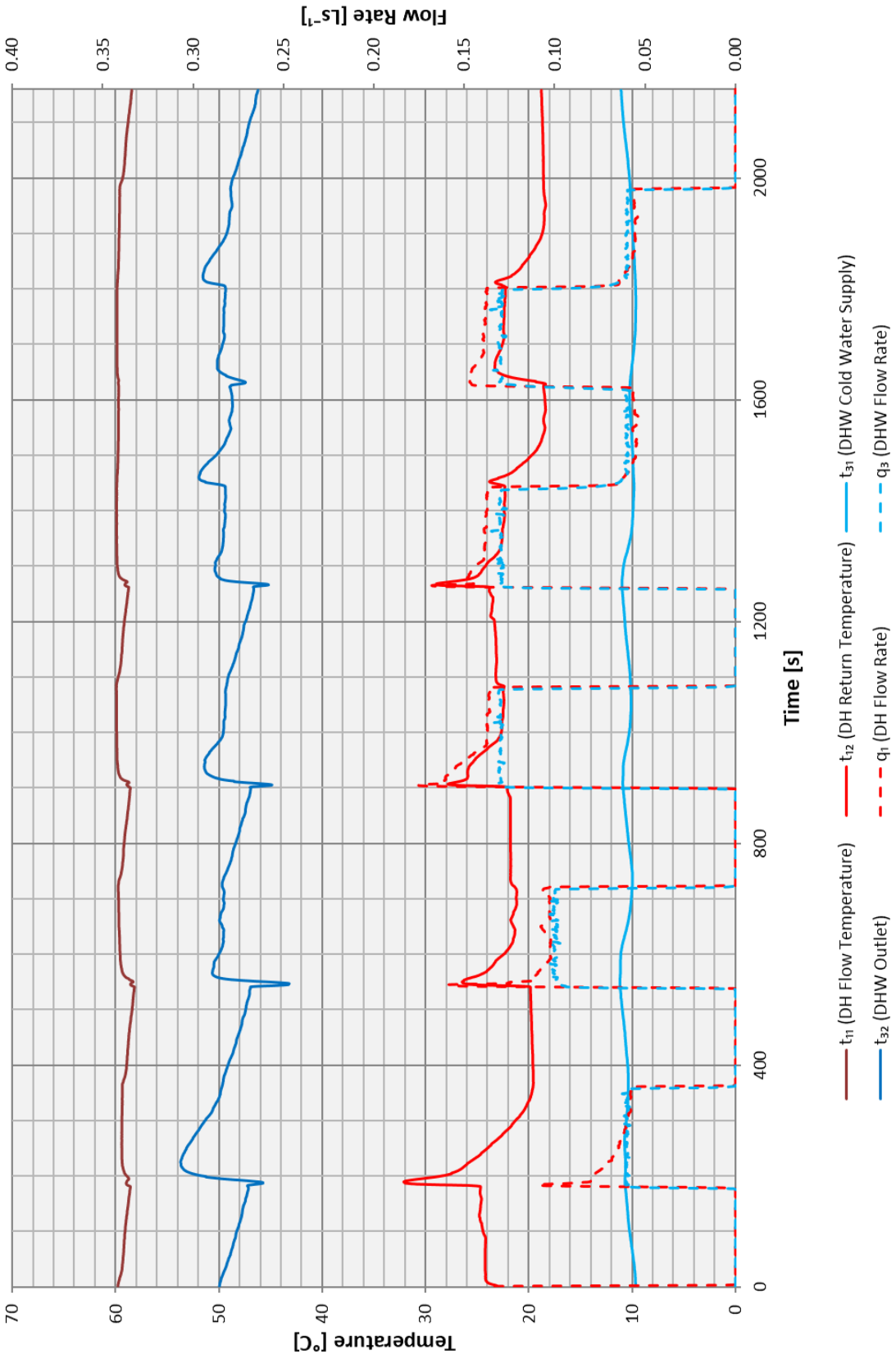

Figure 7.8 - Test 2b – DHW only at 60 °C

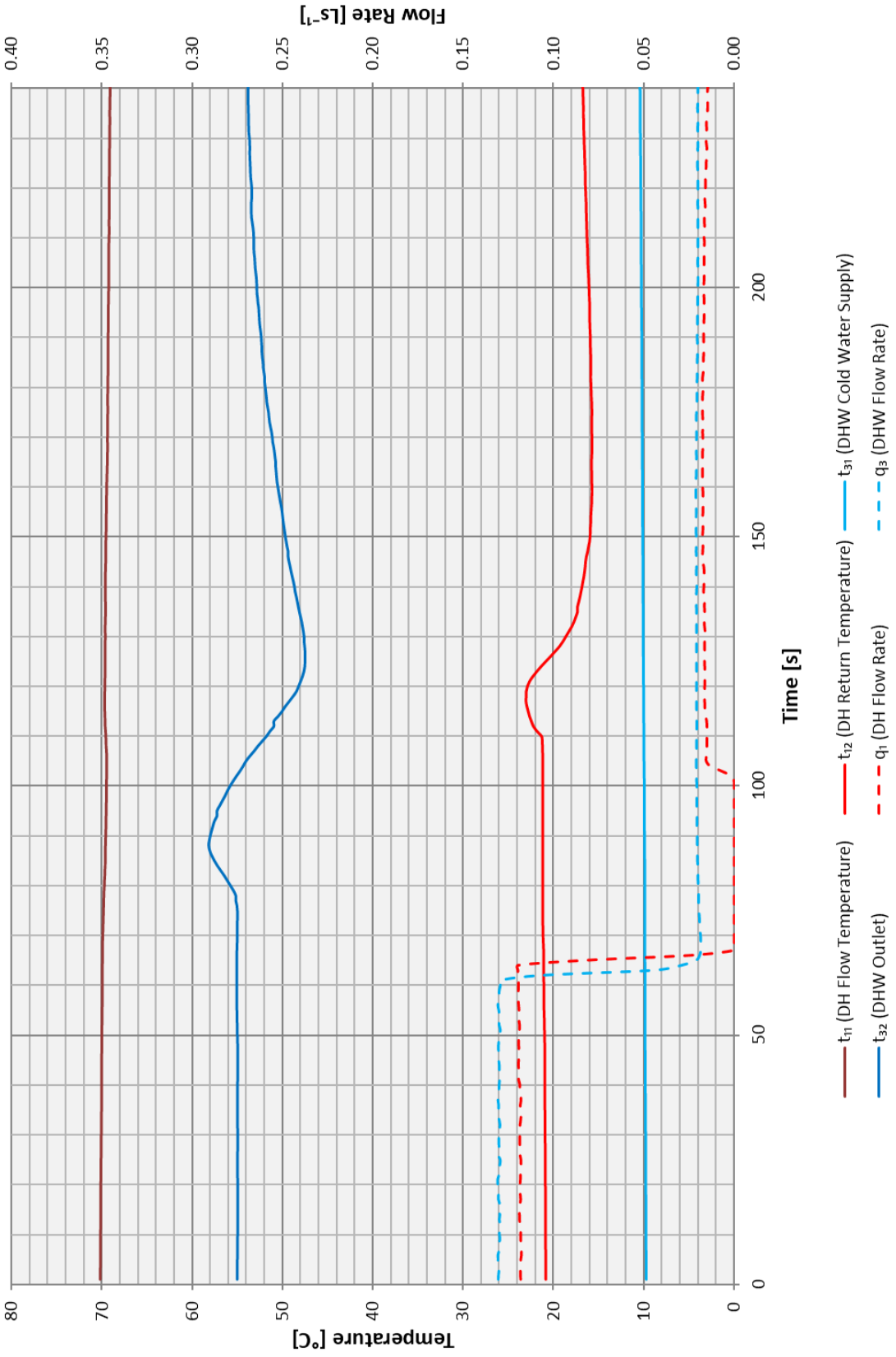

Figure 7.9 - Test 3a – Low Flow DHW at 70 °C

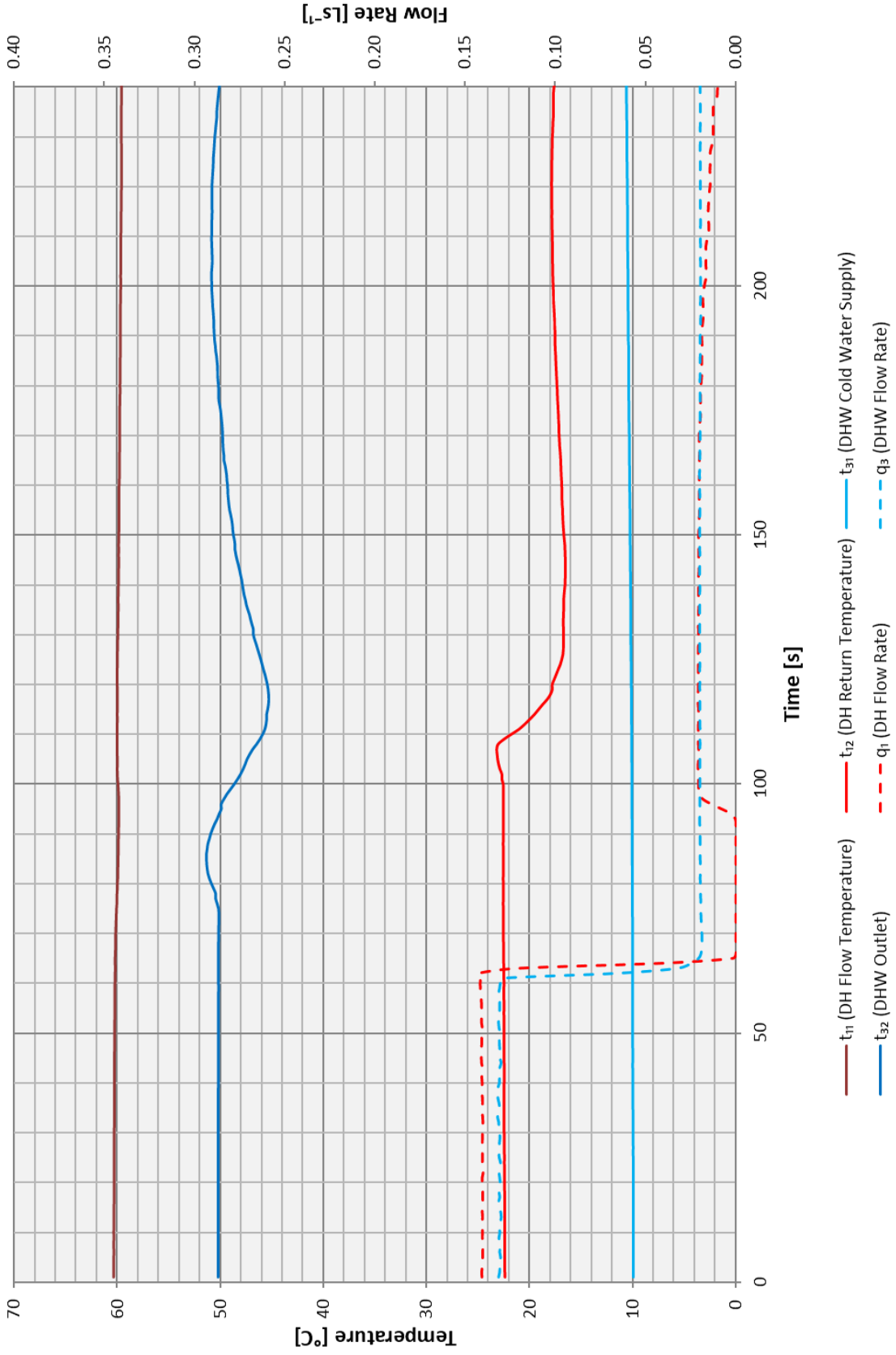

Figure 7.10 - Test 3b – Low Flow DHW at 60 °C

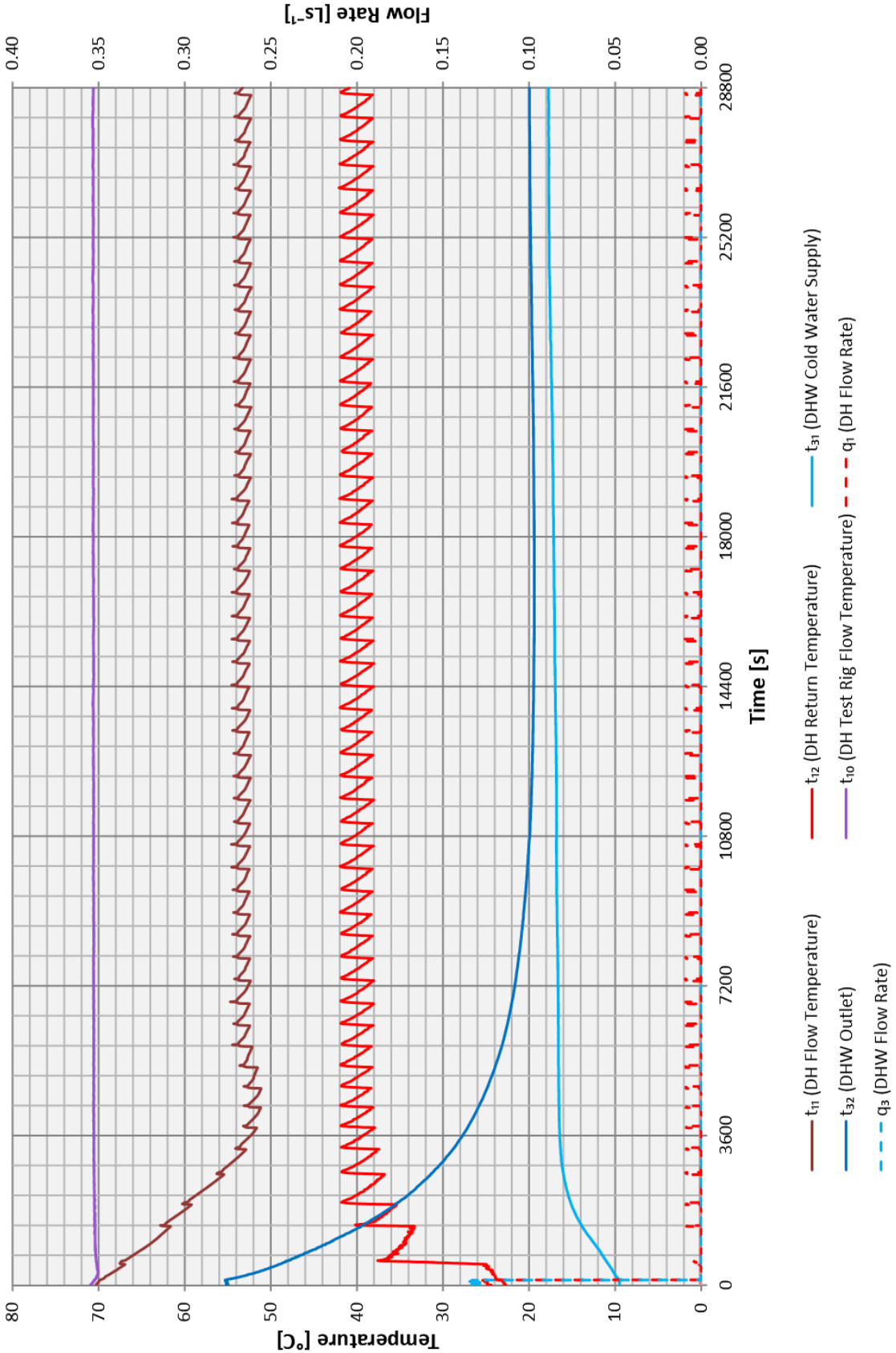

Figure 7.11 - Test 4a – Keep-warm at 70 °C

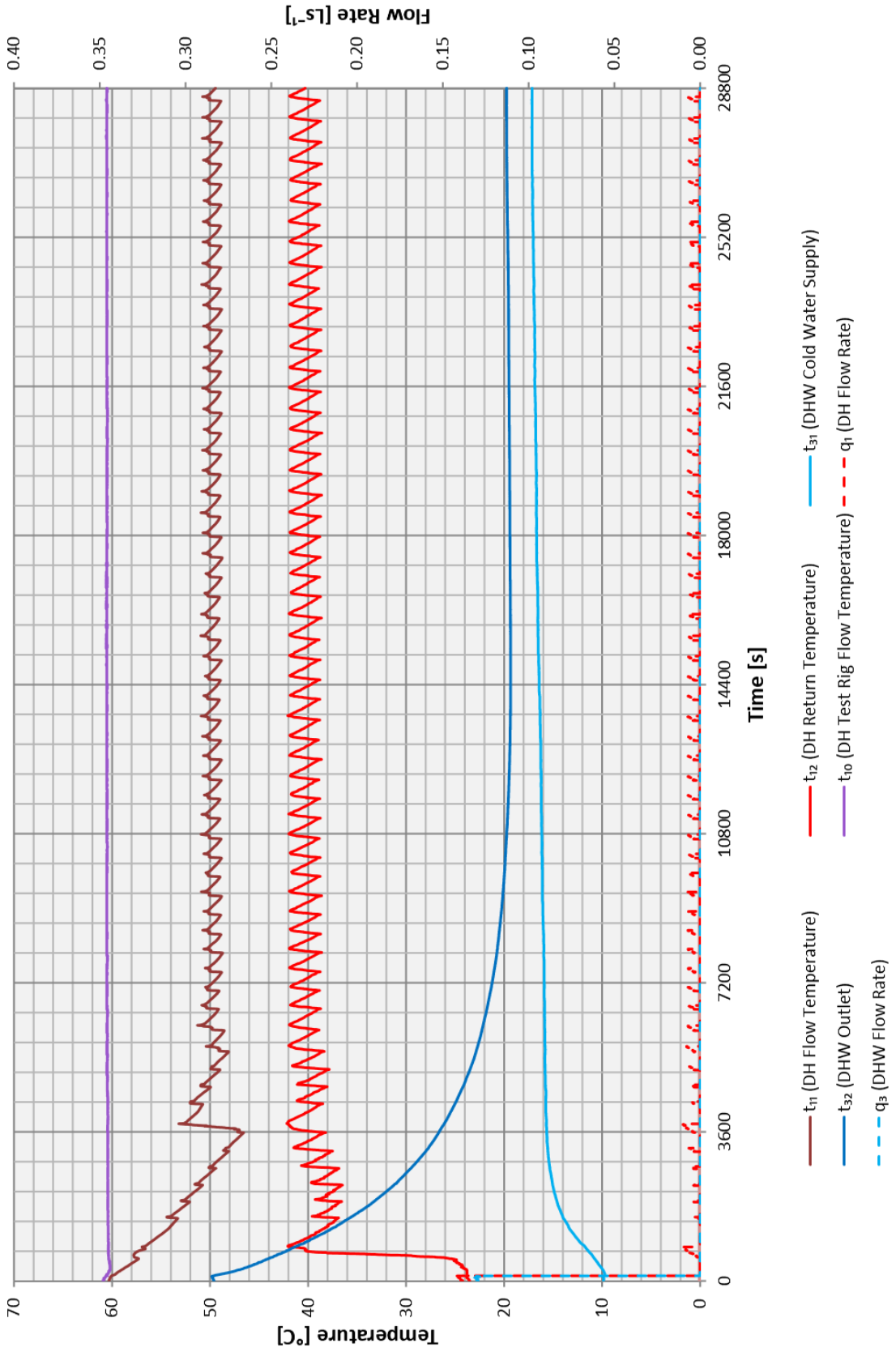

Figure 7.12 - Test 4b – Keep-warm at 60 °C

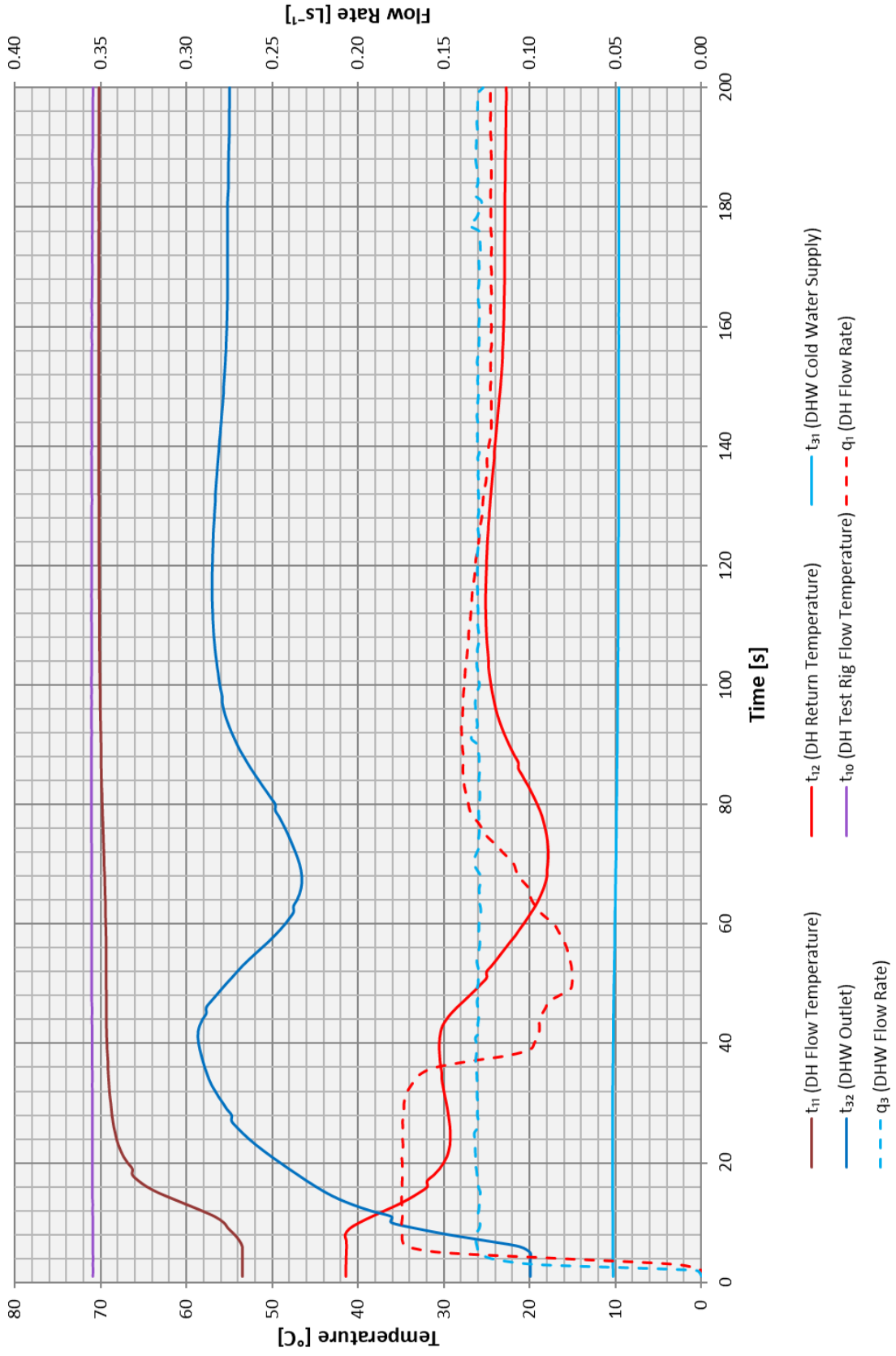

Figure 7.13 - Test 5a – DHW Response Time at 70 °C

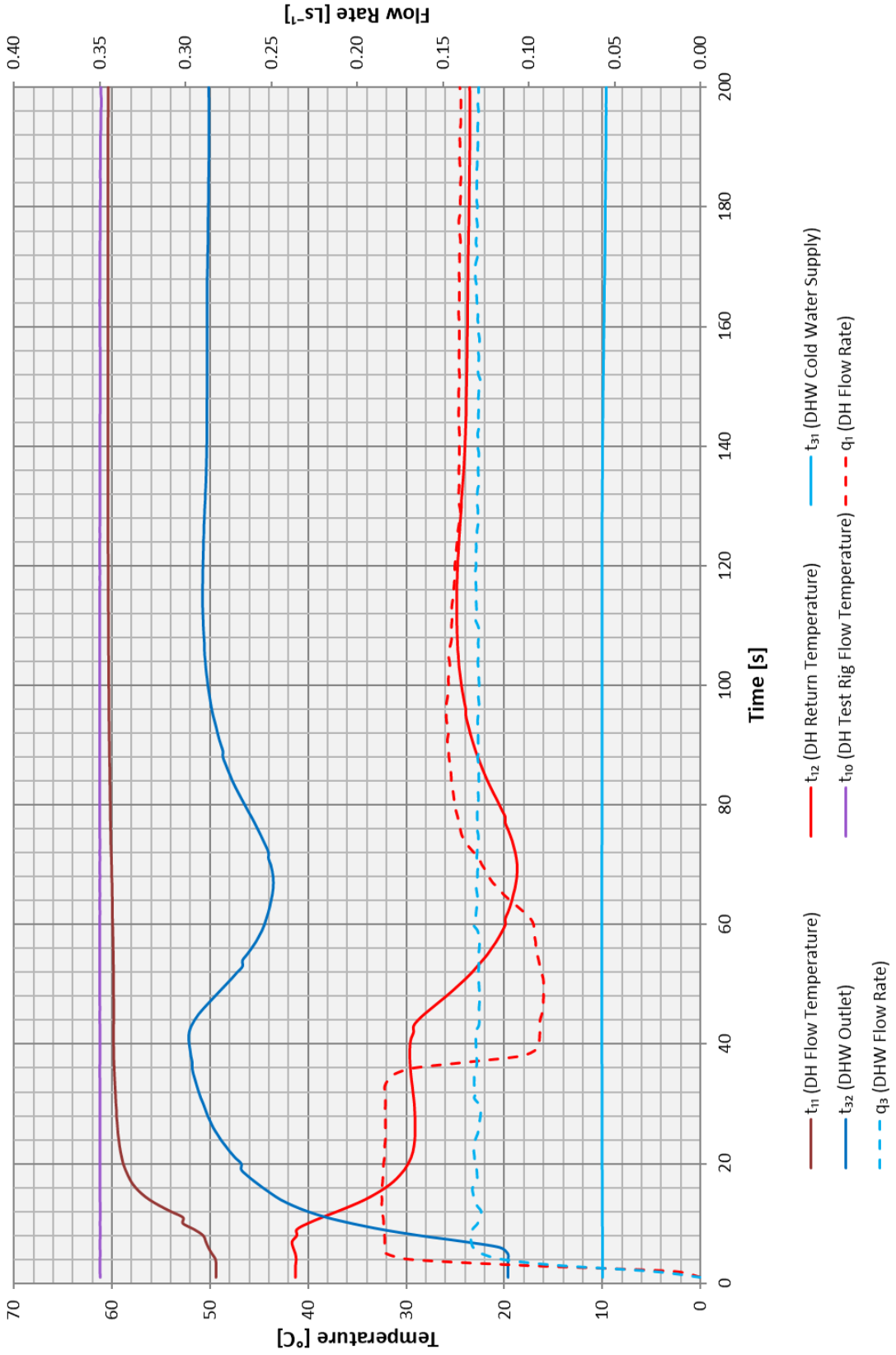

Figure 7.14 - Test 5b – DHW Response Time at 60 °C

7.2 Key Metric and VWART Summary

7.2.1 The summary tables of the key metrics and VWARTs 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:	George Fischer Sales	Primary Flow Temperature:	70°C
Model:	HPTP Indirect Heat interface unit	DHW Setpoint:	55°C
Serial number:	GF2039 0001	Space Heating Temperature:	60/40°C
Calculation performed by I.Williamson of Enertek on:	18/12/2020		

	VWART (°C)	Volume (m3)
DHW	21	28.0
Standby	40	16.1
Space Heating	44	48.5

	VWART with keep warm active	
Period	**VWART (°C)**	**% Time**
No Heating	28	93%
Heating	43	7%
Overall	**29**	

		Test Results							
		Power [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	1129	0.037	44	107	94.4	3.54	-	-
2kW Space Heating	1b	1964	0.063	43	804	409.3	25.91	-	-
4kW Space Heating	1c	3970	0.136	45	556	140.0	19.07	-	-
DHW Low Flow Rate	2a	551	0.006	19	451	1323.1	7.67	-	-
DHW Medium Flow Rate	2a	772	0.009	21	196	384.9	3.44	-	-
DHW High Flow Rate	2a	894	0.011	25	287	496.8	5.60	-	-
DHW Post Low Flow Rate	2a	-	0.342	24	-	-	7.91	10000	30
DHW Post Medium Flow Rate	2a	-	0.468	25	-	-	1.67	660	70
DHW Post High Flow Rate	2a	-	0.492	27	-	-	1.67	300	145
DHW Keep Warm Standby	4a	-	0.003	40	-	5911.4	16.11	-	-

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:	George Fischer Sales	Primary Flow Temperature:	60°C
Model:	HPTP Indirect Heat Interface Unit	DHW Setpoint:	50°C
Serial number:	GF2039 0001	Space Heating Temperature:	45/35°C
Calculation performed by I.Williamson of Enertek on:	18/12/2020		

	VWART (°C)	Volume (m3)
DHW	25	33.8
Standby	40	25.4
Space Heating	36	53.6

Period	**VWART with keep warm active** **VWART (°C)**	**% Time**
No Heating	31	93%
Heating	36	7%
Overall	**32**	

		Test Results							
		Power [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	1057	0.038	36	105	99.5	3.79	-	-
2kW Space Heating	1e	2030	0.072	36	811	399.4	28.71	-	-
4kW Space Heating	1f	4051	0.149	36	574	141.6	21.08	-	-
DHW Low Flow Rate	2b	791	0.019	23	732	922.0	17.58	-	-
DHW Medium Flow Rate	2b	1198	0.027	26	258	248.0	6.60	-	-
DHW High Flow Rate	2b	1273	0.028	27	363	348.7	9.66	-	-
DHW Post Low Flow Rate	2b	-	0.000	0	-	-	0.00	10000	30
DHW Post Medium Flow Rate	2b	-	0.000	0	-	-	0.00	660	70
DHW Post High Flow Rate	2b	-	0.000	0	-	-	0.00	300	145
DHW Keep Warm Standby	4b	-	0.004	40	-	6600.8	25.44	-	-

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	Zilmet ZB315 13 plate
2	Domestic Hot Water Heat Exchanger	Y	Zilmet ZB315 43 plate
3	Controller for Space Heating	Y	Inta HIUC R2 PID Controller Selco
4	Control Valve and Actuator for Space Heating	Y	Frese 01-188X 12v Fast Acting Actuator with Frese Optima High PICV cartridge
5	Space Heating Strainer	Y	NOV hydroblock M0105622A 500 micron
6	Controller for Domestic Hot Water	Y	SEE Ref 3
7	Control Valve and Actuator for Domestic Hot Water	Y	Novasfer NVM02 + NOVV5 Block / Valve
8	Temperature Sensors	Y	T&P srl TPI0007 and 001 Type NTC
9	Domestic Hot Water Isolating Valve	Y	Novasfer 70309132
10	Primary Side Strainer	Y	NOV hydroblock M0105621 500 micron
11	Drain Valves	Y	NOV hydroblock V5 SC43
12	Vent Valves	Y	NOV hydroblock V5 SC43
13	Circulation Pump set with AAV & PRV	Y	Grundfos UPM3 Hybrid 15-70 130 OEM version
14	Heat Meter	Y	Ista Ultego III ¾" Connection
15	Domestic Hot Water Flow Sensor	Y	Sika VTY10
16	Pipes	See IOI	Copper
17	Connections	See IOI	¾" and 1" Flat face with Gasket
18	Joints	See IOI	O ring seal
19	Gaskets	See IOI	Klingersil C4324 Wras 1706523
20	Expansion Vessel	Y	Zilmet 13I0000901 9 Litres
21	Insulation		FT7 724 FR NP Low Density Open Cell Polyether Polyurethane
22	Pressure Sensors	Y	Bitron Type S10 0.35 bar ON 0.15 OFF
A1	'O' Ring	Y	EPDM
A2	Commissioning guide.	Y	Manufacturers operating manual
A3	Operation guides with a function description / description of operation and care instructions as suited to the intended user category.	Y	Manufacturers operating manual and see USER GUIDE
A4	Declaration of Conformity for CE-marked HIUs.		TBA
A5	Full parameter list for electrically controlled HIUs.	Y	Inta Controller Programming Guide doc
A6	Maximum primary static operating differential pressure.	IOI	16 bar
A7	Deactivation procedure of the internal SH pump.	Y	As advised on IOI addendum sheet
	Model name and type number	IOI	HPTP HIU – 20014N135
	Serial number		GF20390001

8.2 Appliance Photographs

Figure 8.1 – Photograph of Appliance [Case Fitted]

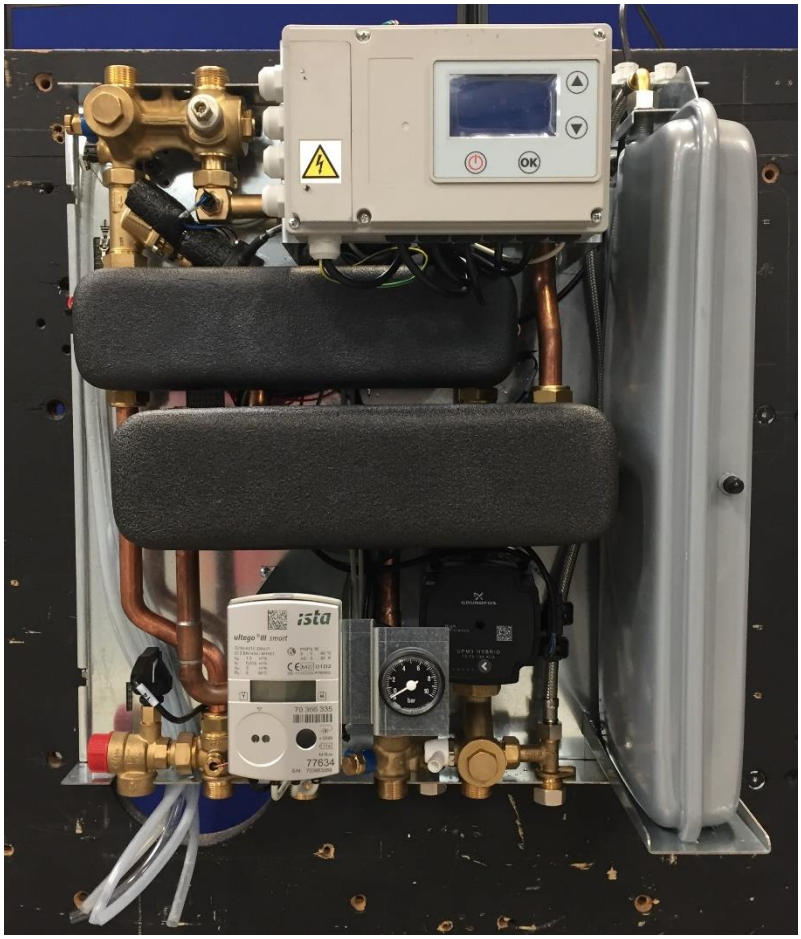

Figure 8.2 – Photograph of Appliance [Case Removed]

Description	HPTP Indirect Heat Interface Unit
Item Code (without Heat Meter) Item Code (with fitted Heat Meter)	20014N134 20014N135
Serial Number	GF21020001
PRIMARY MAX PRESSURE	16 bar
PRIMARY MAX TEMPERATURE	95 °C
PRIMARY MAX PRESSURE DIFFERENTIAL	6 bar
PRIMARY MAX FLOW RATE	1300 l/h
SECONDARY (HEATING) MAX PRESSURE	3 bar
SECONDARY (HEATING) MAX TEMP.	85 °C
SECONDARY (HEATING) NOMINAL HEATING OUTPUT	10 kW
DHW MAXIMUM PRESSURE	10 bar
DHW MAX (at max primary temperature and flow)	75 kW
POWER SUPPLY MAX RATED INPUT FREQUENCY ELECTRONICS CASING	230-240 V 52 W 50/60 Hz IP42
+GF+ George Fischer Sales Paradise Way Coventry CV2 2ST	

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	U99513-19	±0.0004	l/s	26-06-2019	26/06/2021
Flow Meter [DHW Flow Rate]	FM 602	U98515-19	±0.00305	l/s	26-06-2019	26/06/2021
Flow Meter [SH Flow Rate]	FM 603	U98530-19	±0.04871	l/s	27-06-2019	27/06/2021
Flow Meter [DHW Flow Rate]	FM 605	U98539-19	±0.00576	l/s	28-06-2019	28-06-2021
Pressure Transducer [Primary Supply]	PT 086	U98458-19	±6.82	kPa	22-06-2019	22/06/2021
Pressure Transducer [Primary Return]	PT 085	U98460-19	±7.88	kPa	22-06-2019	22/06/2021
Pressure Transducer [DHW Output Pressure]	PT 083	U98469-19	±7.73	kPa	23-06-2019	23/06/2021
Pressure Transducer [DHW Cold Water Supply]	PT 084	U98468-19	±7.31	kPa	23-06-2019	23/06/2021
Pressure Transducer [SH Flow]	PT 087	U98463-19	±7.26	kPa	22-06-2019	22/06/2021
Pressure Transducer [SH Return]	PT 088	U98461-19	±7.30	kPa	22-06-2019	22/06/2021
PRT Probe [Primary Supply Temp]	PRT 4709	EIL 436771	±0.4	°C	31/07/2019	31/07/2021
PRT Probe [Primary Return Temp]	PRT 4708	EIL 436771	±0.6	°C	31/07/2019	31/07/2021
PRT Probe [DHW Output Temp]	PRT 4711	EIL 436772	±0.4	°C	31/07/2019	31/07/2021
PRT Probe [Cold Water Supply Temp]	PRT 4710	EIL 436771	±1.9	°C	31/07/2019	31/07/2021
PRT Probe [SH Supply Temp]	PRT 4707	EIL 436771	±0.4	°C	31/07/2019	31/07/2021
PRT Probe [SH Return Temp]	PRT 4706	EIL 436771	±1.0	°C	31/07/2019	31/07/2021
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	27/07/2020	27/07/2021
Software	VERSION – LabVIEW, Version 5, Service pack 1					

Report Issue No	Reason for Report Update
1	Original Issue
2	Rig Schematic updated, p100 removed from key on Graph. SGB / JW

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