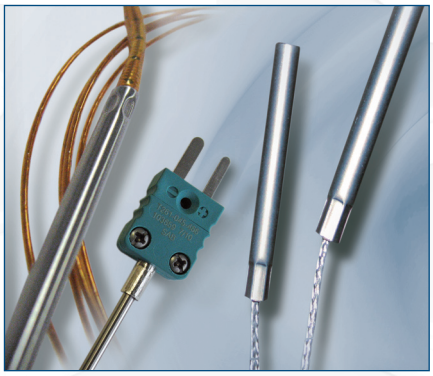
SPECIAL CABLES SAB North America

# FAQ's
## Thermocouples

*When you need to detect a temperature in your system, not only must you weigh various tradeoffs between temperature sensors, you must also be sure you have the right cable for data handling and to ensure accurate measurements. SAB North America has expertise in thermocouples, resistance thermometers, and the cabling you need to build an optimal assembly. We're well-positioned to answer cabling questions that pertain to your temperature measurement needs. Here is a sample of some of the questions we often answer:*



**Q:** **Should I use a resistance thermometer or a thermocouple to measure the temperature in my system?**

**A:** Both devices have advantages. To find the ideal solution, you should match your system's requirements with the benefits of each type of sensor. This table can help you compare each sensor:

| Characteristics | Resistance Thermometer | Thermocouples |
|---|---|---|
| ***Dimensions*** | larger sensor surface | small sensor surface possible |
| ***Response Time*** | relatively long | short |
| ***Connection Cables*** | copper cables | thermocompensating cable |
| ***Accuracy*** | very good | good |
| ***Consistency*** | very good | satisfactory |
| ***Surface Temperature Measurement*** | not possible | possible |
| ***Hot Junction*** | over the whole length of the RTD | punctual |
| ***Robustness*** | good | very good |
| ***Spontaneous Heating*** | has to be considered | does not occur |
| ***Temperature Range*** | up to +600°C | higher temperature possible |
| ***Cold Junction*** | not necessary | necessary |
| ***Circuit Supply*** | yes | no |
| ***Vibration Resistance*** | relatively sensitive | very rugged |

**Q:** **I need a measurement system with a very fast response time?**

**A:** Jacket construction has the largest effect on response time. For example, you can speed up your response time by choosing the right metal jacket, heat transfer compounds, and measurement point position. You can also talk to SAB North America's experts to determine an ideal solution for your assembly.

**Q:** **I have a large distance between the measurement point and the temperature display unit. How can I reliably transfer my data?**

**A:** Away from the hottest spot of measurement, the temperature will decrease rapidly. At this point, a temperature-resistant metal sheath is no longer necessary and it is possible to switch to an extension cable to transfer the measured value. Depending on the remaining distance, SAB North America can offer suitable cable with the right cross-section.

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**Q:** What type of connection cable should I choose for my thermocouple?

**A:** Thermocouple cables consist of the same element material as the thermocouple and are tested for the same temperatures. Extension cables are made of conductors with a nominal structure that's identical to the corresponding thermocouple and are normally tested within a temperature range of 0° up to +200°C. Compensating cables are made of substitute insulating material and have thermoelectric characteristics in the allowed temperature range (usually 0° up to +200°C) as the corresponding thermocouple.

**Q:** I use my measurement system in a hazardous environment. How can I protect the sensor?

**A:** The metal sheath is an important part of a temperature sensor assembly, and it should be chosen carefully. There are several metallic alloys to resist acids, combustible gases, and rust, as well as maximum temperature. SAB North America can provide an overview of various steel types to address your application's harsh environment.

| Max. Application Temperature | Material No. | Material Characteristics | Application Range |
|---|---|---|---|
| **Unalloyed High Temperature Steel** | | | |
| 400°C | 1.305 (ASTM 105) | Unalloyed steel | weld-in and screw-in protecting tubes in steam lines |
| 500°C | 1.5415 (AISI A204 Gr. A) | Low Alloy and high temperature steel with molybdenum addition | weld-in and screw-in protecting tubes |
| 540°C | 1.7335 (AIAI A182 F11) | Low-alloy and high temperature steel with chromium and molybdenum addition | weld-in and screw-in protecting tubes |
| 570°C | 1.7380 (AISI A182 F11) | Low-alloy and high temperature steel with chromium and molybdenum addition | weld-in and screw-in protecting tubes |
| 650°C | 1.4961 | High temperature austenitic chromium nickel steel (Niobium stabilized) | weld-in and screw-in protecting tubes |
| **Rust and Acid Resistant Steel** | | | |
| 550°C | 1.4301 (AISI 304) | Good resistance against organic acids with medium temperatures, saline solutions p.e. sulphates, sulphides, alkaline solvents with medium temperature | food, luxury market, medical, apparatus engineering |
| 550°C | 1.4404 (AISI 316 L) | With the addition of molybdenum it is more corrosion-proof in oxidizing acids, p.e. acid of vinegar, acidity of wine, phosphoric acid, sulphuric acid and others. There is an elevated resistance against intercrystalline corrosion by a reduced carbon content | chemical, pulp, nuclear, textile, pharmaceutical, dairies and breweries |
| 550°C | 1.4435 (AISI 316 L) | elevated resistance against corrosion compared with 1.4404, smaller delta ferrite portion | pharmaceutical |
| 550°C | 1.4541 (AISI 321) | good intercystalline corrosion resistance, good resistance against heavy products, vapor, and combustion gases. Good resistance against oxidation | chemical industry, nuclear power plants, textile |
| 550°C | 1.4571 (AISI 316 TI) | elevated corrosion resistance compared to certain acids due to the addition of molybdenum. Resistant against crevice corrosion, salt water and aggressive industrial influences | pharmaceutical, dairies, and breweries |

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**Q:** **There are many different types of thermocouples. How can I find the right one?**

**A:** The main differences among the various types are the temperature range in combination with the accuracy of the classes. The experts at SAB North America can walk you through the different types of thermocouples or customize a thermocouple to fit your needs.

| | | | class 1 | | class 2 | | class 3 | |
|---|---|---|---|---|---|---|---|---|
| **Type** | **Standard** | **Material** | **Temp Range** | **(2) Limit deviation** | **Temp Range** | **(2) Limit deviation** | **Temp Range** | **(2) Limit deviation** |
| T | DIN EN 60584 | Cu-CuNi | -40°C to +350°C | 0.5°C or 0.40% | -40°C to +350°C | 1.0°C or 0.75% | -200°C to +40°C | 1.0°C or 1.5% |
| (1) U | DIN 43710 | Cu-CuNi | - | - | 0°C to +600°C | ± 3°C / ±0.75% | - | - |
| J | DIN EN 60584 | Fe-CuNi | -40°C to +750°C | 1.5°C or 0.40% | -40°C to +750°C | 2.5°C or 0.75% | - | - |
| (1) L | DIN 43710 | Fe-CuNi | - | - | 0°C to +900°C | ±3°C / ±0.75% | - | - |
| K | DIN EN 60584 | NiCr-Ni | -40°C to +1000°C | 1.5°C or 0.40% | -40°C to +1200°C | 2.5°C or 0.75% | -200°C to +40°C | 2.5°C or 1.5% |
| E | DIN EN 60584 | NiCr-CuNi | -40C° to +800°C | 1.5°C or 0.40% | -40°C to +900°C | 2.5°C or 0.75% | -200°C to +40°C | 2.5°C or 1.5% |
| N | DIN EN 60584 | NiCrSi-NiSi | -40°C to +1000°C | 1.5°C or 0.40% | -40°C to +1200°C | 2.5°C or 0.75% | -200°C to +40°C | 2.5°C or 1.5% |
| S | DIN EN 60584 | PtRh 10-Pt | 0°C to +1600°C | 1.0°C or (3) | 0°C to +1600°C | 1.5°C or 0.25% | - | - |
| R | DIN EN 60584 | PtRh-13-Pt | 0°C to +1600°C | 1.0°C or (3) | 0°C to +1600°C | 1.5°C or 0.25% | - | - |
| B | DIN EN 60584 | PtRh30-PtRh6 | - | - | 600°C to +1700°C | 1.5°C or 0.50% | +600°C to +1700°C | 4.0°C or 1.0% |

Classes 1, 2, and 3 are valid for thermocouples.
(1) Since April 1994 the standard DIN 43710 is no longer valid.
(2) For the limit deviation, the higher value is valid
(3) 1°C or [1+(t-1100) x 0.003]°C

**Q:** **Get Temperature Sensors Tailor-Made To Your Requirements**

**A:** As a leading manufacturer of electric thermometers for many different applications, SAB North America can help you select the right thermocouple or create a custom solution for your application. And, we can provide the right thermocouple cable with the quality and reliability your system demands. Be sure to talk to SAB to get all your temperature measurement questions answered.