



<b>Technical Note:</b> DHW Heat Load MAX Output Test		TN-016	
Test: Proposed Heat Load MAX output		Tests affected: <b>N/A (new test)</b>	
Assumption:			
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## 1. Introduction

The reported max Domestic Hot Water (DHW) power output rating of a HIU can be influential in purchasing decisions. To ensure fair reporting of output, we wish to test and verify HIUs up to their maximum heat output capability.

The HIU Standard Scope includes testing of HIUs up to 70 kW in *output (at 50 kPa difference in primary pressure and up to a temperature of 70 °C)*.

The aim of this Technical Note is to describe a new test method that will test the HIU at maximum DHW output to be added to the HIU Standard.

## 2. Proposal

A new test is proposed to measure the maximum DHW output of a HIU. The test consists of a series of hot water draws starting from 0.15 l/s and increasing in steps of 0.03 l/s up to 0.42 l/s (approx. 5 kW steps from 25 kW up to 70 kW). The HIU will be rated at the final step where it was successful in maintaining hot water output above 45 °C. The test can be carried out in the high or low primary temperature regimes with a target DHW output temperature of 50 °C.

The test will also have a secondary purpose of measuring the pressure loss across the HIU at the different flow rates. This will help establish the minimum viable inlet DHW pressure for the HIU to function as expected.

## 3. Methodology

The HIU will have the same settings as used for Test 2.

The test consists of a series of steps of 60 seconds in duration (see Table 1: Proposed series of DHW Draws for the MAX heat load test.)

The test involves 60 seconds of pre-test DHW draw at 0.13 l/s in order to bring the HIU to working temperature followed by a period of no draw for 60 seconds. These are labelled steps 0 and 1 respectively and are to be included in any graphs. Subsequent steps will involve DHW output at higher and higher flow rates. The final step is 60 seconds of no draw.

In the final ten seconds of each step the mean average DHW output temperature is measured and noted. If this temperature is below 45 °C then the test is to be stopped. Otherwise, the test is to be carried out to completion until there are no more steps.

### Measurements

For the duration of the test, these measurements will be recorded:

- DHW output temperature (t32)
- DHW flow rate (q3)
- DHW cold temperature (t31)
  
- Pressure drop across the HIU on the DHW line ( $\Delta p_3$ )
  
- Primary flow temperature (t11)
- Primary return temperature (t12)
- Primary pressure difference ( $\Delta p_1$ )
- Primary flow rates (q1)

### Test Conditions

The test conditions will be:

- The settings on the HIU will be unchanged from Test 2.
- 70 °C (High temperature test) or 55 °C (low temperature test) primary temperature at 50 kPa pressure difference (usual tolerances and gauge pressure).
- The preheat stage DHW output and the target DHW output temperature for each step is to be 50 °C  $\pm$ 1 °C.
- The average DHW flow rates for each step are to be within 5% of the target flow rates, and the time to achieve 95% of the target flow rates shall not exceed 5 seconds from the onset of the step change. (taken from Clause 4.18 of HIU Std.2018)
- DHW Gauge pressure is set to 300kPa (3 bar)  $\pm$ 5%. The average DHW cold temperature will be 10 °C  $\pm$ 0.5 °C for the test.
- The average pressure drop in the DHW line will also be reported at each step to  $\pm$ 1 kPa.

The series of DHW hot water draws are given in Table 1.

Step	Draw Duration (s)	Test Time (s)	Flow (l/s)
0	60	0	0.13
1	60	60	0.00
2	60	120	0.15
3	60	180	0.18
4	60	240	0.21
5	60	300	0.24
6	60	360	0.27
7	60	420	0.3
8	60	480	0.33
9	60	540	0.36
10	60	600	0.39
11	60	660	0.42
12	60	720	0.00

*Table 1: Proposed series of DHW Draws for the MAX heat load test.*

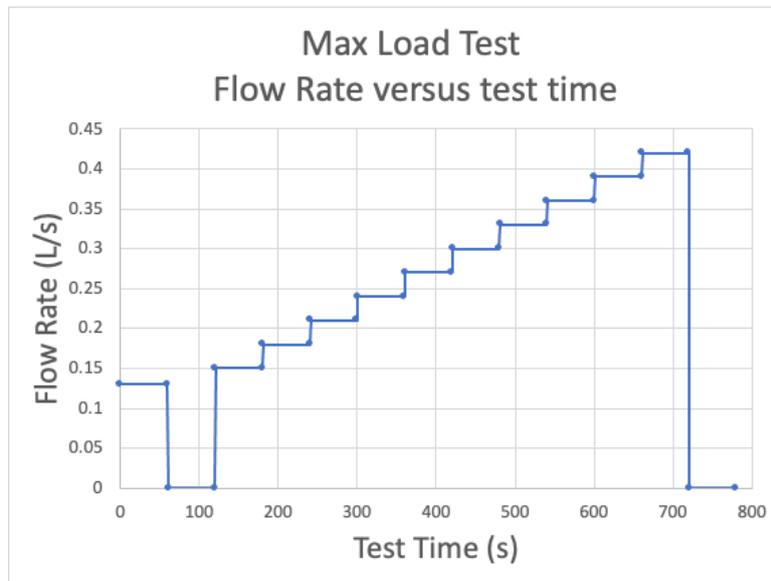


Figure 1: Flow Rate versus Test Time. Note, before time zero there is 60 seconds of draw acting as a pre-heat.

The testing scheme shown in Table 1 gives the resulting flow pattern seen in Figure 1.

#### 4. Calculations

The following average values shall be calculated for the last ten seconds of every step.

- Flow Rate
- DHW Output Temperature
- kW Heat Output (assumed 4.18 kJ/L·K at any and all temperatures and pressures)
- Pressure Drop across HIU DHW line

#### 5. Reporting

The results will be shown in words, tabulated and in a graph.

##### Tables

The report will contain a table like this: (example data)

Step	LAST 10 SECONDS AVERAGE				Above 45.0°C (Y/N)
	Flow-Rate (l/s)	DHW OUPUT Temperature (°C)	kW Heat Output*	Pressure Drop (bar)	
0	0.13	50	21.7	0.047	Y
1	0.00	0	0	0.000	Y
2	0.15	50	25.1	0.054	Y
3	0.18	50	30.1	0.065	Y
4	0.21	50	35.1	0.076	Y
5	0.24	49	39.1	0.086	Y
6	0.27	48	42.9	0.097	Y
7	0.3	46	45.1	0.108	Y

8	0.33	42	44.1	0.119	N
9	0.36	-	-	-	
10	0.39	-	-	-	
11	0.42	-	-	-	
12	0	-	-	0	

Table 2: Example table of reported results. \* assumed 1kg=1L; uncorrected for pressure or density changes

## Graphs

The report will contain a graph like this:

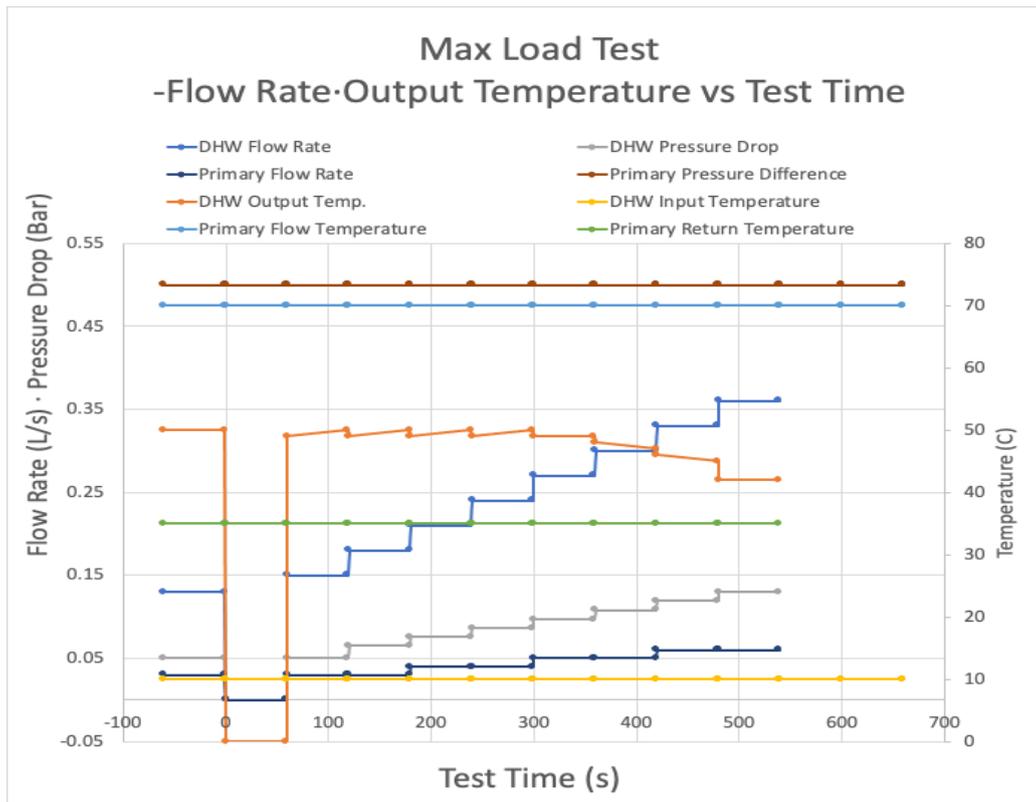


Figure 2: Graphed data for the MAX heat load test

## WORDING

- 1) The test results will be reported as “The HIU was successful in producing stable DHW at 45 °C or above up to the flow rate of XX l/s, equivalent to approximately YY kW”.
- 2) A further sentence will say “The pressure drop across the HIU was found to be ZZ kPa at this XX l/s flow rate”.