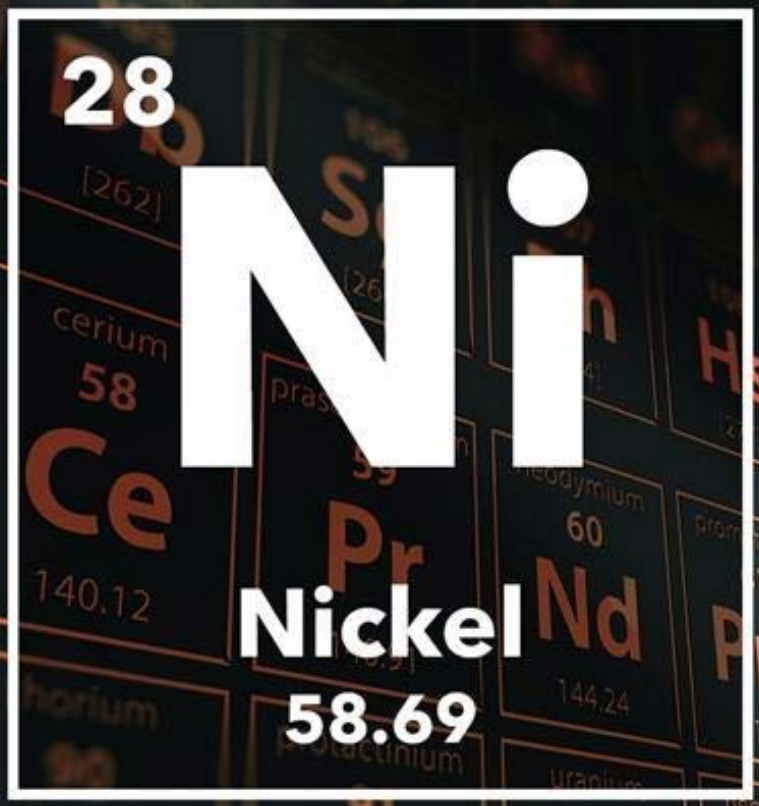
# Nickel & Thermocouple Alloy




- Thermocouple Conductor
- Extension Conductor
- Compensating Conductor
- Nickel Conductor
- TRHA (NiCr) 80/20 Nichrome Wire
- TRHA 1 & 4 (FeCrAl)
- Low Resistance - TRHA (CUPRONICKEL CuNi)

TEMPSENS

www.tempsens.com

# Index


About Us .....3

Testing and Calibration .....3

Thermocouples .....4

Thermocouple Conductors.....4

Extension/Compensating Conductor Alloy .....5

Pure Nickel Conductor Alloy .....5

Tempsens Resistance Heating Alloy .....6

Packaging and Shipping .....7

Spool sizes .....7

TEMPSENS TECHNICAL DATASHEET FOR (KP) & (KPX) TYPE CONDUCTOR.....8

TEMPSENS TECHNICAL DATA SHEET FOR (KN) & (KNX) TYPE CONDUCTOR .....9

TEMPSENS TECHNICAL DATA SHEET FOR (KNCB)/(VNX) TYPE CONDUCTOR .....10

TEMPSENS TECHNICAL DATA SHEET FOR (JP) & (JPX) TYPE CONDUCTOR .....11

TEMPSENS TECHNICAL DATA SHEET FOR (JN) & (JNX) TYPE CONDUCTOR .....12

TEMPSENS TECHNICAL DATA SHEET FOR (EP) & (EPX) TYPE CONDUCTOR .....13

TEMPSENS TECHNICAL DATA SHEET FOR (EN) & (ENX) TYPE CONDUCTOR .....14

TEMPSENS TECHNICAL DATA SHEET FOR (NP) & (NPX) TYPE CONDUCTOR .....15

TEMPSENS TECHNICAL DATA SHEET FOR (NN) & (NNX) TYPE CONDUCTOR .....16

TEMPSENS TECHNICAL DATA SHEET FOR (RNCA) & (SNCA) TYPE CONDUCTOR .....17

TEMPSENS TECHNICAL DATA SHEET FOR (TP) & (TPX) TYPE CONDUCTOR .....18

TEMPSENS TECHNICAL DATASHEET FOR C TYPE COMPENSATING CONDUCTOR(CPC) .....19

TEMPSENS TECHNICAL DATASHEET FOR C TYPE COMPENSATING CONDUCTOR(CNC) .....20

TEMPSENS TECHNICAL DATA SHEET FOR (TN) & (TNX) TYPE CONDUCTOR .....21

TEMPSENS TECHNICAL DATASHEET FOR TRHA 80:20 (NiCr) RESISTANCE ALLOY .....22

TEMPSENS TECHNICAL DATASHEET FOR TRHA 1 & 4 (FeCrAl) ALLOY .....23

TEMPSENS TECHNICAL DATASHEET FOR LOW RESISTANCE - TRHA CuNi(CUPRONICKEL) ALLOY .....24

# ABOUT US

Tempsens Instruments (I) Pvt. Ltd. is a part of the diversified manufacturing group of companies of PYROTECH Group, which was established in 1976 by four tech-savvy technocrats. TEMPSENS has carved its niche in bringing technology and engineering together in the field of temperature measurement applications. We offer thermal engineering and cable solutions in industrial markets around the world.

Besides the headquarter and manufacturing facilities in India, Tempsens has broadened its horizon with manufacturing facilities in Germany and Indonesia besides sales offices in UAE and USA.

After the initial beginning with Thermocouples and RTDs, Tempsens has continuously focused on the manufacturing and supply of high quality thermal engineering products, accessories and services; built to specific customer needs. The company is involved in manufacturing of Thermocouple Nickel Alloys,

Thermocouples, RTDs, Thermowells, Cables & Wires, Non-Contact Pyrometers, Heaters, Furnaces and Calibration equipments etc. with covered area of 2,70,000 sq. ft. Tempsens is an ISO 9001:2015, ISO 14001:2015, OHSAS 18001 certified company with NABL Accredited Laboratories.

Tempsens has earned the customer reputation worldwide of being a Preferred Vendor for its innovative solutions, quick delivery, high technical standards and outstanding quality.

**Tempsens Instruments U# I**

**Tempsens Instruments U# II**

**AST Plant -** First Floor
**Marathon Plant -** Ground Floor

**Tempsens Instruments U# II Cable Plant**

**Tempsens Instruments GmbH - Germany**

**Pt. Tempsens Asia Jaya - Indonesia**

## Processing Of Conductor Wire

Raw Material

Melting

Drawing

Annealing

Inspection &Packing

# TESTING AND CALIBRATION

Thermocouple, extension and compensating grades are calibrated over the temperature range according to international specifications. All our grades are individually calibrated versus Pt 67. Each coil/spool is tested for EMF and value of deviation from the standard EMF at different temperatures is shown on the labels attached to each coil/spool. Alternatively, calibration can also be performed as per ASTM E220 comparison technique.

- Calibration Test
- Proof Stress Test
- Torsion Test
- Positive Material Identification(PMI) Test
- Bend Test
- Hardness Test
- Tensile Strength Test
- Elongation
- Electrical Resistivity (Loop Resistance)

# THERMOCOUPLE

Many combinations of materials have been used to produce acceptable thermocouples, each with its own particular application spectrum. However, the value of interchangeability and the economics of mass production have led to standardization, with a few specific types now being easily available, and covering by far the majority of the temperature and environmental applications.

These thermocouples are made to conform to an e.m.f/ temperature relationship specified in the form of tabulated values of e.m.f's resolved normally to 1mV against temperature in 1C intervals, and vice versa. Internationally, these reference tables are published as IEC 584 1, 2 & 4, which is based on the International Temperature Scale ITS-90. It is worth noting here, however, that the standards do not address the construction or insulation of the cables themselves or other performance criteria. With the diversity to be found, manufacturers' own standards must be relied upon in this respect.

The standard covers the eight specified and most commonly used thermocouples, referring to their internationally recognized alpha character type designation & providing the full reference tables for each. These thermocouple types can be subdivided in 3 groups, base metal, and noble (rare) metal & Refractory metal thermocouple.

## Base Metal Thermocouples

Base metal thermocouple types are composed of common, inexpensive metals such as nickel, iron and copper. The thermocouple types E, J, K, N and T are among this group and are the most commonly used type of thermocouple. Each leg of these different thermocouples is composed of a special alloy, which is usually referred to by their common names.

Type E – The type E thermocouple is composed of a positive leg of chromel (90%nickel/10%chromium) and a negative leg of constantan (45%nickel/55% copper). The temperature range for this thermocouple is -200 to 900°C (-330 to 16000F).

**Type J –** Type J thermocouples have an iron positive leg and a constantan negative leg. Type J thermocouples have a useful temperature range of 0 to 750°C (32 to 1400 °F) and can be used in vacuum, oxidizing, reducing and inert atmospheres.

**Type K –** The type K thermocouple has a Chromel (90% nickel/10% copper) positive leg and an Alumel (95%nickel/ 5% manganese, aluminum and silicon) negative leg. The temperature range for type K alloys is -200 to 1250°C (-328 to 2282°F).

**Type N –** Type N thermocouples are made with a Nicrosil (74.1%nickel – 14.4% chromium – 1.4 % silicon.0.1%magnesium) positive leg and a Nisil (95.6% nickel to 4.4% silicon) negative leg. The temperature range for Type N is -270 to 1300°C (-450 to 2372°F).

**Type T –** Type T thermocouples are made with a copper positive leg and a constantan negative leg. The temperature range for type T is -200 to 350°C (-328 to 662°F).

| Thermocouple Type | Material + & - | Temperature Range(°C) | Application |
|---|---|---|---|
| E | Chromel & Constantan (Ni-Cr & Cu-Ni) | -200 to 900°C | Inert media, Oxidizing media |
| J | Iron & Constantan (Fe & Cu-Ni) | 0 to 750°C | Inert media, Oxidizing media, Reducing media Vacuum |
| K | Chromel & Alumel (Ni-Cr & Ni-Al) | -200 to 1250°C | Inert media, Oxidizing media |
| N | Nicrosil & Nisil (Ni-Cr & Ni-Si) | -270 to 1300°C | Inert media, Oxidizing media |
| T | Copper & Constantan (Cu & Cu-Ni) | -200 to 350°C | Inert media, Oxidizing media, Reducing media Vacuum |

# THERMOCOUPLE CONDUCTORS

All base metal thermocouples are offered according to ANSI/ASTM standards.

**Type** : K, T, J, N, E.

**Dia** : 0.16mm to 8 mm Dia

**Standard** : ANSI MC 96.1, ASTM E 230, other standard as per customer requirement.

# THERMOCOUPLE CONDUCTORS

| Type | Conductor (*) Chemical Composition % | | | | | Conductor (-) Chemical Composition % | | | Temp Range | American Standard ASTM E230/ANSI MC95.2 | | | European Standard IEC 584 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ni | Cr | Fe | Cu | Others | Cu | Ni | Others | | T/c Range | Class 1 (0.4%) | Class 2 (0.75%) | T/c Range | Class 1 (0.4%) | Class 2 (0.75%) |
| K | 90 | 10 | - | - | - | - | 94 | Mn+ Si+ Others | -200°C to +1260°C | 0°C to 1260°C | ±1.1°C | ±2.2°C | 0°C to 1260°C | ±1.5°C | ±2.5°C |
| N | 84.4 | 14.2 | - | - | Si 1.4 | - | 95.6 | Si 4.4 | -200°C to +1260°C | 0°C to 1260°C | ±1.1°C | ±2.2°C | 0°C to 1260°C | ±1.5°C | ±2.5°C |
| J | - | - | 100 | - | - | Bal | 44 | Mn+ | -40°C to +760°C | 0°C to 760°C | ±1.1°C | ±2.2°C | 0°C to 760°C | ±1.5°C | ±2.5°C |
| T | - | - | - | 100 | - | Bal | 44 | Mn+ | -200°C to +370°C | 0°C to 370°C | ±0.5°C | ±1°C | 0°C to 370°C | ±0.5°C | ±1°C |
| E | 90 | 10 | - | - | - | Bal | 44 | Mn+ | -200°C to +870°C | 0°C to 870°C | ±1.1°C | ±1.7°C | 0°C to 870°C | ±1.5°C | ±2.5°C |

- Available with high linearity, sensitivity, stability & homogeneity and with anti oxidizing properties.
- Available in bright and oxidized form.
- Special alloy and special curves can be provided for MI cable application.
- Stranded conductors also available.

# EXTENSION/COMPENSATING CONDUCTOR ALLOY

**Type** : KX, TX, JX, NX, EX, KCA, KCB, RCB/SCB, CPC/CNC.

**Dia** : 0.16mm to 3.0 mm Dia

**Standard** : ANSI MC 96.1, other standard as per customer requirement.

| Type | Conductor (*) Chemical Composition % | | | | | Conductor (-) Chemical Composition % | | | American Standard ASTM E230/ANSI MC95.2 | | | European Standard IEC 584 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ni | Cr | Fe | Cu | Others | Cu | Ni | Others | T/c Range | Class 1 | Class 2 | T/c Range | Class 1 | Class 2 |
| KX | 90 | 10 | - | - | Si+ | - | 94 | Si+ Mn+ Others | 0°C to 200°C | ±1.1°C | ±2.2°C | -25°C to 200°C | ±1.5°C | ±2.5°C |
| KCA (WX) | - | - | 100 | - | - | Bal | 43 | Mn 2 - Fe 2 | - | - | - | 0°C to 150°C | - | ±2.5°C |
| KCB (VX) | - | - | - | 100 | - | Bal | 44 | - | - | - | - | 0°C to 100°C | - | ±2.5°C |
| NX | 84.4 | 14.2 | - | - | Si 1.4 | - | 95.6 | Si 4.4 | 0°C to 200°C | ±1.1°C | ±2.2°C | -25°C to 200°C | ±1.5°C | ±2.5°C |
| JX | - | - | 100 | - | - | Bal | 44 | Mn+ | 0°C to 200°C | ±1.1°C | ±2.2°C | -25°C to 200°C | ±1.5°C | ±2.5°C |
| TX | - | - | - | 100 | - | Bal | 44 | Mn+ | 0°C to 100°C | ±0.5°C | ±1°C | -25°C to 100°C | ±0.5°C | ±1°C |
| EX | 90 | 10 | - | - | - | Bal | 44 | Mn+ | 0°C to 200°C | ±1°C | ±1.7°C | -25°C to 200°C | ±1.5°C | ±2.5°C |
| RCB/SCB | - | 100 | - | - | - | 2 | 95 | Mn+ | 0°C to 100°C | - | - | -25°C to 200°C | - | ±2.5°C |

# PURE NICKEL CONDUCTOR ALLOY

Nickel as a material has very high corrosion resistivity & high conductivity as well as high melting point. It has proper resistance, good radiation coefficient and provides great heat transfer coefficient.

**Dia :** 0.16 to 3.0 mm

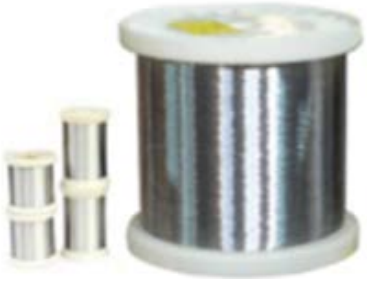
# TEMPSENS RESISTANCE HEATING ALLOYS

The Tempsens Resistance Heating Alloys (TRHA) can be divided into two main groups, for higher temperature range iron-chromium-aluminum (FeCrAl) and nickel-chromium (NiCr) based alloys. For lower temperature applications copper-nickel (CuNi) based alloys are also used.

All different alloys are described below.

## Tempsens Resistance Heating Alloy TRHA 1 & 4 (FeCrAl)

High-Al and high-Cr alloy, it's a high-grade electric heating material which is known for its electric resistance properties. The heating element features a maximum service temperature as high as 1400ºC and is suitable for high-temperature furnaces. It has a longer service life than other materials even in a carburizing atmosphere and gases atmospheres. It is economical with its high resistance. TRHA 1 & 4 (FeCrAl) is also used as a resistant material.



**Available Form** : Wire & Bar in Acid wash Oxidized and luster surface finished

**Diameter** : 0.16 mm to 25 mm

## Tempsens Resistance Heating Alloy TRHA 80:20( NiCr)

80/20 Ni Cr Resistance Wire is used at operating temperatures up to 1200°C (2200°F). Its chemical composition gives good oxidation resistance especially under conditions of frequent switching or wide temperature fluctuations. 80/20 Ni Cr is known for their excellent mechanical properties and their high creep strength.

### Features

- Higher surface load
- Higher resistivity
- Higher yield strength
- Longer life
- Better oxidation properties
- Lower density
- Better resistance to Sulphur

- **Available Form :** Wire & Bar
- **Diameter** : 0.16 mm to 25 mm

## Tempsens Resistance Heating Alloy –TRHA CuNi (CUPRONICKEL)

Copper Nickel (CuNi) alloys are medium to low resistance materials typically used in applications with maximum operating temperatures up to 400°C (750°F). With low temperature coefficients of electrical resistance, thus performance is consistent regardless of different temperature range.

Copper Nickel alloys mechanically boast good ductility, easily soldered and welded, as well as have outstanding corrosion resistance. These alloys are typically used in high current applications requiring a high level of precision.

- Available Form : Wire & Bar
- Diameter : 0.16 mm to 25 mm

# TEMPSENS RESISTANCE HEATING ALLOYS

## Features

- Good mechanical properties both a low and elevated temperatures
- High electric resistivity and its low temperature coefficient
- Less stress corrosion cracking and corrosion fatigue
- Good wear resistance

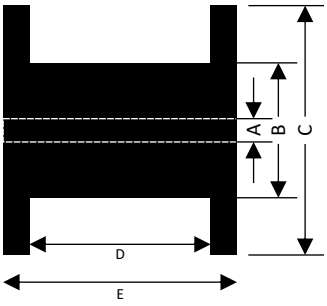
# PACKAGING AND SHIPPING

**Wire in coils, spools and cut lengths / bars**

We offer a wide variety of packaging in the form of coils, spools and cut lengths. All items are clearly labelled with customer's order number, alloy, dimensions and weight. There is also the option to supply neutral labels or labels with the customer's branding on them. Special packaging to individual requirements may also be available on request.

We deliver globally and all products are securely packed suitable for transporting by road, air courier or sea depending on shipment size and delivery location.

# SPOOLS SIZES




| Spool Type | A | B | C | D | E | Wire Diameter Range | Max. Weight |
|---|---|---|---|---|---|---|---|
|  DIN 80 | 16mm | 50mm | 80mm | 64mm | 80mm | upto 0.25mm | 0.800 kg |
|  DIN100 | 16mm | 64mm | 100mm | 80mm | 100mm | 0.19 - 0.4mm | 1.500kg |
|  DIN125 | 16mm | 80mm | 125mm | 100mm | 125mm | 0.19 - 0.55mm | 3kg |
|  DIN160 | 22mm | 100mm | 160mm | 128mm | 160mm | 0.25 - 0.71mm | 5 kg |
|  DIN200 | 36mm | 125mm | 200mm | 160mm | 200mm | 0.4 - 0.81mm | 10kg |
|  DIN250 | 36mm | 160mm | 250mm | 160mm | 200mm | 0.4 - 1.5mm | 20kg |
|  DIN355 | 36mm | 225mm | 355mm | 162mm | 200mm | 1.0 - 3.0mm | 40KG |
|  DIN500 | 36mm | 316mm | 500mm | 180mm | 250mm | 1.2 - 3.0mm | 75kg |

# TEMPSENS TECHNICAL DATASHEET FOR (KP) & (KPX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens KP is used as positive leg for the thermocouple type-K (KP) as well as the positive leg for extension type-K (KPX)

| | |
|---|---|
| Leg | Chromel |
| Chemical Composition | (Ni + 10% Cr) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density (g/cm$^3$) | 8.73 |

| Melting Point | |
|---|---|
| C | C-1427 |
| F | F-2600 |

| Magnetic Attraction |
|---|
| NO |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 70.6 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | | Elongation | Hardness (HV10) |
|---|---|---|---|
| **Soft** | 610 | 28 | 130 |
| **Hard** | 970 | 2 | >310 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **400** | **600** | **800** | **1000** | **1200** |
| 2 | **E.M.F. (mV) (KP)** | 2.814 | 5.97 | 12.764 | 19.618 | 26.205 | 32.499 | 38.508 |
| 3 | **E.M.F. (mV) (KPX)** | 2.814 | 5.97 | | | | | |

Tempsens KP & KPX is supplied in the form of bare wire with dimension from 8.00 mm to 0.20mm. Tempsens KP & KPX can also be supplied in the form of stranding wire and rods.

| SWG | | | |
|---|---|---|---|
| **SWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8 | 4.064 | 8.84 | 113.1 |
| 9 | 3.658 | 10.91 | 91.64 |
| 10 | 3.251 | 13.82 | 72.38 |
| 12 | 2.642 | 20.92 | 47.8 |
| 14 | 2.032 | 35.36 | 28.28 |
| 16 | 1.626 | 55.23 | 18.11 |
| 18 | 1.219 | 98.26 | 10.19 |
| 19 | 1.016 | 141 | 7.07 |
| 20 | 0.914 | 175 | 5.72 |
| 21 | 0.813 | 221 | 4.53 |
| 22 | 0.711 | 289 | 3.46 |
| 24 | 0.559 | 467 | 2.14 |
| 26 | 0.457 | 699 | 1.43 |
| 30 | 0.315 | 1472 | 0.68 |
| 34 | 0.234 | 2667 | 0.38 |
| 36 | 0.193 | 3920 | 0.26 |

| B & S (AWG) | | | |
|---|---|---|---|
| **B & S or AWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 6 | 4.115 | 8.62 | 116 |
| 7 | 3.658 | 10.91 | 91.64 |
| 8 | 3.251 | 13.82 | 72.38 |
| 10 | 2.591 | 21.75 | 45.98 |
| 12 | 2.057 | 34.51 | 28.98 |
| 14 | 1.626 | 55.23 | 18.11 |
| 16 | 1.295 | 87.07 | 11.49 |
| 18 | 1.016 | 141 | 7.07 |
| 20 | 0.813 | 221 | 4.53 |
| 22 | 0.643 | 353 | 2.83 |
| 24 | 0.511 | 559 | 1.79 |
| 25 | 0.455 | 705 | 1.418 |
| 26 | 0.404 | 895 | 1.12 |
| 28 | 0.32 | 1426 | 0.7 |
| 32 | 0.203 | 3543 | 0.28 |

| METRIC | | | | | |
|---|---|---|---|---|---|
| **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8.00 | 2.28 | 438.3 | 1.20 | 101 | 9.86 |
| 7.00 | 2.98 | 335.6 | 1.15 | 110 | 9.06 |
| 6.00 | 4.06 | 246.6 | 1.13 | 114 | 8.75 |
| 4.70 | 6.61 | 151.3 | 1.00 | 146 | 6.85 |
| 4.00 | 9.13 | 109.6 | 0.81 | 223 | 4.49 |
| 3.90 | 9.60 | 104.2 | 0.64 | 356 | 2.81 |
| 3.26 | 13.74 | 72.8 | 0.63 | 368 | 2.72 |
| 3.20 | 14.26 | 70.1 | 0.60 | 406 | 2.47 |
| 3.00 | 16.22 | 61.6 | 0.51 | 561 | 1.78 |
| 2.50 | 23.36 | 42.8 | 0.50 | 584 | 1.71 |
| 2.30 | 27.60 | 36.2 | 0.45 | 721 | 1.39 |
| 2.05 | 34.74 | 28.8 | 0.40 | 913 | 1.10 |
| 2.00 | 36.50 | 27.4 | 0.32 | 1426 | 0.70 |
| 1.63 | 54.96 | 18.2 | 0.30 | 1622 | 0.62 |
| 1.50 | 64.89 | 15.4 | 0.25 | 2336 | 0.43 |
| 1.40 | 74.50 | 13.14 | 0.20 | 3650 | 0.27 |
| 1.29 | 87.74 | 11.41 | | | |

# TEMPSENS TECHNICAL DATA SHEET FOR (KN) & (KNX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens KN is used as negative leg for the thermocouple type-K (KN) as well as the negative leg for extension type-K (KNX)

| | |
|---|---|
| Leg | Alumel |
| Chemical Composition | (Ni 95% + Si + Mn) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density ($g/cm^3$) | 8.6 |

| Melting Point | |
|---|---|
| C | C-1399 |
| F | F-2550 |

| Magnetic Attraction |
|---|
| Yes |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 29.4 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | |
|---|---|
| Soft | 600 |
| Hard | >1.050 |

| Elongation |
|---|
| 35 |
| <2 |

| Hardness (HV10) |
|---|
| 100 |
| >300 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **400** | **600** | **800** | **1000** | **1200** |
| 2 | **E.m.f (mV) (KN)** | 1.283 | 2.168 | 3.633 | 5.287 | 7.07 | 8.777 | 10.33 |
| 3 | **E.m.f (mV) (KNX)** | 1.283 | 2.168 | | | | | |

Tempsens KN & KNX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens KN & KNX can also be supplied in the form of stranding wire and rods.

| SWG | | | |
|---|---|---|---|
| **SWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8 | 4.064 | 8.961 | 111.6 |
| 9 | 3.658 | 1.061 | 90.38 |
| 10 | 3.251 | 4.012 | 71.39 |
| 12 | 2.642 | 1.213 | 47.15 |
| 14 | 2.032 | 5.865 | 27.89 |
| 16 | 1.626 | 6.009 | 17.86 |
| 18 | 1.219 | 9.63 | 10.04 |
| 19 | 1.016 | 143 | 6.97 |
| 20 | 0.914 | 177 | 5.64 |
| 21 | 0.813 | 224 | 4.46 |
| 22 | 0.711 | 293 | 3.41 |
| 24 | 0.559 | 474 | 2.11 |
| 26 | 0.457 | 709 | 1.41 |
| 30 | 0.315 | 1492 | 0.67 |
| 34 | 0.234 | 2704 | 0.37 |
| 36 | 0.193 | 3975 | 0.25 |

| B & S (AWG) | | | |
|---|---|---|---|
| **B & S or AWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 6 | 4.115 | 8.7 | 114.4 |
| 7 | 3.658 | 11.1 | 90.38 |
| 8 | 3.251 | 14.0 | 71.39 |
| 10 | 2.591 | 22.1 | 45.34 |
| 12 | 2.057 | 35.0 | 28.58 |
| 14 | 1.626 | 56.0 | 17.86 |
| 16 | 1.295 | 88.3 | 11.33 |
| 18 | 1.016 | 143.0 | 6.97 |
| 20 | 0.813 | 224.0 | 4.46 |
| 22 | 0.643 | 353.0 | 2.79 |
| 24 | 0.511 | 567.0 | 1.76 |
| 25 | 0.455 | 715.0 | 1.36 |
| 26 | 0.404 | 907.0 | 1.10 |
| 28 | 0.320 | 1446.0 | 0.69 |
| 32 | 0.203 | 3593.0 | 0.28 |

| METRIC | | | | | |
|---|---|---|---|---|---|
| **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8.00 | 2.31 | 432.3 | 1.20 | 103 | 9.73 |
| 7.00 | 3.02 | 331 | 1.15 | 112 | 8.93 |
| 6.00 | 4.11 | 243.2 | 1.13 | 116 | 8.62 |
| 4.70 | 6.7 | 149.2 | 1.00 | 148 | 6.75 |
| 4.00 | 9.25 | 108.1 | 0.81 | 226 | 4.43 |
| 3.90 | 9.73 | 102.7 | 0.64 | 361 | 2.77 |
| 3.26 | 13.93 | 71.78 | 0.63 | 373 | 2.68 |
| 3.20 | 14.46 | 69.17 | 0.60 | 411 | 2.43 |
| 3.00 | 16.45 | 60.79 | 0.51 | 569 | 1.76 |
| 2.50 | 23.69 | 42.22 | 0.50 | 592 | 1.69 |
| 2.30 | 27.99 | 35.73 | 0.45 | 731 | 1.37 |
| 2.05 | 35.23 | 28.39 | 0.40 | 925 | 1.08 |
| 2.00 | 37.01 | 27.02 | 0.32 | 1446 | 0.69 |
| 1.63 | 55.72 | 17.95 | 0.30 | 1645 | 0.61 |
| 1.50 | 65.8 | 15.2 | 0.25 | 2369 | 0.42 |
| 1.40 | 75.54 | 13.24 | 0.20 | 3701 | 0.27 |

# TEMPSENS TECHNICAL DATA SHEET FOR (KNCB)/(VNX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens KNCB/VNX is used as Negative leg for the Compensating grade Type K.

| | |
|---|---|
| Leg | CONSTANTAN |
| Chemical Composition | (44% Ni-balance Cu) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density ($g/cm^3$) | 8.6 |

| Melting Point | |
|---|---|
| C | C- 1280 |
| F | F- 2156 |

| Magnetic Attraction |
|---|
| No |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 49 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | | Elongation | Hardness (HV10) |
|---|---|---|---|
| **Soft** | 420 | 30 | 95 |
| **Hard** | > 740 | 2 | >230 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | |
|---|---|---|
| 1 | **Temperature** | **100** |
| 2 | **E.m.f (mV) (KNCB)** | 3.323 |

Tempsens KNCB/VNX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens KNCB/VNX can also be supplied in the form of stranding wire and rods.

**SWG**

| SWG | Diam. (mm) | Length (m/kg) | Weight (g/m) |
|---|---|---|---|
| 8 | 4.064 | 8.66 | 115.4 |
| 9 | 3.658 | 10.69 | 93.53 |
| 10 | 3.251 | 13.54 | 73.88 |
| 12 | 2.642 | 20.5 | 48.79 |
| 14 | 2.032 | 34.65 | 28.86 |
| 16 | 1.626 | 54.11 | 18.48 |
| 18 | 1.219 | 96.27 | 10.39 |
| 19 | 1.016 | 138.6 | 7.22 |
| 20 | 0.914 | 171.2 | 5.84 |
| 21 | 0.813 | 216.4 | 4.62 |
| 22 | 0.711 | 283 | 3.53 |
| 24 | 0.559 | 457.8 | 2.18 |
| 26 | 0.457 | 685 | 1.46 |
| 30 | 0.315 | 1442 | 0.69 |
| 34 | 0.234 | 2613 | 0.38 |
| 36 | 0.193 | 3841 | 0.26 |

**B & S (AWG)**

| B & S or AWG | Diam. (mm) | Length (m/kg) | Weight (g/m) |
|---|---|---|---|
| 6 | 4.115 | 8.4 | 118.4 |
| 7 | 3.658 | 10.7 | 93.53 |
| 8 | 3.251 | 13.5 | 73.88 |
| 10 | 2.591 | 21.3 | 46.93 |
| 12 | 2.057 | 33.8 | 29.58 |
| 14 | 1.626 | 54.1 | 18.48 |
| 16 | 1.295 | 85.3 | 11.72 |
| 18 | 1.016 | 139.0 | 7.22 |
| 20 | 0.813 | 216.0 | 4.62 |
| 22 | 0.643 | 346.0 | 2.89 |
| 24 | 0.511 | 548.0 | 1.83 |
| 25 | 0.455 | 691.0 | 1.45 |
| 26 | 0.404 | 877.0 | 1.14 |
| 28 | 0.320 | 1397.0 | 0.72 |
| 32 | 0.203 | 3472.0 | 0.29 |

**METRIC**

| Diam. (mm) | Length (m/kg) | Weight (g/m) | Diam. (mm) | Length (m/kg) | Weight (g/m) |
|---|---|---|---|---|---|
| 8.00 | 2.24 | 447.4 | 1.20 | 99 | 10.07 |
| 7.00 | 2.92 | 342.5 | 1.15 | 108 | 9.24 |
| 6.00 | 3.97 | 251.6 | 1.13 | 112 | 8.93 |
| 4.70 | 6.48 | 154.4 | 1.00 | 143 | 6.99 |
| 4.00 | 8.94 | 111.8 | 0.81 | 218 | 4.59 |
| 3.90 | 9.41 | 106.3 | 0.64 | 349 | 2.86 |
| 3.26 | 13.46 | 74.29 | 0.63 | 360 | 2.77 |
| 3.20 | 13.97 | 71.58 | 0.60 | 397 | 2.52 |
| 3.00 | 15.9 | 62.91 | 0.51 | 550 | 1.82 |
| 2.50 | 22.89 | 43.69 | 0.50 | 572 | 1.75 |
| 2.30 | 27.04 | 36.98 | 0.45 | 707 | 1.42 |
| 2.05 | 34.04 | 29.38 | 0.40 | 894 | 1.12 |
| 2.00 | 35.77 | 27.96 | 0.32 | 1397 | 0.72 |
| 1.63 | 53.84 | 18.57 | 0.30 | 1590 | 0.63 |
| 1.50 | 63.58 | 15.73 | 0.25 | 2289 | 0.44 |
| 1.40 | 72.99 | 13.7 | 0.20 | 3577 | 0.28 |
| 1.29 | 85.97 | 11.63 | | | |

# TEMPSENS TECHNICAL DATA SHEET FOR (JP) & (JPX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens JP is used as positive leg for the thermocouple type-J (JP) as well as the positive leg for extension type-J (JPX)

| | |
|---|---|
| Leg | IRON |
| Chemical Composition | (Fe 100%) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density (g/cm$^3$) | 7.86 |

| Melting Point | |
|---|---|
| C | C- 1490 |
| F | F- 2715 |

| Magnetic Attraction |
|---|
| YES |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 12 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | | Elongation | Hardness (HV10) |
|---|---|---|---|
| **Soft** | 370 | 28 | 90 |
| **Hard** | >600 | 0-1 | 200 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **400** | **600** | **700** |
| 2 | **E.m.f (mV) (JP)** | 1.78 | 3.38 | 5.74 | 7.73 | 9.08 |
| 3 | **E.m.f (mV) (JPX)** | 1.78 | 3.38 | | | |

Tempsens JP & JPX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM.
Tempsens JP & JPX can also be supplied in the form of stranding wire and rods.

| SWG | | | |
|---|---|---|---|
| **SWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8 | 4.064 | 9.8 | 102.0 |
| 9 | 3.658 | 12.1 | 82.6 |
| 10 | 3.251 | 15.3 | 65.24 |
| 12 | 2.642 | 23.2 | 43.09 |
| 14 | 2.032 | 39.2 | 25.49 |
| 16 | 1.626 | 61.3 | 16.32 |
| 18 | 1.219 | 109 | 9.17 |
| 19 | 1.016 | 157 | 6.37 |
| 20 | 0.914 | 194 | 5.16 |
| 21 | 0.813 | 245 | 4.08 |
| 22 | 0.711 | 320 | 3.12 |
| 24 | 0.559 | 518 | 1.93 |
| 26 | 0.457 | 776 | 1.29 |
| 30 | 0.315 | 1633 | 0.61 |
| 34 | 0.234 | 2958 | 0.34 |
| 36 | 0.193 | 4349 | 0.23 |

| B & S (AWG) | | | |
|---|---|---|---|
| **B & S or AWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 6 | 4.115 | 9.57 | 104.51 |
| 7 | 3.658 | 12.11 | 82.60 |
| 8 | 3.251 | 15.33 | 65.24 |
| 10 | 2.591 | 24.13 | 41.44 |
| 12 | 2.057 | 38.28 | 26.12 |
| 14 | 1.626 | 61.27 | 16.32 |
| 16 | 1.295 | 96.59 | 10.35 |
| 18 | 1.016 | 157 | 6.37 |
| 20 | 0.813 | 245 | 4.08 |
| 22 | 0.643 | 392 | 2.55 |
| 24 | 0.511 | 620 | 1.61 |
| 25 | 0.455 | 783 | 1.28 |
| 26 | 0.404 | 992 | 1.01 |
| 28 | 0.32 | 1582 | 0.63 |
| 32 | 0.203 | 3931 | 0.25 |

| METRIC | | | | | |
|---|---|---|---|---|---|
| **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8.00 | 2.53 | 395.1 | 1.20 | 112 | 8.89 |
| 7.00 | 3.31 | 302.5 | 1.15 | 122 | 8.16 |
| 6.00 | 4.5 | 222.2 | 1.13 | 127 | 7.88 |
| 4.70 | 7.33 | 136.4 | 1.00 | 162 | 6.17 |
| 4.00 | 10.12 | 98.77 | 0.81 | 247 | 4.05 |
| 3.90 | 10.65 | 93.89 | 0.64 | 395 | 2.53 |
| 3.26 | 15.24 | 65.61 | 0.63 | 408 | 2.45 |
| 3.20 | 15.82 | 63.21 | 0.60 | 450 | 2.22 |
| 3.00 | 18 | 55.56 | 0.51 | 623 | 1.61 |
| 2.50 | 25.92 | 38.58 | 0.50 | 648 | 1.54 |
| 2.30 | 30.62 | 32.66 | 0.45 | 800 | 1.25 |
| 2.05 | 38.55 | 25.94 | 0.40 | 1012 | 0.99 |
| 2.00 | 40.50 | 24.69 | 0.32 | 1582 | 0.63 |
| 1.63 | 60.97 | 16.4 | 0.30 | 1800 | 0.56 |
| 1.50 | 72 | 13.89 | 0.25 | 2592 | 0.39 |
| 1.40 | 82.65 | 12.1 | 0.20 | 4050 | 0.25 |
| 1.29 | 97.34 | 10.27 | | | |

# TEMPSENS TECHNICAL DATA SHEET FOR (JN) & (JNX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens JN is used as negative leg for the thermocouple type-J (JN) as well as the negative leg for extension type-J (JNX).

| | |
|---|---|
| Leg | CONSTANTAN |
| Chemical Composition | (Ni 44% + Cu 56%) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density (g/cm$^3$) | 8.92 |

| Melting Point | |
|---|---|
| C | C- 1220 |
| F | F-2228 |

| Magnetic Attraction |
|---|
| No |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 49 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | | Elongation | Hardness (HV10) |
|---|---|---|---|
| **Soft** | 420 | 30 | 95 |
| **Hard** | > 740 | 2 | > 230 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **400** | **600** | **700** |
| 2 | **E.m.f (mV) (JN)** | 3.49 | 7.404 | 16.105 | 25.368 | 30.053 |
| 3 | **E.m.f (mV) (JNX)** | 3.49 | 7.404 | | | |

Tempsens JN & JNX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens JN & JNX can also be supplied in the form of stranding wire and rods.

| SWG | | | |
|---|---|---|---|
| **SWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8 | 4.064 | 8.66 | 115.4 |
| 9 | 3.658 | 10.69 | 93.53 |
| 10 | 3.251 | 13.54 | 73.88 |
| 12 | 2.642 | 20.5 | 48.79 |
| 14 | 2.032 | 34.65 | 28.86 |
| 16 | 1.626 | 54.11 | 18.48 |
| 18 | 1.219 | 96.27 | 10.39 |
| 19 | 1.016 | 138.6 | 7.22 |
| 20 | 0.914 | 171.2 | 5.84 |
| 21 | 0.813 | 216.4 | 4.62 |
| 22 | 0.711 | 283 | 3.53 |
| 24 | 0.559 | 457.8 | 2.18 |
| 26 | 0.457 | 685 | 1.46 |
| 30 | 0.315 | 1442 | 0.69 |
| 34 | 0.234 | 2613 | 0.38 |
| 36 | 0.193 | 3841 | 0.26 |

| B & S (AWG) | | | |
|---|---|---|---|
| **B & S or AWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 6 | 4.115 | 8.4 | 118.4 |
| 7 | 3.658 | 10.7 | 93.53 |
| 8 | 3.251 | 13.5 | 73.88 |
| 10 | 2.591 | 21.3 | 46.93 |
| 12 | 2.057 | 33.8 | 29.58 |
| 14 | 1.626 | 54.1 | 18.48 |
| 16 | 1.295 | 85.3 | 11.72 |
| 18 | 1.016 | 139 | 7.22 |
| 20 | 0.813 | 216 | 4.62 |
| 22 | 0.643 | 346 | 2.89 |
| 24 | 0.511 | 548 | 1.83 |
| 25 | 0.455 | 691 | 1.45 |
| 26 | 0.404 | 877 | 1.14 |
| 28 | 0.32 | 1397 | 0.72 |
| 32 | 0.203 | 3472 | 0.29 |

| METRIC | | | | | |
|---|---|---|---|---|---|
| **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8.00 | 2.24 | 447.4 | 1.20 | 99 | 10.07 |
| 7.00 | 2.92 | 342.5 | 1.15 | 108 | 9.24 |
| 6.00 | 3.97 | 251.6 | 1.13 | 112 | 8.93 |
| 4.70 | 6.48 | 154.4 | 1.00 | 143 | 6.99 |
| 4.00 | 8.94 | 111.8 | 0.81 | 218 | 4.59 |
| 3.90 | 9.41 | 106.3 | 0.64 | 349 | 2.86 |
| 3.26 | 13.46 | 74.29 | 0.63 | 360 | 2.77 |
| 3.20 | 13.97 | 71.58 | 0.60 | 397 | 2.52 |
| 3.00 | 15.9 | 62.91 | 0.51 | 550 | 1.82 |
| 2.50 | 22.89 | 43.69 | 0.50 | 572 | 1.75 |
| 2.30 | 27.04 | 36.98 | 0.45 | 707 | 1.42 |
| 2.05 | 34.04 | 29.38 | 0.40 | 894 | 1.12 |
| 2.00 | 35.77 | 27.96 | 0.32 | 1397 | 0.72 |
| 1.63 | 53.84 | 18.57 | 0.30 | 1590 | 0.63 |
| 1.50 | 63.58 | 15.73 | 0.25 | 2289 | 0.44 |
| 1.40 | 72.99 | 13.7 | 0.20 | 3577 | 0.28 |
| 1.29 | 85.97 | 11.63 | | | |

# TEMPSENS TECHNICAL DATA SHEET FOR (EP) & (EPX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens EP is used as Positive leg for the thermocouple type-E (EP) as well as the Positive leg for extension type-E (EPX).

| | |
|---|---|
| Leg | CHROMEL |
| Chemical Composition | (Ni+ 10 % Cr) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density ($g/cm^3$) | 8.73 |

| Melting Point | |
|---|---|
| C | C- 1427 |
| F | F-2600 |

| Magnetic Attraction |
|---|
| No |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 70.6 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | |
|---|---|
| Soft | 610 |
| Hard | 970 |

| Elongation |
|---|
| 28 |
| 2 |

| Hardness (HV10) |
|---|
| 130 |
| > 130 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **300** | **400** | **600** | **700** | **800** |
| 2 | **E.m.f (mV) (EP)** | 2.814 | 5.97 | 9.323 | 12.764 | 19.618 | 22.951 | 26.205 |
| 3 | **E.m.f (mV) (EPX)** | 2.814 | 5.97 | | | | | |

Tempsens EP & EPX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens EP & EPX can also be supplied in the form of stranding wire and rods.

| SWG | | | |
|---|---|---|---|
| SWG | Diam. (mm) | Length (m/kg) | Weight (g/m) |
| 8 | 4.064 | 8.84 | 113.1 |
| 9 | 3.658 | 10.91 | 91.64 |
| 10 | 3.251 | 13.82 | 72.38 |
| 12 | 2.642 | 20.92 | 47.8 |
| 14 | 2.032 | 35.36 | 28.28 |
| 16 | 1.626 | 55.23 | 18.11 |
| 18 | 1.219 | 98.26 | 10.18 |
| 19 | 1.016 | 141 | 7.07 |
| 20 | 0.914 | 175 | 5.72 |
| 21 | 0.813 | 221 | 4.53 |
| 22 | 0.711 | 289 | 3.46 |
| 24 | 0.559 | 467 | 2.14 |
| 26 | 0.457 | 699 | 1.43 |
| 30 | 0.315 | 1472 | 0.68 |
| 34 | 0.234 | 2667 | 0.38 |
| 36 | 0.193 | 3920 | 0.26 |

| B & S (AWG) | | | |
|---|---|---|---|
| B & S or AWG | Diam. (mm) | Length (m/kg) | Weight (g/m) |
| 6 | 4.115 | 8.62 | 116 |
| 7 | 3.658 | 10.91 | 91.64 |
| 8 | 3.251 | 13.82 | 72.38 |
| 10 | 2.591 | 21.75 | 45.98 |
| 12 | 2.057 | 34.51 | 28.98 |
| 14 | 1.626 | 55.23 | 18.11 |
| 16 | 1.295 | 87.07 | 11.49 |
| 18 | 1.016 | 141 | 7.07 |
| 20 | 0.813 | 221 | 4.53 |
| 22 | 0.643 | 353 | 2.83 |
| 24 | 0.511 | 559 | 1.79 |
| 25 | 0.455 | 705 | 1.418 |
| 26 | 0.404 | 895 | 1.12 |
| 28 | 0.32 | 1426 | 0.70 |
| 32 | 0.203 | 3543 | 0.28 |

| METRIC | | | | | |
|---|---|---|---|---|---|
| Diam. (mm) | Length (m/kg) | Weight (g/m) | Diam. (mm) | Length (m/kg) | Weight (g/m) |
| 8.00 | 2.28 | 438.3 | 1.20 | 101 | 9.86 |
| 7.00 | 2.98 | 335.6 | 1.15 | 110 | 9.06 |
| 6.00 | 4.06 | 246.6 | 1.13 | 114 | 8.75 |
| 4.70 | 6.61 | 151.3 | 1.00 | 146 | 6.85 |
| 4.00 | 9.13 | 109.6 | 0.81 | 223 | 4.49 |
| 3.90 | 9.60 | 104.2 | 0.64 | 356 | 2.81 |
| 3.26 | 13.74 | 72.8 | 0.63 | 368 | 2.72 |
| 3.20 | 14.26 | 70.1 | 0.60 | 406 | 2.47 |
| 3.00 | 16.22 | 61.6 | 0.51 | 561 | 1.78 |
| 2.50 | 23.36 | 42.8 | 0.50 | 584 | 1.71 |
| 2.30 | 27.60 | 36.2 | 0.45 | 721 | 1.39 |
| 2.05 | 34.74 | 28.8 | 0.40 | 913 | 1.10 |
| 2.00 | 36.50 | 27.4 | 0.32 | 1426 | 0.70 |
| 1.63 | 54.96 | 18.2 | 0.30 | 1622 | 0.62 |
| 1.50 | 64.89 | 15.4 | 0.25 | 2336 | 0.43 |
| 1.40 | 74.50 | 13.41 | 0.20 | 3650 | 0.27 |
| 1.29 | 87.74 | 11.41 | | | |

# TEMPSENS TECHNICAL DATA SHEET FOR (EN) & (ENX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens EN is used as negative leg for the thermocouple type-E (EN) as well as the negative leg for extension type-E (ENX).

| | |
|---|---|
| Leg | CONSTANTAN |
| Chemical Composition | (Ni 44% + Cu 56%) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density (g/cm$^3$) | 8.92 |

| Melting Point | |
|---|---|
| C | C- 1220 |
| F | F-2228 |

| Magnetic Attraction |
|---|
| No |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 49 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | |
|---|---|
| Soft | 420 |
| Hard | > 740 |

| Elongation |
|---|
| 30 |
| 2 |

| Hardness (HV10) |
|---|
| 95 |
| > 230 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **300** | **400** | **600** | **700** | **800** |
| 2 | **E.m.f (mV) (EN)** | 3.505 | 7.457 | 11.71 | 16.18 | 25.48 | 30.16 | 34.81 |
| 3 | **E.m.f (mV) (ENX)** | 3.505 | 7.457 | | | | | |

Tempsens EN & ENX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens EN & ENX can also be supplied in the form of stranding wire and rods.

**SWG**

| SWG | Diam. (mm) | Length (m/kg) | Weight (g/m) |
|---|---|---|---|
| 8 | 4.064 | 8.66 | 115.4 |
| 9 | 3.658 | 10.69 | 93.53 |
| 10 | 3.251 | 13.54 | 73.88 |
| 12 | 2.642 | 20.5 | 48.79 |
| 14 | 2.032 | 34.65 | 28.86 |
| 16 | 1.626 | 54.11 | 18.48 |
| 18 | 1.219 | 96.27 | 10.39 |
| 19 | 1.016 | 138.6 | 7.22 |
| 20 | 0.914 | 171.2 | 5.84 |
| 21 | 0.813 | 216.4 | 4.62 |
| 22 | 0.711 | 283 | 3.53 |
| 24 | 0.559 | 457.8 | 2.18 |
| 26 | 0.457 | 685 | 1.46 |
| 30 | 0.315 | 1442 | 0.69 |
| 34 | 0.234 | 2613 | 0.38 |
| 36 | 0.193 | 3841 | 0.26 |

**B & S (AWG)**

| B & S or AWG | Diam. (mm) | Length (m/kg) | Weight (g/m) |
|---|---|---|---|
| 6 | 4.115 | 8.4 | 118.4 |
| 7 | 3.658 | 10.7 | 93.53 |
| 8 | 3.251 | 13.5 | 73.88 |
| 10 | 2.591 | 21.3 | 46.93 |
| 12 | 2.057 | 33.8 | 29.58 |
| 14 | 1.626 | 54.1 | 18.48 |
| 16 | 1.295 | 85.3 | 11.72 |
| 18 | 1.016 | 139 | 7.22 |
| 20 | 0.813 | 216 | 4.62 |
| 22 | 0.643 | 346 | 2.89 |
| 24 | 0.511 | 548 | 1.83 |
| 25 | 0.455 | 691 | 1.45 |
| 26 | 0.404 | 877 | 1.14 |
| 28 | 0.32 | 1397 | 0.72 |
| 32 | 0.203 | 3472 | 0.29 |

**METRIC**

| Diam. (mm) | Length (m/kg) | Weight (g/m) | Diam. (mm) | Length (m/kg) | Weight (g/m) |
|---|---|---|---|---|---|
| 8.00 | 2.24 | 447.4 | 1.20 | 99 | 10.07 |
| 7.00 | 2.92 | 342.5 | 1.15 | 108 | 9.24 |
| 6.00 | 3.97 | 251.6 | 1.13 | 112 | 8.93 |
| 4.70 | 6.48 | 154.4 | 1.00 | 143 | 6.99 |
| 4.00 | 8.94 | 111.8 | 0.81 | 218 | 4.59 |
| 3.90 | 9.41 | 106.3 | 0.64 | 349 | 2.86 |
| 3.26 | 13.46 | 74.29 | 0.63 | 360 | 2.77 |
| 3.20 | 13.97 | 71.58 | 0.60 | 397 | 2.52 |
| 3.00 | 15.9 | 62.91 | 0.51 | 550 | 1.82 |
| 2.50 | 22.89 | 43.69 | 0.50 | 572 | 1.75 |
| 2.30 | 27.04 | 36.98 | 0.45 | 707 | 1.42 |
| 2.05 | 34.04 | 29.38 | 0.40 | 894 | 1.12 |
| 2.00 | 35.77 | 27.96 | 0.32 | 1397 | 0.72 |
| 1.63 | 53.84 | 18.57 | 0.30 | 1590 | 0.63 |
| 1.50 | 63.58 | 15.73 | 0.25 | 2289 | 0.44 |
| 1.40 | 72.99 | 13.7 | 0.20 | 3577 | 0.28 |
| 1.29 | 85.97 | 11.63 | | | |

# TEMPSENS TECHNICAL DATA SHEET FOR (NP) & (NPX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens NP is used as Positive leg for the thermocouple type-N (NP) as well as the Positive leg for extension type-N (NPX)

| | |
|---|---|
| Leg | NICROSIL |
| Chemical Composition | (Ni 84% + 14% Cr + Si) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density (g/cm$^3$) | 8.5 |

| Melting Point | |
|---|---|
| C | C- 1420 |
| F | F- 2590 |

| Magnetic Attraction |
|---|
| No |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 97.8 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | |
|---|---|
| Soft | 650 |
| Hard | > 1.300 |

| Elongation |
|---|
| 30 |
| <2 |

| Hardness (HV10) |
|---|
| 160 |
| 400 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **400** | **600** | **800** | **1000** | **1200** |
| 2 | **E.m.f (mV) (NP)** | 1.784 | 3.943 | 8.919 | 14.37 | 20.094 | 26.046 | 32.144 |
| 3 | **E.m.f (mV) (NPX)** | 1.784 | 3.943 | | | | | |

Tempsens NP & NPX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens NP & NPX can also be supplied in the form of stranding wire and rods.

| SWG | | | |
|---|---|---|---|
| **SWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8 | 4.064 | 9.00 | 110.6 |
| 9 | 3.658 | 11.2 | 89.65 |
| 10 | 3.251 | 14.1 | 70.81 |
| 12 | 2.642 | 21.4 | 46.76 |
| 14 | 2.032 | 36.2 | 27.66 |
| 16 | 1.626 | 56.50 | 17.71 |
| 18 | 1.219 | 100 | 9.96 |
| 19 | 1.016 | 145 | 6.92 |
| 20 | 0.914 | 179 | 5.6 |
| 21 | 0.813 | 226 | 4.43 |
| 22 | 0.711 | 295 | 3.39 |
| 24 | 0.559 | 478 | 2.09 |
| 26 | 0.457 | 715 | 1.4 |
| 30 | 0.315 | 1504 | 0.66 |
| 34 | 0.234 | 2726 | 0.37 |
| 36 | 0.193 | 4007 | 0.25 |

| B & S (AWG) | | | |
|---|---|---|---|
| **B & S or AWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 6 | 4.115 | 8.8 | 113.4 |
| 7 | 3.658 | 11.2 | 89.65 |
| 8 | 3.251 | 14.1 | 70.81 |
| 10 | 2.591 | 22.2 | 44.98 |
| 12 | 2.057 | 35.3 | 28.35 |
| 14 | 1.626 | 56.5 | 17.71 |
| 16 | 1.295 | 89.0 | 11.24 |
| 18 | 1.016 | 145.0 | 6.92 |
| 20 | 0.813 | 226.0 | 4.43 |
| 22 | 0.643 | 361.0 | 2.77 |
| 24 | 0.511 | 572.0 | 1.75 |
| 25 | 0.455 | 721.0 | 1.39 |
| 26 | 0.404 | 915.0 | 1.09 |
| 28 | 0.320 | 1458.0 | 0.69 |
| 32 | 0.203 | 3622.0 | 0.28 |

| METRIC | | | | | |
|---|---|---|---|---|---|
| **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8.00 | 2.33 | 428.8 | 1.20 | 104 | 9.65 |
| 7.00 | 3.05 | 328.3 | 1.15 | 113 | 8.86 |
| 6.00 | 4.15 | 241.2 | 1.13 | 117 | 8.55 |
| 4.70 | 6.76 | 148 | 1.00 | 149 | 6.7 |
| 4.00 | 9.33 | 107.2 | 0.81 | 228 | 4.4 |
| 3.90 | 9.81 | 101.9 | 0.64 | 364 | 2.74 |
| 3.26 | 14.05 | 71.2 | 0.63 | 376 | 2.66 |
| 3.20 | 14.58 | 68.6 | 0.60 | 415 | 2.41 |
| 3.00 | 16.59 | 60.3 | 0.51 | 574 | 1.74 |
| 2.50 | 23.88 | 41.87 | 0.50 | 597 | 1.67 |
| 2.30 | 28.22 | 35.44 | 0.45 | 737 | 1.36 |
| 2.05 | 35.52 | 28.15 | 0.40 | 933 | 1.07 |
| 2.00 | 37.32 | 26.8 | 0.32 | 1458 | 0.69 |
| 1.63 | 56.18 | 17.8 | 0.30 | 1659 | 0.6 |
| 1.50 | 66.34 | 15.07 | 0.25 | 2388 | 0.42 |
| 1.40 | 76.16 | 13.13 | 0.20 | 3732 | 0.27 |
| 1.29 | 89.7 | 11.15 | | | |

# TEMPSENS TECHNICAL DATA SHEET FOR (NN) & (NNX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens NN is used as negative leg for the thermocouple type-N (NN) as well as the negative leg for extension type-N (NNX)

| | |
|---|---|
| Leg | NISIL |
| Chemical Composition | (Ni 95% + 5% Si) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density (g/cm$^3$) | 8.55 |

| Melting Point | |
|---|---|
| C | C- 1330 |
| F | F- 2425 |

| Magnetic Attraction |
|---|
| No |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 34.6 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | |
|---|---|
| Soft | 650 |
| Hard | >1.200 |

| Elongation |
|---|
| 30 |
| <2 |

| Hardness (HV10) |
|---|
| 130 |
| 450 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **400** | **600** | **800** | **1000** | **1200** |
| 2 | **E.m.f (mV) (NN)** | 0.99 | 1.97 | 4.055 | 6.243 | 8.36 | 10.21 | 11.702 |
| 3 | **E.m.f (mV) (NNX)** | 0.99 | 1.97 | | | | | |

Tempsens EN & ENX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens EN & ENX can also be supplied in the form of stranding wire and rods.

**SWG**

| SWG | Diam. (mm) | Length (m/kg) | Weight (g/m) |
|---|---|---|---|
| 8 | 4.064 | 9.0 | 111.3 |
| 9 | 3.658 | 11.1 | 90.17 |
| 10 | 3.251 | 14 | 71.22 |
| 12 | 2.642 | 21.3 | 47.04 |
| 14 | 2.032 | 35.9 | 27.82 |
| 16 | 1.626 | 56.10 | 17.82 |
| 18 | 1.219 | 100 | 10.01 |
| 19 | 1.016 | 144 | 6.96 |
| 20 | 0.914 | 178 | 5.63 |
| 21 | 0.813 | 225 | 4.45 |
| 22 | 0.711 | 294 | 3.41 |
| 24 | 0.559 | 475 | 2.11 |
| 26 | 0.457 | 711 | 1.41 |
| 30 | 0.315 | 1496 | 0.67 |
| 34 | 0.234 | 2710 | 0.37 |
| 36 | 0.193 | 3984 | 0.25 |

**B & S (AWG)**

| B & S or AWG | Diam. (mm) | Length (m/kg) | Weight (g/m) |
|---|---|---|---|
| 6 | 4.115 | 8.8 | 114.1 |
| 7 | 3.658 | 11.1 | 90.17 |
| 8 | 3.251 | 14.0 | 71.22 |
| 10 | 2.591 | 22.1 | 45.24 |
| 12 | 2.057 | 35.1 | 28.51 |
| 14 | 1.626 | 56.1 | 17.82 |
| 16 | 1.295 | 88.5 | 11.3 |
| 18 | 1.016 | 144.0 | 6.96 |
| 20 | 0.813 | 225.0 | 4.45 |
| 22 | 0.643 | 359.0 | 2.79 |
| 24 | 0.511 | 568.0 | 1.76 |
| 25 | 0.455 | 717.0 | 1.4 |
| 26 | 0.404 | 909.0 | 1.10 |
| 28 | 0.320 | 1449.0 | 0.69 |
| 32 | 0.203 | 3601.0 | 0.28 |

**METRIC**

| Diam. (mm) | Length (m/kg) | Weight (g/m) | Diam. (mm) | Length (m/kg) | Weight (g/m) |
|---|---|---|---|---|---|
| 8.00 | 2.32 | 431.3 | 1.20 | 103 | 9.7 |
| 7.00 | 3.03 | 330.2 | 1.15 | 112 | 8.91 |
| 6.00 | 4.12 | 242.6 | 1.13 | 116 | 8.6 |
| 4.70 | 6.72 | 148.9 | 1.00 | 148 | 6.74 |
| 4.00 | 9.27 | 107.8 | 0.81 | 226 | 4.42 |
| 3.90 | 9.76 | 102.5 | 0.64 | 362 | 2.76 |
| 3.26 | 13.96 | 71.62 | 0.63 | 374 | 2.67 |
| 3.20 | 14.49 | 69 | 0.60 | 412 | 2.43 |
| 3.00 | 16.49 | 60.65 | 0.51 | 571 | 1.75 |
| 2.50 | 23.74 | 42.12 | 0.50 | 594 | 1.68 |
| 2.30 | 28.05 | 35.65 | 0.45 | 733 | 1.37 |
| 2.05 | 35.31 | 28.32 | 0.40 | 927 | 1.08 |
| 2.00 | 37.10 | 26.95 | 0.32 | 1449 | 0.69 |
| 1.63 | 55.85 | 17.9 | 0.30 | 1649 | 0.61 |
| 1.50 | 65.95 | 15.16 | 0.25 | 2374 | 0.42 |
| 1.40 | 75.71 | 13.21 | 0.20 | 3710 | 0.27 |
| 1.29 | 89.181 | 11.21 | | | |

# TEMPSENS TECHNICAL DATA SHEET FOR (RNCA) & (SNCA) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens RNCA&SNCA is used as Negative leg for the Compensating grade Type R&S

| | |
|---|---|
| Leg | CONSTANTAN |
| Chemical Composition | (Cu 95% + Ni 3%+Mn) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density (g/cm$^3$) | 8.91 |

| Melting Point | |
|---|---|
| C | C- 1080 |
| F | F- 1976 |

| Magnetic Attraction |
|---|
| No |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 12 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | | Elongation | Hardness (HV10) |
|---|---|---|---|
| **Soft** | 320 | 33 | 90 |
| **Hard** | >500 | 2 | >170 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

| | Standard E.M.F. Against PT67 | |
|---|---|---|
| 1 | **Temperature** | **100** |
| 2 | **E.m.f (mV) (RNCA)** | 0.126 |
| 3 | **E.m.f (mV) (SNCA)** | 0.126 |

Tempsens RNCA & SNCA is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens RNCA & SNCA can also be supplied in the form of stranding wire and rods.

| SWG | | | |
|---|---|---|---|
| **SWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8 | 4.064 | 8.70 | 115.6 |
| 9 | 3.658 | 10.7 | 93.64 |
| 10 | 3.251 | 13.5 | 73.96 |
| 12 | 2.642 | 20.5 | 48.85 |
| 14 | 2.032 | 34.6 | 28.89 |
| 16 | 1.626 | 54.00 | 18.5 |
| 18 | 1.219 | 96 | 10.4 |
| 19 | 1.016 | 138 | 7.22 |
| 20 | 0.914 | 171 | 5.85 |
| 21 | 0.813 | 216 | 4.63 |
| 22 | 0.711 | 283 | 3.54 |
| 24 | 0.559 | 457 | 2.19 |
| 26 | 0.457 | 684 | 1.46 |
| 30 | 0.315 | 1440 | 0.69 |
| 34 | 0.234 | 2610 | 0.38 |
| 36 | 0.193 | 3836 | 0.26 |

| B & S (AWG) | | | |
|---|---|---|---|
| **B & S or AWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 6 | 4.115 | 8.4 | 118.5 |
| 7 | 3.658 | 10.7 | 93.64 |
| 8 | 3.251 | 13.5 | 73.96 |
| 10 | 2.591 | 21.3 | 46.98 |
| 12 | 2.057 | 33.8 | 29.61 |
| 14 | 1.626 | 54.0 | 18.5 |
| 16 | 1.295 | 85.2 | 11.74 |
| 18 | 1.016 | 138.0 | 7.22 |
| 20 | 0.813 | 216.0 | 4.63 |
| 22 | 0.643 | 346.0 | 2.89 |
| 24 | 0.511 | 547.0 | 1.83 |
| 25 | 0.455 | 690.0 | 1.45 |
| 26 | 0.404 | 876.0 | 1.14 |
| 28 | 0.320 | 1390.0 | 0.72 |
| 32 | 0.203 | 3468.0 | 0.29 |

| METRIC | | | | | |
|---|---|---|---|---|---|
| **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8.00 | 2.23 | 447.9 | 1.20 | 99 | 10.08 |
| 7.00 | 2.92 | 342.9 | 1.15 | 108 | 9.25 |
| 6.00 | 3.97 | 251.9 | 1.13 | 112 | 8.94 |
| 4.70 | 6.47 | 154.6 | 1.00 | 143 | 7.00 |
| 4.00 | 8.93 | 112 | 0.81 | 218 | 4.59 |
| 3.90 | 9.40 | 106.4 | 0.64 | 349 | 2.87 |
| 3.26 | 13.45 | 74.37 | 0.63 | 360 | 2.78 |
| 3.20 | 13.96 | 71.66 | 0.60 | 397 | 2.52 |
| 3.00 | 15.88 | 62.98 | 0.51 | 549 | 1.82 |
| 2.50 | 22.86 | 43.74 | 0.50 | 572 | 1.75 |
| 2.30 | 27.01 | 37.02 | 0.45 | 706 | 1.42 |
| 2.05 | 34 | 29.41 | 0.40 | 893 | 1.12 |
| 2.00 | 35.73 | 27.99 | 0.32 | 1396 | 0.72 |
| 1.63 | 53.78 | 18.59 | 0.30 | 1588 | 0.63 |
| 1.50 | 63.51 | 15.75 | 0.25 | 2286 | 0.44 |
| 1.40 | 72.91 | 13.72 | 0.20 | 3573 | 0.28 |
| 1.29 | 85.87 | 11.65 | | | |

# TEMPSENS TECHNICAL DATA SHEET FOR (TP) & (TPX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens TP is used as Positive leg for the thermocouple type-T (TP) as well as the Positive leg for extension type-T (TPX)

| | |
|---|---|
| Leg | COPPER |
| Chemical Composition | (Cu 100%) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density ($g/cm^3$) | 8.91 |

| Melting Point | |
|---|---|
| C | C- 1080 |
| F | F- 1976 |

| Magnetic Attraction |
|---|
| No |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 1.7 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | | Elongation | Hardness (HV10) |
|---|---|---|---|
| **Soft** | 200 | 30 | 55 |
| **Hard** | 400 | 3 | 120 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | |
|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **300** | **400** |
| 2 | **E.m.f (mV) (TP)** | 0.773 | 1.837 | 3.149 | 4.69 |
| 3 | **E.m.f (mV) (TPX)** | 0.773 | 1.837 | | |

Tempsens TP & TPX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens TP & TPX can also be supplied in the form of stranding wire and rods.

| SWG | | | |
|---|---|---|---|
| **SWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8 | 4.064 | 8.70 | 115.6 |
| 9 | 3.658 | 10.7 | 93.64 |
| 10 | 3.251 | 13.5 | 73.96 |
| 12 | 2.642 | 20.5 | 48.85 |
| 14 | 2.032 | 34.6 | 28.89 |
| 16 | 1.626 | 54.00 | 18.5 |
| 18 | 1.219 | 96 | 10.4 |
| 19 | 1.016 | 138 | 7.22 |
| 20 | 0.914 | 171 | 5.85 |
| 21 | 0.813 | 216 | 4.63 |
| 22 | 0.711 | 283 | 3.54 |
| 24 | 0.559 | 457 | 2.19 |
| 26 | 0.457 | 684 | 1.46 |
| 30 | 0.315 | 1440 | 0.69 |
| 34 | 0.234 | 2610 | 0.38 |
| 36 | 0.193 | 3836 | 0.26 |

| B & S (AWG) | | | |
|---|---|---|---|
| **B & S or AWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 6 | 4.115 | 8.4 | 118.5 |
| 7 | 3.658 | 10.7 | 93.64 |
| 8 | 3.251 | 13.5 | 73.96 |
| 10 | 2.591 | 21.3 | 46.98 |
| 12 | 2.057 | 33.8 | 29.61 |
| 14 | 1.626 | 54.0 | 18.5 |
| 16 | 1.295 | 85.2 | 11.74 |
| 18 | 1.016 | 138.0 | 7.22 |
| 20 | 0.813 | 216.0 | 4.63 |
| 22 | 0.643 | 346.0 | 2.89 |
| 24 | 0.511 | 547.0 | 1.83 |
| 25 | 0.455 | 690.0 | 1.45 |
| 26 | 0.404 | 876.0 | 1.14 |
| 28 | 0.320 | 1390.0 | 0.72 |
| 32 | 0.203 | 3468.0 | 0.29 |

| METRIC | | | | | |
|---|---|---|---|---|---|
| **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8.00 | 2.23 | 447.9 | 1.20 | 99 | 10.08 |
| 7.00 | 2.92 | 342.9 | 1.15 | 108 | 9.25 |
| 6.00 | 3.97 | 251.9 | 1.13 | 112 | 8.94 |
| 4.70 | 6.47 | 154.6 | 1.00 | 143 | 7.00 |
| 4.00 | 8.93 | 112 | 0.81 | 218 | 4.59 |
| 3.90 | 9.40 | 106.4 | 0.64 | 349 | 2.87 |
| 3.26 | 13.45 | 74.37 | 0.63 | 360 | 2.78 |
| 3.20 | 13.96 | 71.66 | 0.60 | 397 | 2.52 |
| 3.00 | 15.88 | 62.98 | 0.51 | 549 | 1.82 |
| 2.50 | 22.86 | 43.74 | 0.50 | 572 | 1.75 |
| 2.30 | 27.01 | 37.02 | 0.45 | 706 | 1.42 |
| 2.05 | 34 | 29.41 | 0.40 | 893 | 1.12 |
| 2.00 | 35.73 | 27.99 | 0.32 | 1396 | 0.72 |
| 1.63 | 53.78 | 18.59 | 0.30 | 1588 | 0.63 |
| 1.50 | 63.51 | 15.75 | 0.25 | 2286 | 0.44 |
| 1.40 | 72.91 | 13.72 | 0.20 | 3573 | 0.28 |
| 1.29 | 85.87 | 11.65 | | | |

# TEMPSENS TECHNICAL DATASHEET FOR C TYPE COMPENSATING CONDUCTOR (CPC)

## Feature & Application Notes

Tempsens CPC is used as positive leg for the compensating grade type-C (CPC).

| Name of the Material | | TRHA 1 |
|---|---|---|
| Nominal Composition | Cu | Balance |
| | Ni | 44 |
| | Fe | 2 |
| | Mn | 3 |
| Max Continuous Operating Temprature | | 0°C TO +200°C |
| **Thermoelectrical and Electrical Values in soft-Annealed Condition** | | |
| Electrical resistivity in µΩ x cm at +20 °C | | 52 |
| EMF versus Pt67/NIST 175 at +100 °C / mV | | (-)2.000 |
| **Physical Characteristics** | | |
| Density at +20 °C | | 8.90 g /cm³ |
| Melting Point | | C- 1280 |
| Specific heat at +20 °C | | 0.41 J/g K |
| Thermal conductivity at +20 °C | | 23 W/m K |
| Average linear thermal expansion coefficient between +20 °C and +100 °C | | 13.50 10^6/ K |
| **Mechanical Properties** | | |
| Tensile strength N $mm^{-2}$ | | > 740 (Hard)<br>420 (Soft) |
| Elongation % | | 2 (Hard)<br>30 (Soft) |
| Hardness Hv | | > 230 (Hard)<br>95 (Soft) |
| Magnetic Properties | | No |

# TEMPSENS TECHNICAL DATASHEET FOR C TYPE COMPENSATING CONDUCTOR (CNC)

## Feature & Application Notes

Tempsens CNC is used as negative leg for the compensating grade type-C (CNC).

| Name of the Material | | TRHA 1 |
|---|---|---|
| Nominal Composition | Cu | Balance |
| | Ni | 44 |
| | Mn | 1 |
| Max Continuous Operating Temprature | | 0°C TO +200°C |
| **Thermoelectrical and Electrical Values in soft-Annealed Condition** | | |
| Electrical resistivity in μΩ x cm at +20 °C | | 49 |
| EMF versus Pt67/NIST 175 at +100 °C / mV | | (-)3.3 to (-)3.9 |
| **Physical Characteristics** | | |
| Density at +20 °C | | 8.90 g /cm³ |
| Melting Point | | C- 1280 |
| Specific heat at +20 °C | | 0.41 J/g K |
| Thermal conductivity at +20 °C | | 23 W/m K |
| Average linear thermal expansion coefficient between +20 °C and +100 °C | | 13.50 10^6/ K |
| **Mechanical Properties** | | |
| Tensile strength N mm-2 | | > 740 (Hard)<br>420 (Soft) |
| Elongation % | | 2 (Hard)<br>30 (Soft) |
| Hardness Hv | | > 230 (Hard)<br>95 (Soft) |
| Magnetic Properties | | No |

# TEMPSENS TECHNICAL DATA SHEET FOR (TN) & (TNX) TYPE CONDUCTOR

## Feature & Application Notes

Tempsens TN is used as negative leg for the thermocouple type-T (TN) as well as the negative leg for extension type-T (TNX)

| | |
|---|---|
| Leg | CONSTANTAN |
| Chemical Composition | (Ni 44% +56% Cu) |
| Application Standard | ASTM E 230/77, IEC 60584.3 |
| Density (g/cm$^3$) | 8.90 |

| Melting Point | |
|---|---|
| C | C- 1330 |
| F | F- 2425 |

| Magnetic Attraction |
|---|
| No |

| Electrical Resistivity in μΩ x cm at +20°C |
|---|
| 49 |

**Mechanical Properties at +20°C in Annealed Condition**

| Tensile Strength (Mpa) | | Elongation | Hardness (HV10) |
|---|---|---|---|
| **Soft** | 420 | 30 | 95 |
| **Hard** | > 740 | 2 | >230 |

**Thermoelectrical and Electrical Values in Soft-Annealed Condition**

**Standard E.M.F. Against PT67**

| | | | | | |
|---|---|---|---|---|---|
| 1 | **Temperature** | **100** | **200** | **300** | **400** |
| 2 | **E.m.f (mV) (TN)** | 3.505 | 7.451 | 11.713 | 16.182 |
| 3 | **E.m.f (mV) (TNX)** | 3.505 | 7.451 | | |

Tempsens TN & TNX is supplied in the form of bare wire with dimension from 8.00 MM to 0.20 MM. Tempsens TN & TNX can also be supplied in the form of stranding wire and rods.

| SWG | | | |
|---|---|---|---|
| **SWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8 | 4.064 | 8.66 | 115.4 |
| 9 | 3.658 | 10.69 | 93.53 |
| 10 | 3.251 | 13.54 | 73.88 |
| 12 | 2.642 | 20.5 | 48.79 |
| 14 | 2.032 | 34.65 | 28.86 |
| 16 | 1.626 | 54.11 | 18.48 |
| 18 | 1.219 | 96.27 | 10.39 |
| 19 | 1.016 | 138.6 | 7.22 |
| 20 | 0.914 | 171.2 | 5.84 |
| 21 | 0.813 | 216.4 | 4.62 |
| 22 | 0.711 | 283 | 3.53 |
| 24 | 0.559 | 457.8 | 2.18 |
| 26 | 0.457 | 685 | 1.46 |
| 30 | 0.315 | 1442 | 0.69 |
| 34 | 0.234 | 2613 | 0.38 |
| 36 | 0.193 | 3841 | 0.26 |

| B & S (AWG) | | | |
|---|---|---|---|
| **B & S or AWG** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 6 | 4.115 | 8.4 | 118.4 |
| 7 | 3.658 | 10.7 | 93.53 |
| 8 | 3.251 | 13.5 | 73.88 |
| 10 | 2.591 | 21.3 | 46.93 |
| 12 | 2.057 | 33.8 | 29.58 |
| 14 | 1.626 | 54.1 | 18.48 |
| 16 | 1.295 | 85.3 | 11.72 |
| 18 | 1.016 | 139.0 | 7.22 |
| 20 | 0.813 | 216.0 | 4.62 |
| 22 | 0.643 | 346.0 | 2.89 |
| 24 | 0.511 | 548.0 | 1.83 |
| 25 | 0.455 | 691.0 | 1.45 |
| 26 | 0.404 | 877.0 | 1.14 |
| 28 | 0.320 | 1397.0 | 0.72 |
| 32 | 0.203 | 3472.0 | 0.29 |

| METRIC | | | | | |
|---|---|---|---|---|---|
| **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** | **Diam. (mm)** | **Length (m/kg)** | **Weight (g/m)** |
| 8.00 | 2.24 | 447.4 | 1.20 | 99 | 10.07 |
| 7.00 | 2.92 | 342.5 | 1.15 | 108 | 9.24 |
| 6.00 | 3.97 | 251.6 | 1.13 | 112 | 8.93 |
| 4.70 | 6.48 | 154.4 | 1.00 | 143 | 6.99 |
| 4.00 | 8.94 | 111.8 | 0.81 | 218 | 4.59 |
| 3.90 | 9.41 | 106.3 | 0.64 | 349 | 2.86 |
| 3.26 | 13.46 | 74.29 | 0.63 | 360 | 2.77 |
| 3.20 | 13.97 | 71.58 | 0.60 | 397 | 2.52 |
| 3.00 | 15.9 | 62.91 | 0.51 | 550 | 1.82 |
| 2.50 | 22.89 | 43.69 | 0.50 | 572 | 1.75 |
| 2.30 | 27.04 | 36.98 | 0.45 | 707 | 1.42 |
| 2.05 | 34.04 | 29.38 | 0.40 | 894 | 1.12 |
| 2.00 | 35.77 | 27.96 | 0.32 | 1397 | 0.72 |
| 1.63 | 53.84 | 18.57 | 0.30 | 1590 | 0.63 |
| 1.50 | 63.58 | 15.73 | 0.25 | 2289 | 0.44 |
| 1.40 | 72.99 | 13.7 | 0.20 | 3577 | 0.28 |
| 1.29 | 85.97 | 11.63 | | | |

# TEMPSENS TECHNICAL DATASHEET FOR TRHA 80:20 (NiCr) RESISTANCE ALLOY

## Feature & Application Notes

80/20 Ni Cr alloy is an nickel-chromium alloy for use at temperatures up to 1200°C. 80/20 Ni Cr alloys are known for their high mechanical strength and their high creep strength. Common names: NiCr 80/20, Ni80Cr20, Chromel A, N8, Nikrothal 80, Resistohm 80, Cronix 80, Nichrome V, HAl-NiCr 80, X20H80.

| Composition | | Chromium - 19.5% , Manganese - 0.40%, Silicon - 1.25% , Nickel - Balance , Iron - 1% | |
|---|---|---|---|
| Application Standard | | ASTM B344 | |
| Density (g/cm3) | | 8.3 | |
| Melting Point | | Magnetic Attraction | Electrical Resistivity in pQ x cm at +20°C |
| C 1400 | F 2550 | No | 1.09 |

| Mechanical Properties at +20°C in Annealed Condition | | |
|---|---|---|
| Tensile Strength (Mpa) | Elongation % | Hardness (HV10) |
| 800 | 30 | 190 |
| 750 | 30 | 170 |

| Temperature Factor Of Resistivity | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Temperature°C | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 |
| 2 | Temperature°F | 212 | 392 | 572 | 752 | 932 | 1112 | 1292 | 1472 | 1652 | 1832 | 2012 | 2192 |
| 3 | Factor Ct | 1.01 | 1.02 | 1.03 | 1.04 | 1.04 | 1.04 | 1.04 | 1.04 | 1.04 | 1.05 | 1.06 | 1.07 |

| Technical Specification of NiCr 80/20 Bare wire | | | |
|---|---|---|---|
| **Diameter** | **Resistance** | **Resistivity** | **Weight** |
| **MM** | **Ω/M** | **CM2/Ω** | **G/M** |
| 10 | 0.0139 | 22601 | 652 |
| 8 | 0.0217 | 11590 | 417 |
| 7 | 0.0283 | 7764 | 319 |
| 6.5 | 0.0328 | 6217 | 275 |
| 6 | 0.0386 | 4890 | 235 |
| 5.5 | 0.0459 | 3766 | 197 |
| 5 | 0.0555 | 2830 | 163 |
| 4.5 | 0.0685 | 2063 | 132 |
| 4.25 | 0.0768 | 1738 | 118 |
| 4 | 0.0867 | 1449 | 104 |
| 3.75 | 0.0987 | 1194 | 91.7 |
| 3.5 | 0.113 | 971 | 79.9 |
| 3.25 | 0.131 | 777 | 68.9 |
| 3 | 0.154 | 611 | 58.7 |
| 2.8 | 0.177 | 497 | 51.1 |
| 2.6 | 0.205 | 398 | 44.1 |
| 2.5 | 0.222 | 354 | 40.7 |
| 2.3 | 0.262 | 275 | 34.5 |
| 2.2 | 0.287 | 241 | 31.6 |
| 2 | 0.347 | 181 | 26.1 |
| 1.8 | 0.428 | 132 | 21.1 |

# TEMPSENS TECHNICAL DATASHEET FOR TRHA 1 & 4 (FeCrAl) ALLOY

## Feature & Application Notes

High-Al and high-Cr alloy, is a high-grade electric heating material, whose electric resistance is 1.40μΩ-m to 1.50 μΩ-m. The heating element features a maximum service temperature as high as 1400ºC and is suitable for high-temperature furnaces. It has a longer service life than other materials even in a carburizing atmosphere and gases atmospheres. It is thus economical. With its high resistance, Tempsens FeCrAl is also used as a resistant material.

**Features**

- Higher maximum temperature in air Tempsens FeCrAl has a maximum temperature of 1400°C (2550°F)
- Higher surface load
- Higher yield strength
- Longer life
- Better oxidation properties
- Lower density
- Better resistance to sulphur

| Name of the Material | | TRHA 1 | TRHA 4 |
|---|---|---|---|
| Nominal Composition | Cr | 22 | 22 |
| | Al | 5.8 | 4.8 |
| | Fe | Balanced | Balanced |
| | Ni | — | – |
| Max Continuous Operating Temprature | | 1400 | 1200 |
| MELTING POINT | | 1500 | 1500 |
| Density, g/cm3 | | 7.1 | 7.2 |
| Resistivity at 20°C,Ωmm¯2,m¯1, | | 1.45 | 1.42 |
| liner Thermal Expension , K¯1, | 20-100°C | - | |
| | 20-250°C | 11 | 11 |
| | 20-500°C | 12.01 | 12 |
| | 20-750°C | 14.04 | 14 |
| | 20-1000°C | 15.2 | 15 |
| Specific heat capacity at 20°C KJkg-1K-1 | | 0.46 | 0.46 |
| Service life hours/°C | | >300/1300 | >100/1300 |
| Increase by Oxidation 1200°C (mg/cm2.h) | | 0.05 | 0.1 |
| **Mechanical Properties** | | | |
| Tensile strength N mm-2 | | 708 | 670 |
| Yield Point N mm-2 | | 501 | 485 |
| Elongation at Rupture % | | 19.3 | 22 |
| Hardness Hv | | 220 | 230 |
| Magnetic Properties | | Magnetic below 600°C | Magnetic below 600°C |

Tempsens FeCrAl is supplied in the form of bare wire & Bar with dimension from 25.00 MM to 0.20 MM.

| TRHA 1 | | | | TRHA 4 | | | |
|---|---|---|---|---|---|---|---|
| DIAMETER MM | RESISTANCE Ω/M | RESISTIVITY CM2/Ω | WEIGHT G/M | DIAMETER MM | RESISTANCE Ω/M | RESISTIVITY CM2/Ω | WEIGHT G/M |
| 10 | 0.0185 | 17017 | 558 | 10 | 0.0172 | 18277 | 569 |
| 9.5 | 0.0205 | 14590 | 503 | 8 | 0.0269 | 9358 | 364 |
| 8.25 | 0.0271 | 9555 | 380 | 7.5 | 0.0306 | 7711 | 320 |
| 8 | 0.0288 | 8712 | 357 | 7 | 0.0351 | 6269 | 279 |
| 7.35 | 0.034 | 6790 | 300 | 6.5 | 0.0407 | 5019 | 241 |
| 7 | 0.0377 | 5837 | 273 | 6 | 0.0477 | 3948 | 205 |
| 6.5 | 0.0437 | 4673 | 236 | 5.5 | 0.0568 | 3041 | 172 |
| 6 | 0.0513 | 3676 | 201 | 5 | 0.0688 | 2285 | 142 |
| 5.5 | 0.061 | 2831 | 169 | 4.75 | 0.0762 | 1959 | 128 |
| 5 | 0.0738 | 2127 | 139 | 4.5 | 0.0849 | 1665 | 115 |
| 4.75 | 0.0818 | 1824 | 126 | 4.25 | 0.0952 | 1403 | 103 |
| 4.5 | 0.0912 | 1550 | 113 | 4 | 0.107 | 1170 | 91.1 |
| 4.25 | 0.102 | 1306 | 101 | 3.75 | 0.122 | 964 | 80 |
| 4 | 0.115 | 1090 | 89.2 | 3.5 | 0.14 | 784 | 69.8 |
| 3.75 | 0.131 | 897 | 78.4 | 3.25 | 0.163 | 627 | 60.1 |
| 3.5 | 0.151 | 730 | 68.3 | 3 | 0.191 | 493 | 51.2 |
| 3.25 | 0.175 | 584 | 58.9 | 2.8 | 0.219 | 401 | 44.6 |
| 3 | 0.205 | 460 | 50.2 | 2.6 | 0.254 | 321 | 38.5 |
| 2.9 | 0.22 | 416 | 46.9 | 2.5 | 0.275 | 286 | 35.6 |
| 2.8 | 0.235 | 374 | 43.7 | 2.3 | 0.325 | 222 | 30.1 |
| 2.6 | 0.273 | 299 | 37.7 | 2 | 0.43 | 146 | 22.8 |
| 2.5 | 0.295 | 266 | 34.9 | 1.8 | 0.531 | 107 | 18.4 |
| 2.4 | 0.321 | 235 | 32.1 | 1.7 | 0.595 | 89.8 | 16.5 |
| 2.3 | 0.349 | 207 | 29.5 | 1.6 | 0.671 | 74.9 | 14.6 |
| 2.2 | 0.381 | 181 | 27 | | | | |
| 2 | 0.462 | 136 | 22.3 | | | | |
| 1.8 | 0.57 | 99.2 | 18.1 | | | | |
| 1.7 | 0.639 | 83.6 | 16.1 | | | | |

TEMPSENS

# TEMPSENS TECHNICAL DATASHEET FOR LOW RESISTANCE - TRHA CuNi (CUPRONICKEL) ALLOY

## Feature & Application Notes

Cupronickel or copper-nickel (CuNi) is an alloy of copper that contains nickel and strengthening elements, such as iron and manganese. The copper content typically varies from 60 to 90 percent.
Important properties of cupronickel alloys include corrosion resistance, inherent resistance to macrofouling, good tensile strength, excellent ductility when annealed, thermal conductivity and expansion characteristics amenable for heat exchangers and condensers, good thermal conductivity and ductility at cryogenic temperatures and beneficial antimicrobial touch surface properties.Moreover high security against stress corrosion cracking and corrosion fatigue.

### Physical properties

| Identification symbol DIN 17471 | Electrical resistivity in μΩ-cm | | | | | | Temperature coefficient of electrical resistance between 20 and 105° C 10-6/K | Upper application limit in air °C |
|---|---|---|---|---|---|---|---|---|
| | 20°C | 100°C | 200°C | 300°C | 400°C | 500°C | | |
| CuNi2 | 5.1 | 5.7 | 6.4 | - | - | - | +1000 to +1600 | 300 |
| CuNi6 | 10.1 | 10.7 | 11.4 | 12.3 | - | - | +500 to +900 | 300 |
| CuNi10 | 15.10 | 15.6 | 16.2 | 16.9 | 17.5 | - | +350 to +450 | 400 |
| CuNi23 | 30.2 | 30.8 | 31.5 | 32.3 | 33.1 | 33.9 | +220 to +280 | 500 |
| CuNi30 | 40.2 | 40.4 | 41 | 41.7 | 42.4 | 43.2 | +80 to +130 | 500 |
| CuNi44 | 49.2 | 49 | 49 | 49 | 49 | 49 | -80 to +40 | 600 |

### Mechanical properties

Cu-Ni resistance alloys to DIN 17 471; Mechanical properties at 20 C in annealed condition

| Identification symbol | Tensile strength1Rm N/mm2min. | Elongation (Lo = 100 mm) A % for nominal diameter in mm | | | | |
|---|---|---|---|---|---|---|
| | | 0.02 to 0.0632 | >0.063 to 0.1252 | >0.125 to 0.52 | >0.5 to 1 | >13 |
| CuNi2 | 220 | - | approx. 15 | approx. 18 | ⩾18 | ⩾25 |
| CuNi6 | 250 | - | approx. 15 | approx. 18 | ⩾18 | ⩾25 |
| CuNi10 | 290 | - | approx. 15 | approx. 20 | ⩾20 | ⩾25 |
| CuNi23 | 350 | approx. 12 | approx. 18 | approx. 20 | ⩾20 | ⩾25 |
| CuNi30 | 400 | approx. 12 | approx. 18 | approx. 20 | ⩾20 | ⩾25 |
| CuNi44 | 420 | approx. 12 | approx. 18 | approx. 20 | ⩾20 | ⩾25 |

Values are applicable to wire with diameter more than 2 mm; values are substantially higher for smaller diameters.
Values also apply to flat wire and strip whose thickness is equal to diameter.Only guide values.
Measurement length Lo can be agreed for wire diameters more than 3 mm.

### Chemical Composition

Cu-Ni alloys Composition

| Identification symbol in accordance with DIN 17471 | Mean composition (Mass %) |
|---|---|
| CuNi2 | 2 Ni; Rem. Cu |
| CuNi6 | 6 Ni; Rem. Cu |
| CuNi10 | 10 Ni; Rem. Cu |
| CuNi23 | 23 Ni; 1.5 Mn; Rem. Cu |
| CuNi30 | 30 Ni; 3 Mn; Rem. Cu |
| CuNi44 | 44 Ni; 1 Mn; Rem. Cu |

# CERTIFICATES

TÜV NORD

CERTIFICATE

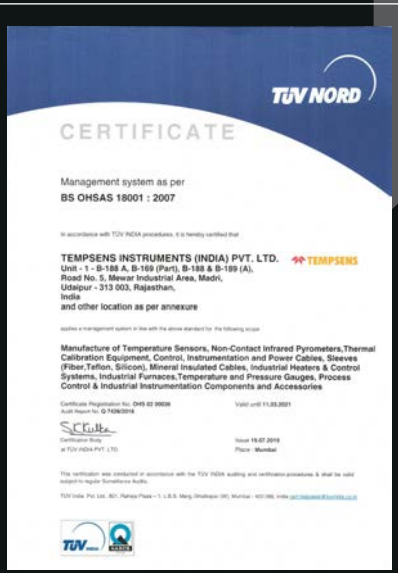
Management system as per

ISO 9001 : 2015

TEMPSENS INSTRUMENTS (INDIA) PVT. LTD.

Unit - 1 - B-188 A, B-169 (Part), B-188 & B-189 (A),
Road No. 5, Mewar Industrial Area, Madri,
Udaipur - 313 003, Rajasthan,
India
and other location as per annexure

Manufacture and Supply of Temperature Sensors, Non-Contact Infrared Pyrometers,Thermal Calibration Equipment, Control, Instrumentation & Power Cables, Sleeves (Fiber,Teflon, Silicon), Mineral Insulated Cables, Industrial Heaters and Control Systems, Industrial Furnaces,Temperature & Pressure Gauges, Process Control and Industrial Instrumentation Components & Accessories.



TÜV NORD

CERTIFICATE

Management system as per

BS OHSAS 18001 : 2007

TEMPSENS INSTRUMENTS (INDIA) PVT. LTD.

Unit - 1 - B-188 A, B-169 (Part), B-188 & B-189 (A),
Road No. 5, Mewar Industrial Area, Madri,
Udaipur - 313 003, Rajasthan,
India
and other location as per annexure

Manufacture of Temperature Sensors, Non-Contact Infrared Pyrometers,Thermal Calibration Equipment, Control, Instrumentation and Power Cables, Sleeves (Fiber,Teflon, Silicon), Mineral Insulated Cables, Industrial Heaters & Control Systems, Industrial Furnaces,Temperature and Pressure Gauges, Process Control & Industrial Instrumentation Components and Accessories

TÜV NORD

CERTIFICATE

Management system as per

ISO 14001 : 2015

TEMPSENS INSTRUMENTS (INDIA) PVT. LTD.

Unit - 1 - B-188 A, B-169 (Part), B-188 & B-189 (A),
Road No. 5, Mewar Industrial Area, Madri,
Udaipur - 313 003, Rajasthan,
India
and other location as per annexure

Manufacture of Temperature Sensors, Non-Contact Infrared Pyrometers,Thermal Calibration Equipment, Control, Instrumentation and Power Cables, Sleeves (Fiber,Teflon, Silicon), Mineral Insulated Cables, Industrial Heaters & Control Systems, Industrial Furnaces,Temperature and Pressure Gauges, Process Control & Industrial Instrumentation Components and Accessories

RAJIV GANDHI NATIONAL QUALITY AWARD, 2005

COMMENDATION CERTIFICATE

SMALL SCALE MANUFACTURING INDUSTRY

This certificate alongwith a Silver Salver Plaque is presented to TEMPSENS INSTRUMENTS (INDIA) PRIVATE LIMITED, UDAIPUR in recognition of their efforts and commitment to quality in the field of ELECTRICAL & ELECTRONIC Industry.

L. MANSINGH
Secretary, Department of Consumer Affairs
Government of India, and
Chairman
National Awards Committee

SHARAD PAWAR
Union Minister for
Agriculture, Consumer Affairs, Food & Public Distribution, and
President
Bureau of Indian Standards

New Delhi, 21 February 2006

EEPCINDIA
ENGINEERING THE FUTURE

Award for Export Excellence

EEPC India, Northern Region

Tempsens Instruments (I) Pvt. Ltd.

Star Performers in Product Groups for 2013-13 (Silver Shield)
Miscellaneous Electrical Machinery and Apparatus
(incl. electricity distribution and control apparatus)
Small Enterprise

Kamna Raj Aggarwalla
Chairperson, EEPC India, Northern Region

5 March 2016
Date

Pyrotech
Group Company
www.pyrotechindia.com

# TEMPSENS


## INDIA

**Tempsens Instruments (I) Pvt. Ltd. U# I**
B-188A, Road No.5, M.I.A.,
Udaipur-313003 (Rajasthan) INDIA
**Ph.:**+91-294-3507700,
**Fax :**+91-294-3507731
**Email :** info@tempsens.com

**Tempsens Instruments (I) Pvt. Ltd. U# II**
A-190, Road No.5, M.I.A.,
Udaipur-313003 (Rajasthan) INDIA
**Ph.:**+91-294-3500600,
**Fax :**+91-294-3500631
**Email :** info@compensatingcables.net
info@tempsens.com

## GERMANY

**Tempsens Instruments GmbH**
Loehestrasse 37,
53773 Hennef, GERMANY
**Ph.:** +49 2242 8703-22,
**Fax :** +49-2242-8703-20,
**Email :** basant@tempsens.com
hmueller@tempsens.de

## INDONESIA

**Pt. Tempsens Asia Jaya**
Jln. Jembatan Tiga Raya No.6
Jakarta 14440, INDONESIA
**Hp. :** (+62)877 8080 4433
**Telp. :** (+62) 21 666 00050
**Fax :** (+62) 21 661 6789
**Email :** support@tempsens-asia.com


www.tempsens.com