| Technical Note | | | TN-008 |
|---|---|---|---|
| **Test:** 2a/2b Dynamic testing of the HIU operation DHW only | | | **Test no.:** 2a/2b, 3a and 5a |
| **Assumption: Pass / Fail criteria for temperature and duration of DHW exceeding scalding limits** | | | **Assumption no: 27 / 28** |
| **Rev: 02** | **Date: 29/10/2020** | **Author: Wayne Early** | **Checked: Gareth Jones** |

## 1. Introduction

To determine whether the pass / fail criteria for domestic hot water Dynamic tests 2a, 3a and 5a, providing sufficient safety for protection of end users.

Assumptions 27 / 28 set the pass/fail criteria for tests 2a/2b, 3a and 5a as, 'Pass/fail on DHW (at t32) exceeding 65°C for more than 10 consecutive seconds as this poses a scalding risk'.

The technical committee have agreed to review these criteria, given that the time for scalding to 3rd degree burns at 65°C is 2 seconds for an adult and 0.5 seconds for a child.

## 2. Consideration 1

BRE Information Paper IP 14/03

The degree of scalding depends on the temperature and volume of hot water, and the length of time the body is exposed to it. However, it can take only seconds for a severe scald to occur. Research (Waller et al, 1993) indicates that: '*As the temperature of the water increases above 50°C, the duration of exposure needed to suffer third-degree burns decreases rapidly. Healthy adult skin requires 30 seconds of exposure to water at 54°C – 55°C before third-degree burning occurs, but only 5 seconds at 60°C and less than one second at 70°C. However, the skin of children and the elderly is even more sensitive to extreme temperatures'.*

## 3. Consideration 2

Research taken from international Association of Plumbing and Mechanical Officials

## Temperature versus Exposure Time

The severity of a burn will be affected by the temperature and the time of exposure to hot water

| Type of Burn | Time of exposure in minutes and seconds | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Temp | 45°C | 50°C | 55°C | 60°C | 65°C | 70°C | 75°C | 80°C |
| Adult 3rd | >60 m (e) | 300 s | 28 s | 5.4 s | 2.0 s | 1.0 s | 0.7 s | 0.6 s (e) |
| Adult 2nd | >60 m (e) | 165 s | 15 s | 2.8 s | 1.0 s | 0.5 s | 0.36 s | 0.3 s (e) |
| Child 3rd | 50 m (e) | 105 s | 8 s | 1.5 s | 0.52 s | 0.27 s | 0.18 s | 0.1 s (e) |
| Child 2nd | 30 m (e) | 45 s | 3.2 s | 0.7 s | 0.27 s | 0.14 s | <0.1 s | <0.1 s (e) |

(e) = estimated

The table has been taken from a 1993 ASSE paper. There are a number of different published figures used to indicate the effect of temperature and time on the severity of the resultant burn. All figures used must be taken as indicators only as from the difference in published figures it is clear that the results will vary from person to person.

Other data sources reviewed:

**Water supply and fittings regulations 1999**

Recommends that DHW distribution temperatures not less than 50°C.

**Plumbing engineering services design guide 2002 [3]:**

The requirement is for the storage of hot water at 60°C and distribution so that a temperature of at least 50°C is attainable at all outlets within 30-60 seconds of running.

**Chartered Institute of Building Services Engineers Guide G 2014:**

Section 2.4.4.5
Safe water temperatures needed to be considered for hot water supplies to appliances used by elderly, infirm and young persons. The requirements of 60–65 °C for stored hot water and a minimum 50–55°C for distributed hot water, in order to minimise the risk of *Legionella*, mean that temperature control will need to be provided at draw off fittings used by persons at risk of being scalded. NHS document D08 (41) limits the temperature to taps in all NHS-type buildings (i.e. hospitals, care homes etc.) and Building Regulation G3 (4) (30) limits bath temperatures in new dwellings and dwellings created by a change of use. Note that requirements may differ in Scotland and Northern Ireland.

**HSG274 Part 2 2014:**

**Section 2.6**, Temperature control is the traditional strategy for reducing the risk of legionella in water systems. Cold water systems should be maintained, where possible, at a temperature below 20°C. Hot water should be stored at least at 60 °C and distributed so that it reaches a temperature of 50°C (55°C in healthcare premises) within one minute at the outlets.

**Section 2.68** Low storage volume heaters (ie no greater than 15 litres) such as instantaneous units and POU heaters, may be generally regarded as lower risk.

**Info box 2.2: Low-risk systems**

An example of a low-risk situation:

- in a small building without people especially 'at risk' from legionella bacteria;
- where daily water usage is inevitable and sufficient to turn over the entire system;
- where cold water comes directly from a wholesome mains supply (no stored water tanks);
- where hot water is fed from instantaneous heaters or low storage volume water heaters (supplying outlets at 50 °C);
- Where the only outlets are toilets and hand washbasins (no showers).

**BS 8558:2015:**

To ensure suitable *Legionella* management in all buildings the water temperature at an outlet should be at least 50 °C within 1 min of running the water. The water supply to any thermostatic mixing valve (TMV) should be at a temperature of at least 50 °C within 1 min of running the water. Where appropriate, for water leaving and returning to a calorifier or hot water storage cistern, the outgoing water temperature should be at least 60 °C and returned to at least 50 °C or 55 °C.

*NOTE 1 Where it is not practical to use pipework to recirculate hot water back to the calorifier, or where the minimum return temperature cannot be guaranteed, a single pipe system with electrical self-regulating trace-heating cables may be installed to ensure temperature maintenance of at least 50 °C, which will also enable the elimination of the dead leg, providing temperature maintenance to the draw-off point. Trace heating might be necessary when the length of hot water pipework and the volume of water the pipework contains become such that it would take an unreasonable length of time to draw off the cool water.*

## 4. Consideration 4

In domestic settings, there is a requirement for TMVs to be attached to baths, limiting temperatures to no more than 48°C. As such, the risk of scalding from immersion is mitigated.

As such, the primary risk is from short shock temperatures from showers, basins and kitchen sinks. Here there is a very real risk of scalding at temperatures of 65°C, with a scalding time of 0.5 seconds for children and 2.0 seconds for adults.

At 60°C this increases to 1.5 seconds for children and 5.4 seconds for adults.

## 5. Conclusions

Water regulations requires DHW to be in excess of 50°C in DHW distribution systems. HSE guidelines and CIBSE recommendations all quote safe DHW distribution temperatures of between 50 and 55°C.

However, it should be appreciated that there are still a large number of systems in use that operate at temperatures of 60°C, as they have domestic hot water cylinders.

Given the high risk of scalding at 65°C, there is clear grounds for reducing the threshold for assessing an HIU to pose a H&S risk.

It is felt however, that while there would be grounds for lowering the maximum DWH temperature to 55°C, the relative risk of scalding from taps is significantly lower at this temperature and it should be taken into account that there are a large number of DHW systems operating at or above this temperature in the wider industry.

## 6. Recommendation

It is recommended that the threshold is lowered to 60°C, with a fail for >1 second hot water delivery at >60°C. This should prevent the risk of 3rd degree burns from short exposure to hot water from a tap.

While it is not felt appropriate to put a hard limit on the consecutive seconds of hot water delivery >55°C, it is felt that this information should be made available to design consultants and there should be a general pressure within the industry to get better control over DHW temperatures and reduce the risk of scalding. As such, it is recommended that there is a requirement for the number of continuous seconds of DHW delivery at a temperature >55°C should be reported in the results.

## 7. References


1) BRE Information Paper IP 14/03
2) International Association of Plumbing and Mechanical Officials, White Paper on scald awareness.
3) Water supply and fittings regulations 1999
4) Plumbing engineering services design guide 2002, The Institute of Plumbing.
5) Chartered Institute of Building Services Engineers Guide G 2014:
6) HSG274 Part 2 2014:
7) BS 8558:2015 Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages