Technical Insulation
Great Britain & Ireland

# The Draft Heat Network Technical Standard TS1 - What It All Means

## Introduction

The long awaited draft standard for heat networks known as TS1 (**Heat Network Technical Standard** (**TS1**) has now been published on the government website, and has a number of clauses which will have a direct impact on the thermal insulation of projects in the future. TS1 will supersede CP1: 2020, transitioning from a code of practice into a formal standard. TS1 is in many ways a step change in requirements for thermal insulation.

TS1 is still a draft standard, and will be subject to public consultation before it is officially introduced. This will come before the launch of the Heat Network Technical Assurance Scheme (HNTAS), which is expected in 2027.

It is important that anyone who will be engaging with TS1 is also familiar with the HNTAS structure and gateways, and especially the assessment procedures, as this will link directly into the TS1 standard.

## The Requirements for Thermal Insulation

Most readers will be familiar with CP1 and Table 8, which lists a "minimum thickness" of insulation to be applied, listing 50 mm thickness of phenolic and 50-60 mm of mineral wool insulation alongside each other. This is one of the more contentious issues of CP1 (from a thermal insulation perspective) as the table lists differently performing materials at the same thickness, and bases this on incorrect thermal conductivities.

Table 8 has been replaced in TS1 with a new table, Table J.1 found in Annex J (See page 2).

Table J.1 has new thermal conductivity bands (=/< 0.030 W/mK, 0.030-0.040 W/mK and =/>0.04 W/mK. This represents a positive development, as the previously assumed conditions of 0.025/0.035 W/mK were not representative of the products on the market and the relevant mean temperatures, and moving this default position will lead to compliance by default, as opposed to compliance by exception where the correct calculations were conducted. This was a common point of failure with CP1 and is a positive change.

Table J.1 is based upon **BS5422: 2023** (Thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40 °C to +700 °C. Method for specifying) Table 19C/20C and has different options for both low and high emissivity insulation.

The thicknesses in the table are the required thicknesses for complying with Table 19C in the assumed conditions 55°C Flow and 20°C Ambient with the stated lambda values i.e. 0.030/0.040 W/mk.

It is important to note that this table does not replace the requirements of Table 19C. TS1 Clause 2/3.13.1 states that the heat length per unit length (W/m) from each above-ground pipe section should not exceed the values in Table 19C.

TS1 Clause 2.13.2 states that the thickness used shall be in accordance with Table J.1, however there are exceptions to this. The first exception is that a smaller thickness than shown in Table J.1 can be used, assuming the maximum permissible heat losses of Table 19C are not exceeded across a range of reasonably foreseeable circumstances (i.e. the relevant operating conditions are considered).

The worked example in Annex K of TS1 also makes it clear that when following Table J.1, if the heat losses exceed the Table 19C values, that the thickness be increased so that it complies.

**This clearly demonstrates that on heat networks in the future, the go to reference table should be BS5422: 2023 - Table 19C/20C (depending on emissivity of insulation).**

The second exception is that a smaller thickness of insulation can be used if required for a specific fire safety standard, however the maximum available thickness shall be used and the lengths of relevant pipework be minimised.

If Table J.1 is included in specifications, it should be treated with caution, especially where the operating conditions vary from the assumed conditions of Table 19C.

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| Outside Diameter of Pipe (mm) Pipework | Minimum Insulation Thickness (mm) | | | | | |
|---|---|---|---|---|---|---|
| | Thermal Conductivity at 40 °C [W/(m K)] (low-emissivity outer surface (ε = 0.05)) | | | Thermal Conductivity at 40 °C [W/(m·K)] (high-emissivity outer surface (ε = 0.90)) | | |
| | ≤ 0.030 | (0.030, 0.040) | > 0.040 | ≤ 0.030 | (0.030, 0.040) | > 0.040 |
| ≤26.9 | 35 | 60 | 105 | 40 | 70 | 120 |
| ≤33.7 | 45 | 80 | 135 | 50 | 90 | 155 |
| ≤42.4 | 50 | 85 | 140 | 55 | 95 | 160 |
| ≤42.4 | 55 | 95 | 160 | 65 | 110 | 180 |

Table 1: Minimum thickness values for pipework insulation on above-ground pipework as per Table J.1 in Annex J of the draft TS1 standard.

| Outside Diameter of Pipe on which Insulation Thickness Has Been Based (mm) | Thermal Conductivity at 40 °C [W/(m·K)] (low emissivity outer surface: ε = 0.05) | | | Maximum Permissible Heat Loss (W/m) |
|---|---|---|---|---|
| | 0.025 | 0.035 | 0.045 | |
| | Thickness of Insulation (mm) | | | |
| ≤21.3 | 19 | 39 | 71 | 4.4 |
| ≤26.9 | 22 | 43 | 76 | 4.7 |
| ≤33.7 | 29 | 56 | 99 | 4.7 |
| ≤42.4 | 32 | 61 | 104 | 5.1 |
| ≤48.3 | 38 | 70 | 121 | 5.1 |
| ≤60.3 | 43 | 79 | 131 | 5.4 |
| ≤76.1 | 50 | 90 | 147 | 5.8 |
| ≤88.9 | 54 | 95 | 153 | 6.1 |
| ≤88.9 | 54 | 95 | 153 | - |

Table 2: Indicative thickness of insulation for district heating systems having low emissivity outer surfaces (secondary system) as per Table 19C, BS5422: 2023.

**Note 1:** Insulation thicknesses in this table have been calculated according to BS EN ISO 12241: 2008 (Thermal insulation for building equipment and industrial Installations. Calculation rules) using standardized assumptions: horizontal pipe at 55 °C in still air at 20 °C, emissivity of outer surface of insulated system as specified.

**Note 2:** Heat loss relates to the specified thickness and temperature.

**Note 3:** Maximum permissible heat losses derived from BS EN 12828: 2012+A1: 2014 (Heating systems in buildings. Design for water-based heating systems) for district heating, linear U-values Class 7 (found in Branschstandard Teknisk Isolering).

It should be noted that this requirement is for all above-ground pipework, and therefore would not be limited to just secondary (communal) distribution systems as CP1 currently is. There is an additional requirement specifically for the communal distribution system.

## Communal Distribution Heat Loss Target

In CP1 we saw the introduction of heat loss targets based on the number of dwellings within the building, and the amount of heat loss permissible across the system. This was set at a maximum permissible value of 100 W/dwelling.

In TS1 this maximum value has been split into 2 targets, one for design and one for in-use to allow a tolerance for inefficiencies caused during installation. The new targets are 75 W/dwelling at design, and 100 W/dwelling in commissioning/ operation.

There is also a new requirement for non-domestic connections, which brings these into scope of the standard where they were previously excluded under CP1.

This value is 1.66 W/kW connection at design stage, and 2.22 W/kW at commissioning/operation.

If these values are not met at design stage, further methods of reducing heat loss should be looked at, including:

- reducing operating temperatures,
- a more efficient pipework configuration, or
- a greater thickness of insulation or lower thermal conductivity of insulation.

In practice, this could be particularly challenging for any network operating above 55°C as thicknesses of insulation will become so large as to be impractical at higher temperatures, and the focus will primarily be on reducing flow temperatures.

It is important however to read these heat loss requirements in the context of clause 2/3.13.5 – that the heat loss from ancillary equipment will be considered (pipe supports, valves, flanges etc).

The method for calculating heat loss for these components can be found in **BS EN ISO 12241: 2022**. (Thermal insulation for building equipment and industrial installations. Calculation rules). However, there is an alternative option of applying a 20% allowance to the heat loss of the system to allow for these components.

If this 20% allowance is used, this will in practice reduce the 75 W/dwelling value to functional 63.5 W/dwelling at design stage.

It is expected due to the complexity of the calculation, that most projects will take the 20% allowance approach, only looking at the thermal performance of flanges/valves etc when they are struggling to meet the W/dwelling target. It should be noted that the type of ancillary can have a big impact on the amount of heat loss, for example it would be typical when insulating a flange to leave sufficient space for the removal of the bolts. A system where the bolts would be removed vertically as opposed to horizontally would reduce the required space and could reduce heat loss by up to 60%.

## Ancillary Equipment

Ancillary equipment is specifically considered in clause 2/3.13.8, where insulation specific for the component should be used, at the same thickness of as the adjacent insulation, where available. Where not available, well fitted insulation products should be used.

Where flexible mineral fibre insulation is used, the installed thickness of the insulation shall be assumed to be 75% of the nominal thickness, allowing for 25% compression of the mineral wool, unless it can be shown that the insulation is not being compressed.

What this means practically, is that the insulation thickness of flexible mineral wool insulation for these ancillary components will need to be increased, so that after the compression factor is considered, it is the same thickness as the adjacent insulation. For example, if the adjacent insulation is 80 mm thick, then the flexible mineral wool insulation would need to be at least 107 mm thickness.

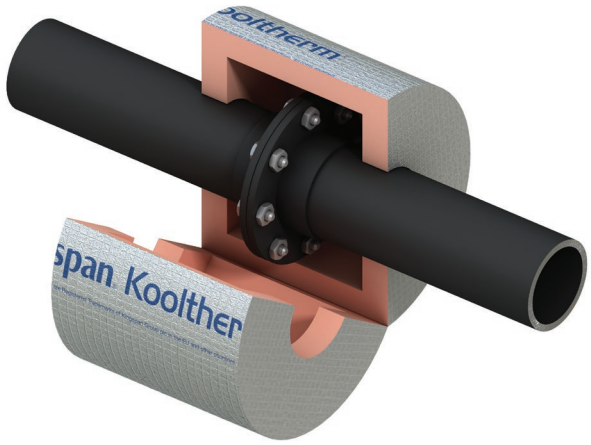


Figure 1: Flange box using Kingspan Kooltherm® Pipe Insulation.

## Thermal Stores

For the first time TS1 brings thermal stores into the spotlight and has a set performance criteria against them. This new value based on average heat loss no greater than 22 W/m$^2$ in its operating conditions. This equates to approximately 65-75 mm thickness of phenolic insulation (depending on vessel size and thermal conductivity) or 95-110 mm of mineral wool insulation (depending on vessel size and thermal conductivity). Figure 2 shows the performance criteria taken from the draft TS1 standard.

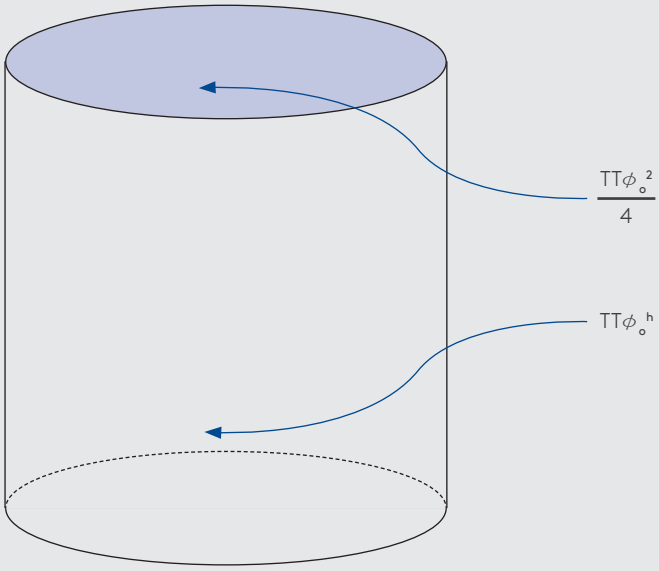
## Thermal stores

2.13.13
3.13.13

Thermal stores and buffer vessels shall be insulated such that the average heat loss is no greater than 22.0 W/m$^2$. This heat loss may be an average of the total standing heat loss divided by total surface area. The heat loss calculation shall be undertaken assuming the full charge temperature of the thermal store, and including consideration of the ambient temperature and exposure of the installed location of the thermal store (e.g. outdoors, unheated space).

**An average heat loss per unit area (in W/m$^2$) may be calculated as shown in Figure 31.**

Figure 31: Example calculation of heat loss per unit area from thermal vessel



$\frac{TT\phi_o^2}{4}$

$TT\phi_o^h$

Surface area = top + bottom + side

$$= \frac{TT\phi_o^2}{4} + \frac{TT\phi_o^2}{4} + TT\phi_o^h$$

$$= TT\phi_o^h \left(h + \frac{\phi_o}{2}\right)$$

Loss in W/m$^2$ = (standing loss) / area

$$= (\text{standing loss}) / \left[TT\phi_o^h \left(h + \frac{\phi_o}{2}\right)\right]$$

Where: $h$ = height of the vessel

$\phi_o$ = outer diameter of the vessel

Figure 2: Performance criteria for thermal stores and example calculation of heat loss as per the draft TS1 standard.

## Technical Submittals

There is a set process laid out in TS1 for what a technical submittal should look like and include for thermal insulation, and the checking of this by an assessor is currently lined up as a mandatory assessment.

This includes many points, but the key ones to highlight are:

- Declaration of Performance (compliant with relevant CE/UKCA marking standards).
- Thermal conductivity curve.
- The thermal conductivity at each calculated mean temperature of insulation.
- The thickness of specified insulation.
- The heat loss per length (W/m) in accordance with clause 2/3.13.1 (i.e. against the permissible values of Table 19C).
- Evidence that the calculations have been performance with the relevant thermal conductivity and not a generic value.
- Details of the proposed solution for ancillary equipment.

This means that if any changes are made to the insulation specified and used for calculations at the design stage, these calculations will need to be reworked with the new insulation product and evidence submitted on how this change will impact the heat loss of the system.

There are further requirements for thermal insulation at Stages 5,6 and 7 around installer competence, evidence requirements on installation quality and on retrofit work. Information on this can be found in section 5.13, 6.13 and 7.13 respectively of TS1.

## Summary

In summary, the proposed amendments in the draft TS1 standard have the following implications:

- That the choice of insulation for heat networks will be covered under standard, rather than a code of practice.
- These decisions will need to be made early in the design process.
- BS5422: 2023 Table 19C needs to be adhered to.
- There will be more stringent requirements than are currently in place.
- A greater focus on the whole system performance rather than just on the lengths of pipe insulation, including flanges, valves, thermal stores and other components.
- Evidence will need to be gathered throughout the design process, and will be independently verified as part of the HNTAS process.
- Any changes to the design during construction will mean a recalculation of the heat loss of the system.

For further information or to understand how Kingspan Technical Insulation Ltd can help you prepare for TS1, please contact us on **techline.hvac@kingspan.com**.

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Second Issue | 03/2026