# Mineral insulated Temperature probes

## Features

- Mineral insulation with high purity MgO(powder> 96%) insuring ahigh thermal conduction and fast response times
- Flexibel, chock and vibration proof
- Available in diameters 1mm, 1.5mm, 2mm, 3mm and 6mm (other diameters are available on request)
- Sheaths of Inconel 600 or Stainless Steel 1.4541 (Other Shealth materials are available on request)
- Fully conform with requirements of the international Standard DIN IEC 60584, Accuracy Class 1
- Fast response
- Fitting length to suit application

## Application

Thanks to their special properties, mineral insulated temperature sensor are used in chemical plant, power stations, pipelines, in engine construction and on test beds. The thermocou plant, power stations, pipelines,in engine construction and on test beds. The thermocouple wires are embedded in temperature sensor fire-re -sistant magnesium oxide inside the flexible thin-walled sheath.

The excellent heat transfer between the sheath and the thocouple enables short response times ($t_{0.5}$ from 0.15sec) and high measu -rement accuracy. The shock-proof construction ensures a long li -fe. The minimum bending radius is 5 x the external diameter. The minimum fitting length EL is 50mm for 0.5mm to 2.0mm dia., and 100mm for 3.0 to 6.0mm

The thermocouples are normally insulated from the sheath. The measuring insert is fitted with thermocouples to EN 60 584 or DIN 43 710. Versions with two thermocouples are also available.

**Test pressure:** 40 bar (helium) leakage test at the measurement point.

**Insulation resistance:** thermocouple against sheath at ambient te -mperature for lengths up to 1m: 200M, for lengths 1m and above: 200M 200MΩxm.

## RTD Accuracy

| | DIN EN 60751 |
|---|---|
| class B | $\Delta t = \pm (0{,}3° C + 0{,}005 \times \lvert t \rvert)$ |
| class A | $\Delta t = \pm (0{,}15° C + 0{,}002 \times \lvert t \rvert)$ |
| class 1/3B | $\Delta t = \pm (0{,}3° C + 0{,}005 \times \lvert t \rvert)/3$ |

## thermocouples accuracy

| sensor | Class 1 | temperature range | Class 2 | temperature range |
|---|---|---|---|---|
| T Cu-CuNi | 0.5℃ or (0.4% x\|T\|)℃ | -40..+350℃ | 1℃ or (0.75% x\|T\|)℃ | -40..+350℃ |
| J Fe-CuNi | 1.5℃ or (0.4% x\|T\|)℃ | -40..+750℃ | 2.5℃ or (0.75% x\|T\|)℃ | -40..+750℃ |
| K NiCr-Ni | | -40..+1200℃ | | -40..+1200℃ |
| E NiCr-CuNi | | -40..+900℃ | | -40..+900℃ |
| N NiCrSi-NiSi | | -40..+1200℃ | | -40..+1200℃ |
| S PtRh10-Pt | 1.0℃ or [0.3% x(\|t\|-1100)]℃ | 0..+1600℃ | 1.5℃ or (0.25% x\|T\|)℃ | 0..+1600℃ |
| R PtRh13-Pt | | 0..+1600℃ | | 0..+1600℃ |
| B PtRh30-PtRh6 | ____ | 0..+1700℃ | 1.5℃ or (0.25% x\|T\|)℃ | 0..+1700℃ |

## RTD response times

| diameters | in water 0.2m/sec | in air 2m/sec |
|---|---|---|
| 1.5mm | $t_{0.5}$=3.60sec $t_{0.9}$=5.50sec | $t_{0.5}$=10.8sec, $t_{0.9}$=26.3sec |
| 3.0mm | $t_{0.5}$=5.20sec $t_{0.9}$=9.80sec | $t_{0.5}$=20.0sec, $t_{0.9}$=51.0sec |
| 6.0mm | $t_{0.5}$=10.4sec $t_{0.9}$=23.2sec | $t_{0.5}$=46.8sec, $t_{0.9}$=121.0sec |

## thermocouples response times

| diameters | in water 0.4m/sec | in air 2m/sec |
|---|---|---|
| 0.5mm | $t_{0.5}$=0.15sec $t_{0.9}$=0.30sec | $t_{0.5}$=3.5sec, $t_{0.9}$=8.0sec |
| 1.0mm | $t_{0.5}$=0.20sec $t_{0.9}$=0.60sec | $t_{0.5}$=7.5sec, $t_{0.9}$=17.0sec |
| 1.5mm | $t_{0.5}$=0.40sec $t_{0.9}$=0.90sec | $t_{0.5}$=10.0sec, $t_{0.9}$=25.0sec |
| 2.0mm | $t_{0.5}$=0.80sec $t_{0.9}$=2.60sec | $t_{0.5}$=13.0sec, $t_{0.9}$=34.0sec |
| 3.0mm | $t_{0.5}$=1.00sec $t_{0.9}$=2.80sec | $t_{0.5}$=22.0sec, $t_{0.9}$=64.0sec |
| 4.5mm | $t_{0.5}$=2.50sec $t_{0.9}$=6.50sec | $t_{0.5}$=34.0sec, $t_{0.9}$=113.0sec |
| 6.0mm | $t_{0.5}$=3.00sec $t_{0.9}$=9.00sec | $t_{0.5}$=55.0sec, $t_{0.9}$=170.0sec |

## Protection tube

| | |
|---|---|
| thermocouples diameters | 0.15mm, 0.5mm, 1.0mm, 1.5mm, 2.0mm, 3.0mm, 4.0mm, 5.0mm, 6.0mm, 8.0mm |
| RTD diameters | 1.5mm, 2.0mm, 3.0mm, 4.0mm, 5.0mm, 6.0mm, 8.0mm |

Available in diameters0.5mm, 1mm, 1.5mm, 2mm, 3mm and 8mm dia.
(other diameters are available on request)

Available in lengths 100mm, 200mm, dia.
(other lengths are available on request)

## Sheath Materials

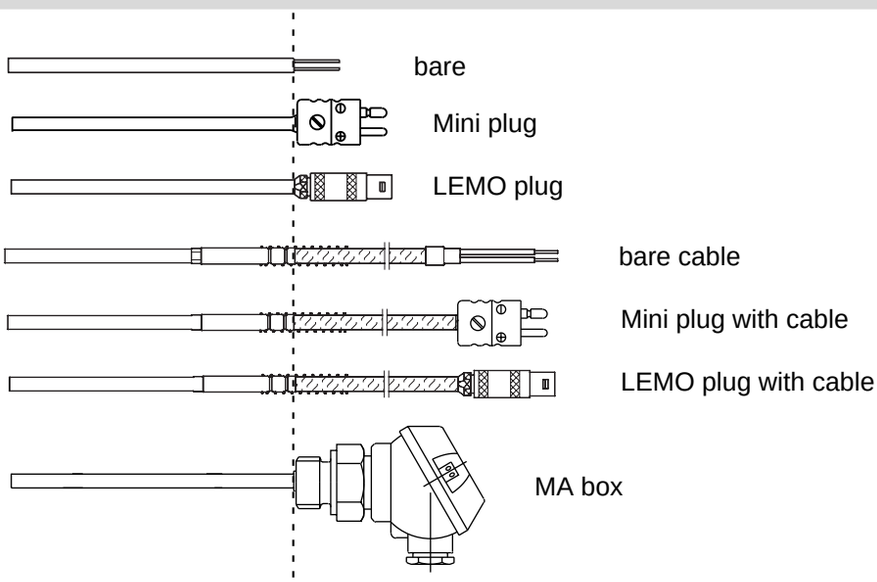
| | |
|---|---|
| **Selection of Suitable Sheath Quality** | Supply and demand on the mineral insulated cable market comprise a vast array of sheath qualities with the main emphasis on materials suitable for certain applications and those with a historical basis. To limit this choice to an acceptable range as far as production and stock are concerned we are obliged, in particular with high grade stainless steels, to carry out a selective process for our standard production programme . A number of other sheath material qualities are available, and can be used for customer specials. |
| AISI 321 | **Corrosion and heat resistance:** This material possesses excellent resistance to a number of aggressive media including hot crude oil products, steam and combustion gases. When operated in air it is oxidation resistant up to 900°C and with temperature variation resistant up to 800°C. It is resistant to carbon dioxide up to 650°C. |
| AISI 316 Ti<br>AISI 316 | **Corrosion and heat resistance:** Additions of molybdenum make these steels superior to molybdenum-free types as regards increased corrosion resistance to certain acids such as acetic acid, phosphoric acid, sulphuric acid, and other similar acids. Furthermore, these steels are more or less insensitive to pitting corrosion and withstand salt-water and aggressive industrial media. They can be used in continuous operation in air up to approx. 900°C and with temperature variation up to 800°C. |
| AISI 304L | **Corrosion and heat resistance:** This steel is also highly resistant to a number of aggressive media e.g. crude oil products, steam, combustion gases, colouring agents and liquid sodium. In contrast to alloys such as 1.4301, it is less prone to intercrystalline corrosion due to the lower carbon content. It can be subjected to continuous operation in air up to 900°C and under temperature variation up to 800°C. |
| AISI 310 | **Corrosion and heat resistance:** Excellent corrosion resistance. Can be operated in an atmosphere with carbon dioxide content up to 900°C. Resistant to concentrated nitric acid at 200°C and molten nitrates up to 420°C. Continuous operation in air up to approx. 1150°C and with temperature variation up to approx. 1000°C. Not recommended - the use of the material in continuous operation between 550°C and 850°C, because the material has a tendency to aphase precipitation and is consequently brittle after cooling to room temperature. |
| Inconel 600 | **Corrosion and heat resistance:** Highly resistant to general corrosion and stress-corrosion-cracking. The limit for use in carbon dioxide is around 500°C, as from 650°C corrosion increases drastically. Inconel 600 should not be used in liquid sodium above 750°C because higher temperatures cause material disintegration. Excellent oxidation resistance up to 1150°C. Not for application above 550°C in a S-containing atmosphere. Can be operated in water free of Cl up to 590°C. |
| Nicromil | **Corrosion and heat resistance:** Highly resistant to general corrosion and stress-corrosion-cracking. Can be operated up to 1250°C. |

## Insulation Materials

**Insulation Material**
**Typical Composition of the Standard Quality MgO and the High Purity Qualities MgO and $Al_2O_3$**

| | MgO (97%) (Standard) | MgO (High Purity) | $Al_2O_3$ (High Purity) |
|---|---|---|---|
| MgO | >97,0 | >99,4 | 0,08 |
| $Al_2O_3$ | 0.15 | 0.019 | 99,8 |
| CaO | 0.7 | 0.02 | 0.004 |
| $Fe_2O_3$ | 0.09 | 0.018 | 0.009 |
| $5iO2_2$ | 2,0 | 0,02 | 0,08 |
| B, Cd, S | <10ppm | <10ppm | <10ppm |
| C * | 10ppm | 50ppm | 20ppm |
| *) can be reduced further if necessary (exposure to radiation) before use. | | | |

## electronic



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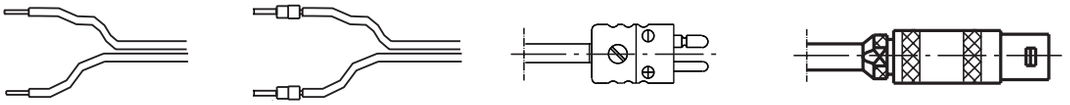
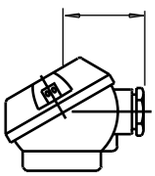


## cable

| | |
|---|---|
| PVC | -20...+100° C |
| Silicone | -50...+180° C |
| PTFE | -200...+260° C |
| Metal braiding | -50...+400° C |
| Glass fiber | -50...+400° C |

## box



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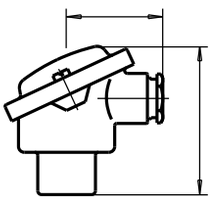

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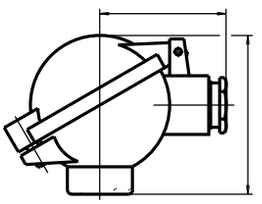
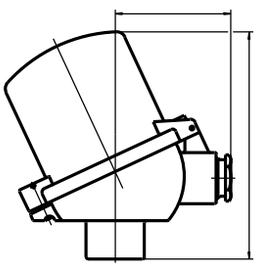


BUZ



BUZH

Form MA,aluminium die-casting,M6*1.5;IP65,ambient temperature -40 to +100° C

Form B,DIN 43 729,aluminium die-casting,M20*1.5;IP54,ambient temperature -40 to +100° C

Form BUZ,aluminium die-casting,M20*1.5;IP65,ambient temperature -40 to +100° C

Form BUZH,aluminium die-casting,M20*1.5;IP65,ambient temperature -40 to +100° C