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Technical Note			TN-023
Test: Non-Keep Warm Module			**Test no.:**
Assumptions: Tests required New tests 6a and 6b: Standby test – results reported and pass criteria New tests 7a and 7b: Standby test – results reported and pass criteria • Test duration • DHW Response time New tests 7a and 7b: Standby test – results reported and pass criteria • Test duration • DHW Response time Configuration of pipework to allow for Non-Keep-Warm test Pipe Volume post-bypass (0.67 ltrs) Pipe Volume pre-bypass (11 ltrs) Flow Temperature at bypass (55°C for high temperature test and 50°C for low temperature test)			**Assumption no:**
Rev: 3	**Date: 18/5/22**	**Author: RH**	**Checked: JA/TN**

1. Introduction

The purpose of the Non-Keep-Warm test module is to simulate the performance of an HIU without keep-warm functionality or with keep-warm functionality switched-off, during DHW start-up, delivery and standby.

For the purposes of this test, the [non-keep-warm reference scheme] has been assumed, attached as Appendix 1 to this note for convenience.

For convenience, and to reduce costs, the intention is to be able to use substantially the same test rig for both the keep-warm module and non-keep-warm module of the test, in order to enable a reduced set of tests to be conducted.

2. Tests required

Having no keep-warm function or the keep-warm function disactivated will primarily impact on performance of the HIU during: (a) the keep-warm tests, 4a and 4b; and (b) the DHW response time tests, 5a and 5b.

Some HIUs might have a boosted primary flow feature to react faster after a long not demand period of time in order to improve the reaction time in tests [5a, 5b, 7a, 7b]. There is a possibility that the special feature for not keep warm might affect the operation of the HIU during Dynamic DHW and low flow DHW tests.

As such, the recommendation is that the Non-Keep-Warm module is made up of:

- Dynamic DHW tests 2a or 2b
- Low flow DHW tests 3a or 3b
- New Non-Keep-Warm standby tests 6a and 6b
- New Non-Keep-Warm DHW response time tests 7a and 7b

For clarity, this would mean that for an HIU with the ability to disactivate the keep-warm function, tests 1, 2 and 3 for the respective temperature regime would be able to be reutilised, together with the new tests 6 and 7 – with these all reported together as a separate test results for the Non-keep-warm module.

3. Test 6a and 6b: Standby test

Test Description

- **Objective**: To establish HIU performance during periods of no load, when operating in standby mode without a keep-warm function.
- For HIUs that can either have the 'keep-warm' function turned on or off, then this function should be turned off for all tests.
- With no space heating load, draw-off domestic hot water is to be set at a rate of 0.13 l/s for a minimum of 120 seconds to establish steady state conditions and then turn the hot water flow rate should be isolated. Measure the primary flow rate and the primary flow and return temperatures for a period of at least 8 hours after the initial hot water draw-off has been completed.
- The heat consumed (kWh) by the HIU together with the electrical consumption (kWh) over the first 8 hours of the test period will be used as a measure of the keep-warm heat losses from each HIU. The HIU case will be fitted for this test to allow a representative estimate of non-keep-warm losses to be made during standby.
    - Test 6a: 70°C primary temperature (t_{10}); 50°C DHW flow temperature.
    - Test 6b: 55°C primary temperature (t_{10}); 50°C DHW flow temperature.
    - Note: The test results from Test 6a and 6b are to be used for calculating the VWARTs for the HIUs.

Reporting of Results:

- Plot of key metrics over duration of test: t_{10}, t_{11}, t_{12}, t_{32}, t_{B1}, q_1, q_3, Δp_1, Δp_2

- State average heat load, average electric load and average combined heat losses (heat load and electric load) for the duration of the test.
- Note: Outputs used as input data to 'High Temperature' Keep-warm Volume Weighted Average Return Temperature calculation.

Pass Criteria:

- Average heat losses <41.7W.
- Electrical use must be <5W

4. Test 7a and 7b: DHW Response Time

Test Description

- **Objective**: To investigate DHW delivery time after a period of at least 8 hours non-keep-warm operation. This tests if the HIU can supply domestic hot water within an acceptable time of turning on the tap, which is a basic comfort requirement.
- Immediately after testing the no-load characteristics for Test 6, steady-state conditions, without domestic hot water draw-off or space heating load, will have been established. At this point, DHW is to be drawn-off at 0.13 l/s. The time taken for the DHW, t_{32}, to achieve 45°C while not dropping below a temperature rise of 42°C thereafter, will be recorded. The time is taken from the first DHW flow reading above 0.001 l/s as recorded by q_3.
- Referencing TN-018; clause 4.42 states that the time at which the DHW response test should be launched is at 75% of the cycle time (period) since the last peak (also by inference the last draw in heat). Even though it is expected that the HIU will not have any flow in a non-keep warm test, this rule is kept in case the manufacturer decides to bypass water for other reasons.
- For this test, the HIU's keep-warm function will have been deactivated during the previous no-load test. The HIU's service connection is represented by the connection hoses from the test rig, which is consistent for all HIUs tested.
- Note that in order for the HIU to be considered as providing an acceptable response time for the purpose of this test, a 45°C DHW temperature (as measured at t_{32}) is to be achieved within 15 seconds while not dropping below 42°C thereafter.
- For this test, the conditions are to be as for tests 6a and 6b i.e. DHW set point is to be 50°C.
- Cold water supply temperature (t_{31}) is to reach 10°C +/-3°C within 3 seconds of DHW flow.

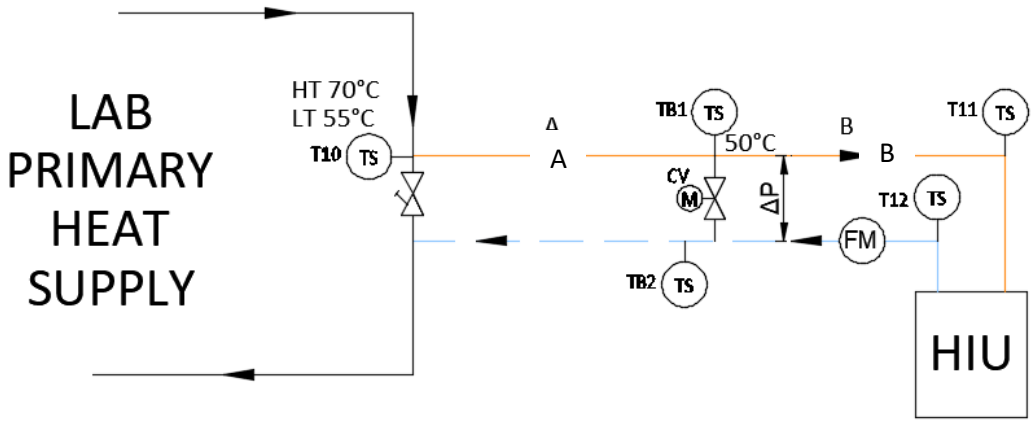
Reporting of results:

- Pass/Fail on DHW (at t_{32}) exceeding 60.0°C (1 decimal place) for more than 1 second. Report on number of consecutive seconds > 55.0°C (1 decimal place).
- State time to achieve a DHW temperature 45.0°C (1 decimal place) and not subsequently drop below 42.0°C (1 decimal place).'
- Assessment of whether valid acceptable DHW response time, based on response time criteria: Pass/Fail
- Plot of key metrics over duration of test: t_{10}, t_{11}, t_{12}, t_{32}, t_{B1}, q_1, q_3, Δp_1, Δp_2

Pass Criteria:

- DHW must not (at t_{32}) exceed 60.0°C (1 decimal place) for > 1 second.
- < 15 seconds to achieve a DHW temperature 45.0°C (1 decimal place) and not subsequently drop below 42.0°C (1 decimal place).

5. Configuration of Pipework



The test setup shall simulate a HIU being located on the 5th floor of the vertical riser using the "model scenario";

- The volume of pipe "A" should be 11 litres, which is the equivalent to 9m of DN32 and 3m of DN25 pipe.
- The volume of pipe "B" should be 0.64 litres, which is the equivalent to 2m of DN20 pipe.

When the keep warm function is deactivated, the bypass should maintain 50°C on the flow pipe at T_{B1} for both the high temperature test and the low temperature test.

Where possible, the pipework should be insulated in accordance with CP1 recommendations and standardised between all test houses.

Assumptions

The test setup shall simulate a HIU on the 5th floor of the vertical riser using the "model scenario". This uses 9m of DN32 pipework and 3m of DN25 within the riser and 2m of DN20 as the service pipe to the dwelling.