EAP-030011

How should we choose a thermocouple?

Choose your thermocouple based on the temperature range and accuracy required. Some thermocouples, for example Type B and R, use expensive materials - platinum and rhodium. Some thermocouples generate only low emf at a low temperature range.

(1) Application temperature

Some may think that the higher the temperature range, the better the thermocouple. If you choose your thermocouple type only by the high recommended temperature range and the upper limit, it may be expensive, or you may find unexpected error at a low temperature. Choose the thermocouple whose recommended temperature range agrees with the temperature that you would normally measure in your application.

(2) Environment

Choose the wire materials which withstand the aggressive application atmosphere (oxidation, corrosion and others). A thermo-well is usually used to protect a thermocouple, mechanically and environmentally.

(3) Accuracy

Choose the thermocouple whose accuracy class meets your required accuracy.

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The following table shows pros and cons of each thermocouple type. Accuracy specification and application temperatures are shown in the previous question (EAP-030010).

TYPE	**PROS**	**CONS**
B	1) Suitable for high temperature measurement; above 1000°C (1600°F) 2) No compensation wire is required because of very low emf at room temperature. Use copper wires for extension. 3) Resistance against oxidation and chemically aggressive atmosphere.	1) Unsuitable for measurement below 600°C (1000°F) because of low emf below 600°C. 2) Low sensitivity. 3) Poor linearity of emf to the measured temperature. 4) Expensive.
R, S	1) High accuracy, only little variation among products, and stable in application atmosphere. 2) Resistance against oxidation and chemically aggressive material. 3) Used as the reference temperature sensor.	1) Low sensitivity. 2) Deterioration in reducing atmosphere, such as hydrogen, and metallic vapor. 3) Poor accuracy of compensation wire. 4) Expensive.
K	1) Good linearity of emf to the measurement temperature. 2) Good resistance against oxidation below 1000°C (1600°F). 3) Most stable among thermocouple of inexpensive material.	1) Not suitable for reducing atmosphere but will withstand metallic vapor. 2) Aging of the emf characteristic, in comparison to thermocouples of noble materials (B, R, and S).
E	1) The highest sensitivity among the existing thermocouples. 2) Good heat-resistance compared to Type J. 3) Non-magnetic. 4) Generally, cheaper than Type K.	1) Not suitable to reducing atmosphere. 2) Some hysteresis (Difference in emf at the same temperature depending upon whether the temperature is increasing or decreasing).
J	1) Usable in reducing atmosphere. 2) High sensitivity, emf is about 20% higher than Type K.	1) The positive wire (iron) rusts easily. 2) The product variation in the sensitivity is high.
T	1) Good linearity of emf. 2) Good characteristics in the low temperature range. 3) Low in the product variation. 4) Usable in reducing atmosphere.	1) Only for low temperature measurement. 2) Positive wire (copper) rusts easily. 3) Heat conduction error is large.

M-System has flexible solutions to meet your specific application and requirements. Consult our Signal Conditioners Data Library. ■

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