

There are a number of standardised thermocouple types which can measure high temperatures over 1000 °C. Which ones are they and what are the criteria for choosing the most appropriate one? Here are some suggestions of relevance to environments such as high temperature furnaces and boilers..

Thermocouples degenerate

The thermocouple's own components can also begin reacting with the wires at high temperatures. For best results, the noble metal types R, S and B require extremely


Metal sheathed cables

Countless trace elements are also present in the thermocouple wires, especially in type K, and can degenerate the readings. This fact, together with the impaired insulating properties at high temperatures, means that the base metal thermocouples K and N are limited in terms of their practical use to approximately 1200 °C, which is close to the metals' melting point. Diameters under 4.5 mm should be avoided. It is possible to use outer protection tubes made of high temperature steel to extend the operating time.

The platinum thermocouples R, S and B are also available in the form of metal sheathed cables. The construction is similar to that

Determine the operating time

In addition to being more precise than the base metal thermocouples, the noble metal thermocouples R/S and B cost more, mostly because of the platinum. However, the noble metals do have a significant scrap value. The required ceramic is sensitive to sudden changes of temperature and mechanical damage. If you are measuring at around 1000 °C it may be worth making a comparison with base metal thermocouples such as N or K. In situ calibration is a good way to determine the operating time after which a thermocouple degenerates outside a deviation which is acceptable to the user. [Ref 2]. If the operating time is long enough, more frequent replacement of base metal thermocouples can be more economic than using noble metal thermocouples.

Figure 3 shows the tolerances for the relevant thermocouple types. Tolerance deviations can be calibrated away to some degree. Thermocouple types K and N should not be calibrated but should instead be replaced with new ones [Ref 2]. Types R, S and B are more stable than the base metal ones at corresponding temperatures. However, calibration can be beneficial. As we have seen, the choice of high temperature sensor depends on many factors. 

References:

[Ref 1] See Pentronic News 2011-4 page 4

[Ref 2] See Pentronic News 2012-1 page 4

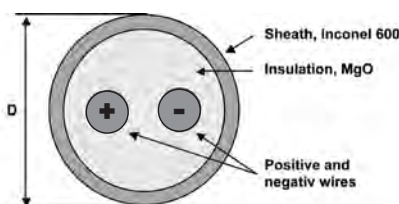


Figure 1: A typical construction of thermocouple types R, S and B. The measurement insert contains noble metal wires with a diameter of 0.5 mm for a longer operating time. The ceramic insert is protected by an outer bottomed ceramic tube. A steel neck provides stability and the attachment for a screw fitting, flange or similar.

Figure 2. A sheathed thermocouple in cross section. The sheath thickness is approx. $0.1D$ and the wire diameter approx. $0.2D$. Versions with double separate thermocouple circuits also exist.

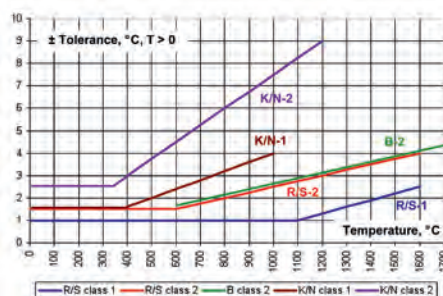


Figure 3. Tolerances for thermocouple types K, N, R/S and B in classes 1 and 2 in accordance with IEC 60584 for temperatures above 0 °C. Note that the measuring ranges have different limits. Types R and S have a shorter lifetime above 1300 °C. Type B is only available as class 2 and the signal level only begins to increase from close to zero at 600 °C. However, in compensation, ordinary copper wires can be used from the terminal head to the measuring equipment

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