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## Airsaces and the BuildDesk U-value software

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The calculation procedure for airsaces is detailed in BS EN ISO 6946 (2007) Annex B: *Thermal resistance of airsaces*. The document BR443 (2006): *Conventions for U-value calculations* gives some example results and provides some additional guidance.

### What is an airspace?

An airspace as described in BS EN ISO 6946 is a region of air within a building component (but not including glazed components such as windows). BS EN ISO 6946 distinguishes between:

**air layers**, where the two dimensions of the airspace (measured at right-angles to the direction of heat flow) are both more than 10 times the thickness of the airspace (measured in the direction of heat flow). A typical example of this would be an uninsulated cavity within a masonry wall.

**air voids**, where the 10-times-thickness condition described above isn't met (i.e. the airspace is small or divided). An example of this would be where there was a 50mm airspace in a timber-framed wall and the clear spacing between timber members was 500mm or less.

The terminology ("airsaces", "air layers", "air voids") is potentially confusing but it's not really that important; it's more important to understand that the regions of air that are divided (according to the 10-times-thickness rule) are calculated differently to the regions of air that are not divided.

There is one issue of terminology that does need to be dealt with to avoid confusion. In BS EN ISO 6946, *airsaces* (the things we're considering in this document) are not the same things as *airgaps*. Airgaps are the spaces between individual boards of insulation and are associated with manufacturing tolerances and imperfections during installation on site. The effect of these airgaps is taken into account by applying a final adjustment to the calculated U-value; this has nothing to do with the calculation of the thermal resistance for airsaces and is treated separately by BS EN ISO 6946 and the BuildDesk U-value software.

## How is the thermal resistance of an airspace calculated?

In BS EN ISO 6946 Annex B, there are separate calculation procedures for air layers (undivided) and air voids (divided). In both cases, the calculations take into account the following:

*The thickness of the airspace (in the direction of heat flow)*

*The direction of heat flow (i.e. horizontal, upwards or downwards)*

*The emissivity of each surface bounding the cavity*

The emissivity of a surface is a measure of how much thermal radiation the surface emits. A standard emissivity value for a non-reflective surface is 0.9. If the surface is reflective (e.g. foil-faced) then the emissivity value will be reduced (0.2 is a standard default value for low-emissivity surfaces). Low-emissivity surfaces are also called “low-e” surfaces. Lower values of emissivity on the surfaces of an airspace lead to an improved thermal performance of the airspace. If a low-e material (such as foil-faced insulation) forms the boundary to an airspace, the emissivity of the low-e surface (taken from product datasheets) can be entered in the U-value software when specifying the airspace. (See the next page for details on where you can do this.)

Table 2 on page 5 of BS EN ISO 6946 shows the thermal resistances for some airspaces of different thicknesses and directions of heat flow. All these example values have been calculated following the detailed procedure in Annex B and assuming that:

- the airspaces are undivided (i.e. they are air layers according to the 10-times-thickness rule described earlier) and
- that surfaces bounding the cavity have a high emissivity (i.e. they are non-reflective surfaces).

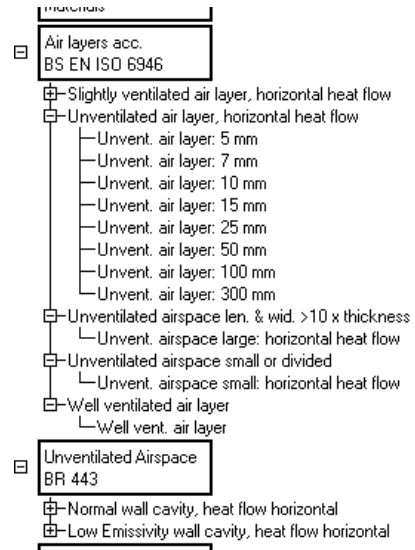
Some other examples are given in the document BR 443: *Conventions for U-value calculations*; these examples have also been calculated using the Annex B procedure with the same assumptions.

Note that:

- The calculation method can sometimes produce the same result for a range of airspace thicknesses. For example, the thermal resistance of air layers (i.e. undivided airspaces) with high-emissivity surfaces and a horizontal heat flow (the case for most unfilled cavities in external walls) is  $0.18\text{m}^2\text{K/W}$  for all thicknesses from 20mm to 300mm.
- BS EN ISO 6946 states that the method is not applicable to air layers over 300mm thick.
- In this document, we've considered *unventilated* airspaces. If the airspace is deemed to be *slightly ventilated* (which, in practice, is difficult to do with confidence) a different calculation applies. If the airspace is *well ventilated*, no thermal resistance is applied to the airspace and the calculation stops at that layer.

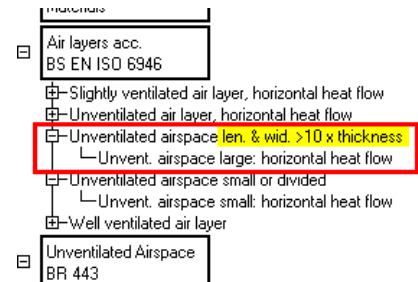
## In the BuildDesk U-value software

The BuildDesk U-value software includes materials catalogues that include predefined air layers with stated thicknesses. In each case, the air layer's thermal resistance has been calculated using the procedure in BS EN ISO 6946 Annex B, and using the same standard assumptions (undivided air layers with high-emissivity surfaces) used to generate the example values given in 6946 and BR443.

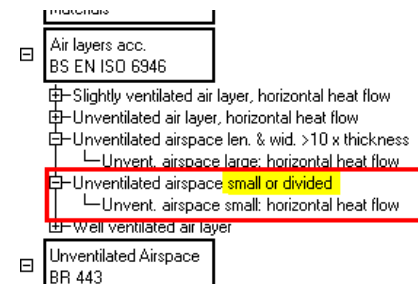


The direction of heat flow shown in the catalogue items will depend on the type of component (wall, floor or roof) that is being specified.

The software's catalogue also provides an option to let users follow the procedure in BS EN ISO 6946 Annex B for bespoke cases. (Choosing this option will let the user specify the thickness of the airspace and the emissivity of the two surfaces bounding the airspace.)



Immediately below this option in the catalogue is an option where the user can specify the details of a small or divided airspace.



When specifying a small or divided airspace, the user is presented with the usual dialog for inhomogeneous layers. For the airspace calculation to be performed correctly, the *dimensions* of the airspace and separating material should be entered; the software will then calculate their proportions.

