## Tempco-Pak Mineral Insulated Cable

Made in USA

### *Tempco's Metal Sheathed, Mineral Insulated Thermocouple Cable*

Tempco-Pak Thermocouples and cable are manufactured using premium quality materials along with rigid quality control standards to ensure a reliable product that is state of the art. The metal outer sheath protects the thermocouple wires and insulation from contamination and mechanical damage as well as hostile and oxidizing environments while allowing the cable to be moisture proof, formable, weldable, compact and have fast response. The mineral insulation isolates the conductors from the sheath and each other while providing excellent high temperature insulation resistance.

Tempco offers a wide variety of sheath materials to choose from as there is no single sheath material that is suitable for all conditions. The most commonly stocked sheath materials are 304 SS, 316 SS and alloy 600. These are offered in all ANSI recognized thermocouple calibrations.

As a standard, Tempco-Pak Thermocouple cable is made with high purity 94% minimum MgO insulation. Other types and purities are available; however, when selecting a mineral insulation, the environment, temperature rating and cost must be taken into consideration.

**Quality Assurance**

All Tempco-Pak Thermocouple cable is inspected for appearance, physical and electrical characteristics, as well as conformity to calibration.

Each coil or batch of Tempco-Pak is made from the same production lot of raw materials and processed together. This eliminates the need to calibrate each length cut from the same coil. Samples from each coil are calibrated as shown in the chart.

### Tempco-Pak Thermocouple Calibration Temperatures

| ANSI Calibration | Standard Calibration Points | Optional Points |
|---|---|---|
| T | 200°F (93°C), 400°F (204°C) | — |
| J | 200°F (93°C), 500°F (260°C), 1000°F (537°C), 1500°F (815°C) | — |
| E | 300°F (149°C), 500°F (260°C), 1000°F (537°C), 1600°F (871°C) | — |
| K | 300°F (149°C), 500°F (260°C), 1000°F (537°C), 1600°F (871°C), 2000°F (1093°C)✳ | 2200°F (1204°C)✳ |
| R | 1000°F (537°C), 1600°F (871°C), 2000°F (1093°C)✳ | 2600°F (1426°C)✳ |
| S | 1000°F (537°C), 1600°F (871°C), 2000°F (1093°C)✳ | 2600°F (1426°C)✳ |
| B | 1600°F (871°C), 2000°F (1093°C)✳, 2600°F (1426°C)✳ | |
| N | 300°F (149°C), 500°F (260°C), 1000°F (537°C), 1600°F (871°C), 2000°F (1093°C)✳ | 2200°F (1204°C)✳ |

✳ These calibration points will be checked if the sheath and insulation are rated to this temperature.

## Tempco-Pak

### *Thermocouple Data, Care and Handling*

#### Calibration

Tempco-Pak Thermocouple Cable is normally supplied to ANSI standard limits (tolerances) of error as set forth in ANSI circular MC96.1–1982 and duplicated in ASTM E230. Special limits (tolerances) per ANSI MC96.1 are available at extra cost (See Table 1 on page 14-103).

#### Annealing

Unless otherwise specified all Tempco-Pak will be furnished in a fully annealed condition.

#### Formability

Because Tempco-Pak is fully annealed it can normally be formed around a mandrel 4 times the sheath diameter without loss of insulation resistance or the sheath's integrity.

#### Weldability

Tempco-Pak can be brazed, soldered or welded upon its sheath. However, because of the delicate nature of the fabricating of hot junctions, it is recommended they be done at the factory. Brazing or soldering material should not come in contact with the mineral insulation as the flux or resin will contaminate the insulation.

#### Insulation Resistance

Tempco-Pak should have a minimum insulation resistance wire to wire and wire to sheath at room temperature of 100 megohms at 50 VDC for 0.093" O.D. and smaller and 100 megohms at 100 VDC for .100" O.D. and larger.

#### Shipping and Packaging

Tempco-Pak is stocked in random lengths with the maximum stock lengths listed in the tables showing the varieties of commonly available material. Tempco reserves the right to supply random lengths of our choice unless specific lengths are specified on your order. Tempco-Pak can be furnished in coil form or in straight lengths. Normally .375" diameter and .312" diameter are shipped in straight lengths. Longer lengths are available on special order.

#### Handling and Storage

To prevent moisture from being absorbed by the hydroscopic insulation, both ends of the lengths of Tempco-Pak are sealed at the factory with a suitable sealer. Under some conditions, moisture absorption could take place that would lower the insulation resistance and may prove to be troublesome in subsequent assembly and welding, so it is advisable to store Tempco-Pak in a dry place. Slight moisture penetration can be remedied by removing approximately 3 inches from each end. Apply heat (approx. 300°F) 6 to 7 inches from the open end and slowly work heat toward and over the open end. Allow end to cool to approximately 180°F and reseal end. When pieces are cut from stock lengths, the exposed ends should be squared and resealed immediately to prevent contamination or moisture absorption. For deeper moisture penetration, bake entire length of material with both ends open for 24 hours at 250°F to 300°F to remove moisture and bring up insulation resistance. If baking does not bring the insulation resistance to acceptable levels, discard the material. As an option Tempco can provide Tempco-Pak with the ends seal welded.



View Product Inventory @ www.tempco.com

## Selecting the Mineral Insulated Thermocouple Cable Suited to Your Requirement

Tempco offers a wide variety of sheathed, mineral insulated thermocouple cable. We stock many varieties of sheath diameters and materials in ANSI recognized thermocouple types and can manufacture a multitude of non-stock combinations of sheath materials, O.D.s, insulations, wire types and wire configurations on special request. Consult Tempco with your specific requirements.

When selecting a cable for an application there are four things that must be considered:

### Sheath Material

The outer sheath protects the insulation and wires from physical damage, contamination and the environment, all of which affect the service life and cost. As there isn't any one particular sheath material that is appropriate for all conditions, Tempco offers you a choice.

### Wire Types *(Calibration)*

Selecting the proper conductors can be crucial to the function the MI cable is to perform. Where thermocouple cable is concerned, selecting the appropriate calibration for the temperature to be measured, the instrumentation available, and the environment will be a significant factor in the accuracy, life and cost.

### Insulation Material

The insulation material isolates the wires from each other and the sheath. Because the wires are used as conductors, the insulating material becomes important in preventing electrical shorts and dielectric breakdown, particularly at elevated temperatures.

### Physical Parameters

The four main physical characteristics of the MI cable that should be taken into account are:

**a.** Sheath Diameter
**b.** Sheath Wall Thickness
**c.** Conductor Size
**d.** Conductor Location (4 and 6 wires)

These will directly affect service life, flexibility, time response, weldability, strength and cost.

The following pages will serve as a guide for sheath materials, insulation materials and the various ANSI thermocouple calibrations.


The following information is designed to be used as a guide and may not be correct in every application. If in doubt, consult with your Tempco sales engineer or the factory. Temperatures shown are maximum recommended operating temperatures.

## Sheath Material

**NOTE: Letters in parentheses following the sheath material are used with the Ordering Worksheet on page 14-119.**

### Alloy 600 (A)

Maximum temperature: 1177°C (2150°F). Most widely used thermocouple sheath material. Good high temperature strength, corrosion resistance, resistance to chloride-ion stress corrosion cracking and oxidation resistance to high temperatures. Do not use in sulfur-bearing environments. Good in nitriding environments.

### 304 SS (B)

Maximum temperature: 900°C (1650°F). Most widely used low temperature sheath material. Extensively used in food, beverage, chemical and other industries where corrosion resistance is required. Subject to damaging carbide precipitation in 482° to 871°C (900° to 1600°F) range. Lowest-cost corrosion resistant sheath material available.

### 316 SS (C)

Maximum temperature: 900°C (1650°F). Best corrosion resistance of the austenitic stainless steel grades. Good corrosion resistance in $H_2S$. Widely used in the food and chemical industry. Subject to damaging carbide precipitation in 482° to 871°C (900° to 1600°F) range.

### 304L (D)

Maximum temperature: 900°C (1650°F). Low-carbon version of 304 SS (B). Low carbon content allows this material to be welded and heated in the 482° to 871°C (900° to 1600°F) range without damage to corrosion resistance.

### 316L (E)

Maximum temperature: 900°C (1650°F). Same as 316 SS (C) except low-carbon version allows for better welding and fabrication.

CONTINUED

## Sheath Material (continued)

**NOTE: Letters in parentheses following the sheath material are used with the Ordering Worksheet on page 14-119.**

### 310 SS (F)

Maximum temperature: 1150°C (2100°F). Mechanical and corrosion resistance, similar to but better than 304 SS. Very good heat resistance. This alloy contains 25% Cr, 20% Ni. Not as ductile as 304 SS.

### 321 SS (G)

Maximum temperature: 871°C (1600°F). Similar to 304 SS except titanium stabilized for intergranular corrosion. This alloy is designed to overcome susceptibility to carbide precipitation in the 482°C to 871°C (900°F to 1600°F) range. Used in aerospace and chemical applications.

### 347 SS (H)

Maximum temperature: 871°C (1600°F). Similar to 304 SS except nickel columbium stabilized. This alloy is designed to overcome susceptibility to carbide precipitation in the 482°C to 871°C (900°F to 1600°F) range. Used in aerospace and chemical applications.

### 446 SS (L)

Maximum temperature: 1150°C (2100°F). Ferritic stainless steel, which has good resistance to sulfurous atmospheres at high temperatures. Good corrosion resistance to nitric acid, sulfuric acid and most alkalies. 27% chromium content gives this alloy the highest heat resistance of any ferritic stainless steel.

### Hastelloy X® (Q)

Maximum temperature: 1204°C (2200°F). Widely used in aerospace applications. Resistant to oxidizing, reducing and neutral atmospheric conditions. Excellent high temperature strength along with superior oxidation resistance. Resistant to stress corrosion cracking in petrochemical applications.

### Incoloy® 800 (S)

Maximum temperature: 1093°C (2000°F). Widely used as heater sheath material. Minimal use in thermocouples. Superior to Alloy 600 in sulfur, cyanide salts and fused neutral salts. Susceptible to intergranular attack in some applications by exposure to the temperature range of 538°C to 760°C (1000° to 1400°F).

### Incoloy® 800HT (T)

Maximum temperature: 1093°C (2000°F). Same as Incoloy 800® (S) except carbon content is limited to upper end of range. This provides significantly higher creep and rupture strength. Used in the chemical and petrochemical industry for long-term exposure to high temperatures.

### Inconel® 601 (R)

Maximum temperature: 1177°C (2150°F) Continuous; 1260°C (2300°F) Intermittent. Similar to Alloy 600 with the addition of aluminum for outstanding oxidation resistance. Designed for high temperature corrosion resistance. This material is good in carburizing environments, and has good creep rupture strength. Do not use in vacuum furnaces! Susceptible to intergranular attack by prolonged heating in 538°C to 760°C (1000°F to 1400°F) temperature range.

### Molybdenum (V)

Maximum temperature in air: 399°C (750°F). Melting point: 2610°C (4730°F). Refractory metal. Brittle; cannot be bent. Use only in inert, vacuum or reducing atmospheres. Most commonly used with BeO insulation and Tungsten Rhenium conductors. Uncompacted assemblies only.

### Nickel 200 (J)

Maximum temperature: 315°C (600°F). Commercially pure wrought Nickel with good resistance to a wide range of corrosive materials. For temperatures above 600°F use Nickel 201 to prevent embrittlement by intergranular corrosion.

### Nickel 201 (K)

Maximum temperature: 1093°C (2000°F). Commercially pure wrought nickel with low carbon. Used in molten salt bath furnaces. Offers good resistance to caustic alkalines and fluorine.

### Platinum 10% Rhodium (N)

Maximum temperature: 1552°C (2825°F). Excellent oxidation resistance. Same type of uses as platinum 20% rhodium except lower cost and reduced operating range.

### Platinum 20% Rhodium (P)

Maximum temperature: 1649°C (3000°F). Excellent oxidation resistance. Very expensive oxidation resistant alloy used in glass manufacturing and in research applications. Also used for gas turbine test thermocouples.

### Pure Platinum (M)

Maximum temperature: 1482°C (2700°F). Platinum is the only metallic material capable of operating in an oxidizing atmosphere above 1260°C (2300°F) for extended periods of time. Normally used with type R, S or B conductors. Used in glass manufacturing, high temperature furnaces and as control standards.

### Tantalum (U)

Maximum temperature in air: 482°C (900°F). Melting point: 2996°C (5425°F). Refractory metal. Very ductile. Use only in inert or very good vacuums—10-3 torr or better. Most commonly used with BeO and Tungsten Rhenium conductors. Do not use in environments containing nitrogen above 371°C (700°F).

## Mineral Insulated Cable Calibration

**NOTE: Letters in parentheses following the sheath material are used with the Ordering Worksheet on page 14-119.**

### ANSI Type (J) Standard; Special Tolerance (3)

Type J is composed of a positive leg (JP) which is iron and a negative leg (JN) which is approximately 45% nickel, 55% copper. When protected by the compacted mineral insulation and appropriate outer sheath, Type J is usable from 32°F to 1500°F. Type J is not susceptible to short range ordering in the 700 to 1000°F temperature range (+2°F to +4°F drift), which occurs with ANSI Type E and K. This low-cost, stable thermocouple calibration is primarily used with 94% minimum purity MgO insulation and a stainless steel sheath.

### ANSI Type (K) Standard; Special Tolerance (4)

Type K is composed of a positive leg (KP) which is approximately 90% nickel, 10% chromium and a negative leg (KN) which is approximately 95% nickel, 2% aluminum, 2% manganese and 1% silicon. When protected by the compacted mineral insulation and appropriate outer sheath, Type K is usable from 32°F to 2300°F and is one of Tempco's most popular calibration types. If the application temperature is between 600°F and 1100°F, we recommend using Type J or Type N because of short range ordering that can cause drift of +2°F to +4°F in a few hours' time. Type K is relatively stable to radiation transmutation and is used in nuclear environments. For applications below 32°F, special alloy selections are usually required.

### ANSI Type (E) Standard; Special Tolerance (5)

Type E is composed of a positive leg (EP) which is approximately 90% nickel, 10% chromium and a negative leg (EN) which is approximately 45% nickel, 55% copper. When protected by the compacted mineral insulation and appropriate outer sheath, Type E is usable from 32°F to 1650°F. This thermocouple has the highest EMF output per degree of all ANSI recognized thermocouples. If the application temperature is between 600°F and 1100°F, we recommend using Type J or Type N because of short range ordering that can cause drift of +2°F to +4°F in a few hours' time. For applications below 32°F, special alloy selections may be required.

### ANSI Type (T) Standard; Special Tolerance (6)

Type T is composed of a positive leg (TP) which is pure copper and a negative leg (TN) which is approximately 45% nickel, 55% copper. When protected by the compacted mineral insulation and appropriate outer sheath, Type T is usable from 32°F to 662°F. Type T is very stable and is used in a wide variety of cryogenic and low temperature applications. For applications below 32°F special alloy selections may be required.

### ANSI Type (N) Standard; Special Tolerance (7)

Type N is composed of a positive leg (Nicrosil) which is approximately 14% chromium, 1.4% silicon, 84.6% nickel and a negative leg (Nisil) which is approximately 4.4% silicon, 95.6% nickel. When protected by compacted mineral insulation and appropriate outer sheath, Type N is usable from 32°F to 2300°F. Type N was designed to overcome several problems inherent in Type K thermocouples. Short range ordering (+2°F to +4°F drift) in the 600°F to 1100°F temperature range is greatly reduced, and the drift rate at high temperatures is considerably less. Type N has also been found to be more stable than Type K in nuclear environments.

### ANSI Type (R) Standard Tolerance

Type R is composed of a positive leg (RP), which is 87% platinum, 13% rhodium and a negative leg (RN), which is 100% platinum. When protected by compacted mineral insulation and appropriate outer sheath, Type R is usable from 32°F to 2700°F. Type R is available as standard limits only, ITS90.

### ANSI Type (S) Standard Tolerance

Type S is composed of a positive leg (SP), which is 90% platinum, 10% rhodium and a negative leg (SN), which is 100% platinum. When protected by compacted mineral insulation and appropriate outer sheath, Type S is usable from 32°F to 2700°F. Type S has a lower EMF output than Type R and is available as standard limits only, ITS90.

### ANSI Type (B) Standard Tolerance

Type B is composed of a positive leg (BP) which is approximately 70% platinum, 30% rhodium and a negative leg (BN) which is approximately 94% platinum, 6% rhodium. When protected by compacted mineral insulation and appropriate outer sheath, Type B is usable from 1600°F to 3100°F. Type B is available as standard limits only, IPTS 1968 scale.

### Tungsten—5% Re/Tungsten, 26% Re (C)

This calibration has not been given a letter designation by ANSI. When this calibration is protected by mineral insulation and appropriate outer sheath, it is usable from 32°F to 4200°F. Calibration is used most often with Beryllium Oxide insulation and either molybdenum or tantalum sheath. These combinations can only be used in an inert or vacuum environment.

### Miscellaneous (O)

Consult Tempco with your requirements.

## Mineral Insulated Thermocouple Cable

Made in USA

### Insulation

**NOTE:** **Letters in parentheses following the sheath material are used with the Ordering Worksheet on page 14-119.**

**Magnesium Oxide** — MgO 96% Typical **(M)**

This insulation is widely used in thermocouple and heater applications below 2000°F. $SiO_2$ is the major impurity that provides excellent insulation resistance. Do not use with platinum or in nuclear application.

**High Purity Magnesium Oxide** — MgO 99.4% Minimum Purity **(H)**

Low impurity levels make this insulation very useful for all thermocouple calibrations up to 2500°F. Above 2500°F we recommend using Hafnia Oxide ($HfO_2$) insulation because of MgO's low resistivity. This material meets the requirements established in ASTM E-235-82.

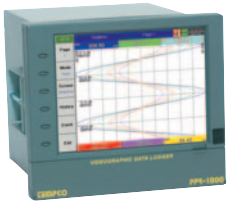
**Alumina Oxide** — $Al_2O_3$ 99.6% Minimum Purity **(A)**

Although this material is comparable to MgO in its electrical properties and cost, it does not compact as well and tends to "powder out." This undesirable characteristic has made this insulation unpopular in industry so cable with this type of insulation is available only as a "special."

## Complete Your Thermal Loop System

### Instrumentation

*Videographic Data Loggers and Paper Chart Recorders*



*Complete details can be found in Section 12 of this catalog.*

### TEC Temperature Controllers

*Complete details can be found in Section 13 of this catalog.*

## Mineral Insulated Thermocouple Cable Ordering Worksheet

**Ordering Code:** MTC – [1] [2] [3] [4] [5]

Designates **TEMPCO-PAK** Sheathed Mineral Insulated Thermocouple Cable

# Ordering Worksheet

**Note:** For a complete description of Worksheet options see pages 14-115 through 14-118.

### Calibration Code — See page 14-117

| ANSI Standard Tolerances | Special Tolerances |
|---|---|
| **J** = (Iron/Constantan) | **3** |
| **K** = (Chromel®/Alumel) | **4** |
| **E** = (Chromel®/Constantan) | **5** |
| **T** = (Cu/Constantan) | **6** |
| **N** = (Nicrosil/Nisil) | **7** |
| **R** = (Pt/Pt-13% Rh) PER ITS-90 | |
| **S** = (Pt/Pt-10% Rh) PER ITS-90 | |
| **B** = (Plat-6% Rh/Plat-30% Rh) | |
| **C** = (W-5% Re/W-26% Re) | |
| **O** = Miscellaneous (Consult Factory) | |

### Number of Conductors

**2** = 2-wire construction (Single Element)
**4** = 4-wire construction (Duplex Element)

### Insulation — See page 14-118

**M** = 96% min. MgO
**H** = 99.4% min. MgO
**A** = 99.6% Alumina

### Sheath O.D.

| | |
|---|---|
| **A** = .020" ±.001 | **L** = 1.0 mm ±.03 |
| **B** = .032" ±.001 | **N** = 1.5 mm ±.03 |
| **C** = .040" ±.001 | **P** = 2.0 mm ±.03 |
| **D** = .063" ±.001 | **Q** = 3.0 mm ±.05 |
| **E** = .093" ±.002 | **R** = 4.5 mm ±.05 |
| **F** = .125" ±.002 | **S** = 6.0 mm +.07/–.05 |
| **G** = .188" ±.002 | **T** = 8.0 mm +.07/–.05 |
| **H** = .250" +.003/–.002 | **V** = 9.0 mm +.07/–.05 |
| **J** = .313" +.003/–.002 | |
| **K** = .375" +.003/–.002 | |

### Sheath Material — See pages 14-115 and 14-116

| | |
|---|---|
| **A** = Alloy 600 | **L** = 446 SS |
| **B** = 304 SS | **M** = Pure platinum |
| **C** = 316 SS | **N** = Platinum 10% rhodium |
| **D** = 304L SS | **P** = Platinum 20% rhodium |
| **E** = 316L SS | **Q** = Hastelloy X® |
| **F** = 310 SS | **R** = Inconel® 601 |
| **G** = 321 SS | **S** = Incoloy® 800 |
| **H** = 347 SS | **T** = Incoloy® 800HT |
| **J** = Nickel 200 | **U** = Tantalum |
| **K** = Nickel 201 | **V** = Molybdenum |

⚠ **WARNING:** Cancer and Reproductive Harm - www.P65Warnings.ca.gov.

Made in USA

## Single Element Standard Size List

| O.D. (in.) | Part Number | ANSI Calibration | Insulation (Min. Purity) | Sheath Material | Nom. Wall Thickness (in.) | Nom. B&S Wire ga. | Max. Operating Temp. (°F) | Max. Stock Length (ft.) |
|---|---|---|---|---|---|---|---|---|
| .020 ±.001 | MTC00001 | J | 99.4% MgO | Alloy 600 | .003 | 39 | 1500 | 50 |
| | MTC00002 | K | 99.4% MgO | Alloy 600 | .003 | 39 | 1650 | 50 |
| | MTC00003 | J | 99.4% MgO | 304 | .003 | 39 | 1500 | 50 |
| | MTC00004 | K | 99.4% MgO | 304 | .003 | 39 | 1650 | 50 |
| .032 ±.001 | MTC00005 | J | 99.4% MgO | Alloy 600 | .005 | 36 | 1500 | 150 |
| | MTC00006 | K | 99.4% MgO | Alloy 600 | .005 | 36 | 1800 | 150 |
| | MTC00007 | J | 99.4% MgO | 304 | .005 | 36 | 1500 | 150 |
| | MTC00008 | K | 99.4% MgO | 304 | .005 | 36 | 1650 | 150 |
| .040 ±.001 | MTC00009 | J | 99.4% MgO | Alloy 600 | .006 | 33 | 1500 | 175 |
| | MTC00010 | K | 99.4% MgO | Alloy 600 | .006 | 33 | 2000 | 175 |
| | MTC00011 | J | 99.4% MgO | 304 | .006 | 33 | 1500 | 175 |
| | MTC00012 | K | 99.4% MgO | 304 | .006 | 33 | 1650 | 175 |
| | MTC00013 | E | 99.4% MgO | 304 | .006 | 33 | 1600 | 175 |
| | MTC00014 | T | 99.4% MgO | 304 | .006 | 33 | 650 | 175 |
| | MTC00015 | J | 99.4% MgO | 316 | .006 | 33 | 1500 | 175 |
| | MTC00016 | K | 99.4% MgO | 316 | .006 | 33 | 1650 | 175 |
| .062 ±.001 | MTC00017 | J | 96.0% MgO | Alloy 600 | .008 | 30 | 1500 | 500 |
| | MTC00018 | J | 99.4% MgO | Alloy 600 | .008 | 30 | 1500 | 500 |
| | MTC00019 | K | 96.0% MgO | Alloy 600 | .008 | 30 | 2000 | 500 |
| | MTC00020 | K | 99.4% MgO | Alloy 600 | .008 | 30 | 2000 | 500 |
| | MTC00021 | J | 96.0% MgO | 304 | .008 | 30 | 1500 | 500 |
| | MTC00022 | J | 99.4% MgO | 304 | .008 | 30 | 1500 | 500 |
| | MTC00023 | K | 96.0% MgO | 304 | .008 | 30 | 1650 | 500 |
| | MTC00024 | K | 99.4% MgO | 304 | .008 | 30 | 1650 | 500 |
| | MTC00025 | E | 96.0% MgO | 304 | .008 | 30 | 1600 | 500 |
| | MTC00026 | T | 99.4% MgO | 304 | .008 | 30 | 650 | 500 |
| | MTC00027 | J | 96.0% MgO | 316 | .008 | 30 | 1500 | 500 |
| | MTC00028 | J | 99.4% MgO | 316 | .008 | 30 | 1500 | 500 |
| | MTC00029 | K | 96.0% MgO | 316 | .008 | 30 | 1650 | 500 |
| | MTC00030 | K | 99.4% MgO | 316 | .008 | 30 | 1650 | 500 |
| .093 ±.002 | MTC00031 | J | 96.0% MgO | Alloy 600 | .010 | 27 | 1500 | 450 |
| | MTC00032 | J | 99.4% MgO | Alloy 600 | .010 | 27 | 1500 | 450 |
| | MTC00033 | K | 96.0% MgO | Alloy 600 | .010 | 27 | 2000 | 450 |
| | MTC00034 | K | 99.4% MgO | Alloy 600 | .010 | 27 | 2150 | 450 |
| | MTC00035 | J | 96.0% MgO | 304 | .010 | 27 | 1500 | 450 |
| | MTC00036 | J | 99.4% MgO | 304 | .010 | 27 | 1500 | 450 |
| | MTC00037 | K | 96.0% MgO | 304 | .010 | 27 | 1650 | 450 |
| | MTC00038 | K | 99.4% MgO | 304 | .010 | 27 | 1650 | 450 |
| .125 ±.002 | MTC00039 | J | 96.0% MgO | Alloy 600 | .014 | 24 | 1500 | 250 |
| | MTC00040 | J | 99.4% MgO | Alloy 600 | .014 | 24 | 1500 | 250 |
| | MTC00041 | K | 96.0% MgO | Alloy 600 | .014 | 24 | 2000 | 250 |
| | MTC00042 | K | 99.4% MgO | Alloy 600 | .014 | 24 | 2150 | 250 |
| | MTC00043 | J | 96.0% MgO | 304 | .014 | 24 | 1500 | 250 |
| | MTC00044 | J | 99.4% MgO | 304 | .014 | 24 | 1500 | 250 |
| | MTC00045 | K | 96.0% MgO | 304 | .014 | 24 | 1650 | 250 |
| | MTC00046 | K | 99.4% MgO | 304 | .014 | 24 | 1650 | 250 |
| | MTC00047 | E | 96.0% MgO | 304 | .014 | 24 | 1600 | 250 |
| | MTC00048 | T | 96.0% MgO | 304 | .014 | 24 | 650 | 250 |
| | MTC00049 | J | 96.0% MgO | 316 | .014 | 24 | 1500 | 250 |
| | MTC00050 | J | 99.4% MgO | 316 | .014 | 24 | 1500 | 250 |
| | MTC00051 | K | 96.0% MgO | 316 | .014 | 24 | 1650 | 250 |
| | MTC00052 | K | 99.4% MgO | 316 | .014 | 24 | 1650 | 250 |
| | MTC00053 | E | 96.0% MgO | 316 | .014 | 24 | 1600 | 250 |
| | MTC00054 | T | 96.0% MgO | 316 | .014 | 24 | 650 | 250 |
| | MTC00055 | J | 96.0% MgO | 310 | .014 | 24 | 1500 | 250 |
| | MTC00056 | K | 96.0% MgO | 310 | .014 | 24 | 2000 | 250 |
| | MTC00057 | R | 99.4% MgO | Alloy 600 | .020 | 24 | 2150 | 250 |
| | MTC00058 | S | 99.4% MgO | Alloy 600 | .020 | 24 | 2150 | 250 |

CONTINUED

## Single Element Standard Size List

*Continued from previous page…*

| O.D. (in.) | Part Number | ANSI Calibration | Insulation (Min. Purity) | Sheath Material | Nom. Wall Thickness (in.) | Nom. B&S Wire ga. | Max. Operating Temp. (°F) | Max. Stock Length (ft.) |
|---|---|---|---|---|---|---|---|---|
| | MTC00059 | J | 96.0% MgO | Alloy 600 | .022 | 21 | 1500 | 120 |
| | MTC00060 | J | 99.4% MgO | Alloy 600 | .022 | 21 | 1500 | 120 |
| | MTC00061 | K | 96.0% MgO | Alloy 600 | .022 | 21 | 2000 | 120 |
| | MTC00062 | K | 99.4% MgO | Alloy 600 | .022 | 21 | 2150 | 120 |
| | MTC00063 | J | 96.0% MgO | 304 | .022 | 21 | 1500 | 120 |
| | MTC00064 | J | 99.4% MgO | 304 | .022 | 21 | 1500 | 120 |
| | MTC00065 | K | 96.0% MgO | 304 | .022 | 21 | 1650 | 120 |
| | MTC00066 | K | 99.4% MgO | 304 | .022 | 21 | 1650 | 120 |
| .188 ±.002 | MTC00067 | E | 96.0% MgO | 304 | .022 | 21 | 1600 | 120 |
| | MTC00068 | T | 96.0% MgO | 304 | .022 | 21 | 650 | 120 |
| | MTC00069 | J | 96.0% MgO | 316 | .022 | 21 | 1500 | 120 |
| | MTC00070 | J | 99.4% MgO | 316 | .022 | 21 | 1500 | 120 |
| | MTC00071 | K | 96.0% MgO | 316 | .022 | 21 | 1650 | 120 |
| | MTC00072 | K | 99.4% MgO | 316 | .022 | 21 | 1650 | 120 |
| | MTC00073 | E | 96.0% MgO | 316 | .022 | 21 | 1600 | 120 |
| | MTC00074 | T | 96.0% MgO | 316 | .022 | 21 | 650 | 120 |
| | MTC00075 | J | 96.0% MgO | 310 | .022 | 21 | 1500 | 120 |
| | MTC00076 | K | 96.0% MgO | 310 | .022 | 21 | 2000 | 120 |
| | MTC00077 | J | 96.0% MgO | Alloy 600 | .029 | 18 | 1500 | 70 |
| | MTC00078 | J | 99.4% MgO | Alloy 600 | .029 | 18 | 1500 | 70 |
| | MTC00079 | K | 96.0% MgO | Alloy 600 | .029 | 18 | 2000 | 70 |
| | MTC00080 | K | 99.4% MgO | Alloy 600 | .029 | 18 | 2150 | 70 |
| | MTC00081 | J | 96.0% MgO | 304 | .029 | 18 | 1500 | 70 |
| | MTC00082 | J | 99.4% MgO | 304 | .029 | 18 | 1500 | 70 |
| | MTC00083 | K | 96.0% MgO | 304 | .029 | 18 | 1650 | 70 |
| | MTC00084 | K | 99.4% MgO | 304 | .029 | 18 | 1650 | 70 |
| .250 +.003 −.002 | MTC00085 | E | 96.0% MgO | 304 | .029 | 18 | 1600 | 70 |
| | MTC00086 | T | 96.0% MgO | 304 | .029 | 18 | 650 | 70 |
| | MTC00087 | J | 96.0% MgO | 316 | .029 | 18 | 1500 | 70 |
| | MTC00088 | J | 99.4% MgO | 316 | .029 | 18 | 1500 | 70 |
| | MTC00089 | K | 96.0% MgO | 316 | .029 | 18 | 1650 | 70 |
| | MTC00090 | K | 99.4% MgO | 316 | .029 | 18 | 1650 | 70 |
| | MTC00091 | E | 96.0% MgO | 316 | .029 | 18 | 1600 | 70 |
| | MTC00092 | T | 96.0% MgO | 316 | .029 | 18 | 650 | 70 |
| | MTC00093 | J | 96.0% MgO | 310 | .029 | 18 | 1500 | 70 |
| | MTC00094 | K | 96.0% MgO | 310 | .029 | 18 | 2000 | 70 |
| | MTC00095 | J | 96.0% MgO | Alloy 600 | .036 | 17 | 1500 | 40 |
| | MTC00096 | J | 96.0% MgO | 304 | .036 | 17 | 1500 | 40 |
| | MTC00097 | K | 96.0% MgO | Alloy 600 | .036 | 17 | 2000 | 40 |
| .313 | MTC00098 | K | 96.0% MgO | 304 | .036 | 17 | 1650 | 40 |
| +.003 | MTC00099 | E | 96.0% MgO | 304 | .036 | 17 | 1600 | 40 |
| −.002 | MTC00100 | E | 96.0% MgO | 316 | .036 | 17 | 1600 | 40 |
| | MTC00101 | J | 96.0% MgO | 316 | .036 | 17 | 1500 | 40 |
| | MTC00102 | K | 96.0% MgO | 316 | .036 | 17 | 1650 | 40 |
| | MTC00103 | J | 96.0% MgO | Alloy 600 | .045 | 15 | 1500 | 30 |
| | MTC00104 | J | 96.0% MgO | 304 | .045 | 15 | 1500 | 30 |
| .375 | MTC00105 | K | 96.0% MgO | Alloy 600 | .045 | 15 | 2000 | 30 |
| +.003 | MTC00106 | K | 96.0% MgO | 304 | .045 | 15 | 1650 | 30 |
| −.002 | MTC00107 | J | 96.0% MgO | 316 | .045 | 15 | 1500 | 30 |
| | MTC00108 | K | 96.0% MgO | 316 | .045 | 15 | 1650 | 30 |

## Mineral Insulated Thermocouple Cable

Made in USA

### Duplex Element — Diagonal Standard Size List

| O.D. (in.) | Part Number | ANSI Calibration | Insulation (Min. Purity) | Sheath Material | Nom. Wall Thickness (in.) | Nom. B&S Wire Ga. | Max. Operating Temp. (°F) | Max. Stock Length (ft.) |
|---|---|---|---|---|---|---|---|---|
| .063 ±.001 | MTC00109 | J | 99.4% MgO | Alloy 600 | .009 | 30 | 1500 | 500 |
| | MTC00110 | K | 99.4% MgO | Alloy 600 | .009 | 30 | 2000 | 500 |
| | MTC00111 | J | 99.4% MgO | 304 | .009 | 30 | 1500 | 500 |
| | MTC00112 | K | 99.4% MgO | 304 | .009 | 30 | 1650 | 500 |
| .125 ±.002 | MTC00113 | J | 96.0% MgO | Alloy 600 | .016 | 24 | 1500 | 250 |
| | MTC00114 | K | 96.0% MgO | Alloy 600 | .016 | 24 | 2000 | 250 |
| | MTC00115 | J | 96.0% MgO | 304 | .016 | 24 | 1500 | 250 |
| | MTC00116 | K | 96.0% MgO | 304 | .016 | 24 | 1650 | 250 |
| | MTC00117 | E | 96.0% MgO | 304 | .016 | 24 | 1600 | 250 |
| | MTC00118 | J | 96.0% MgO | 316 | .016 | 24 | 1500 | 250 |
| | MTC00119 | K | 96.0% MgO | 316 | .016 | 24 | 1650 | 250 |
| .188 ±.002 | MTC00120 | J | 96.0% MgO | Alloy 600 | .024 | 21 | 1500 | 120 |
| | MTC00121 | K | 96.0% MgO | Alloy 600 | .024 | 21 | 2000 | 120 |
| | MTC00122 | J | 96.0% MgO | 304 | .024 | 21 | 1500 | 120 |
| | MTC00123 | K | 96.0% MgO | 304 | .024 | 21 | 1650 | 120 |
| | MTC00124 | E | 96.0% MgO | 304 | .024 | 21 | 1600 | 120 |
| | MTC00125 | T | 96.0% MgO | 304 | .024 | 21 | 650 | 120 |
| | MTC00126 | J | 96.0% MgO | 316 | .024 | 21 | 1500 | 120 |
| | MTC00127 | K | 96.0% MgO | 316 | .024 | 21 | 1650 | 120 |
| .250 +.003 –.002 | MTC00128 | J | 96.0% MgO | Alloy 600 | .031 | 19 | 1500 | 70 |
| | MTC00129 | K | 96.0% MgO | Alloy 600 | .031 | 19 | 2000 | 70 |
| | MTC00130 | J | 96.0% MgO | 304 | .031 | 19 | 1500 | 70 |
| | MTC00131 | K | 96.0% MgO | 304 | .031 | 19 | 1650 | 70 |
| | MTC00132 | E | 96.0% MgO | 304 | .031 | 19 | 1600 | 70 |
| | MTC00133 | T | 96.0% MgO | 304 | .031 | 19 | 650 | 70 |
| | MTC00134 | J | 96.0% MgO | 316 | .031 | 19 | 1500 | 70 |
| | MTC00135 | K | 96.0% MgO | 316 | .031 | 19 | 1650 | 70 |
| .313 +.003 –.002 | MTC00136 | J | 96.0% MgO | Alloy 600 | .039 | 17 | 1500 | 40 |
| | MTC00137 | K | 96.0% MgO | Alloy 600 | .039 | 17 | 2000 | 40 |
| | MTC00138 | J | 96.0% MgO | 304 | .039 | 17 | 1500 | 40 |
| | MTC00139 | K | 96.0% MgO | 304 | .039 | 17 | 1650 | 40 |
| | MTC00140 | E | 96.0% MgO | 304 | .039 | 17 | 1600 | 40 |
| | MTC00141 | T | 96.0% MgO | 304 | .039 | 17 | 650 | 40 |
| .375 +.003 –.002 | MTC00142 | J | 96.0% MgO | Alloy 600 | .047 | 15 | 1500 | 30 |
| | MTC00143 | K | 96.0% MgO | Alloy 600 | .047 | 15 | 2000 | 30 |
| | MTC00144 | J | 96.0% MgO | 304 | .047 | 15 | 1500 | 30 |
| | MTC00145 | K | 96.0% MgO | 304 | .047 | 15 | 1650 | 30 |
| | MTC00146 | E | 96.0% MgO | 304 | .047 | 15 | 1600 | 30 |
| | MTC00147 | T | 96.0% MgO | 304 | .047 | 15 | 650 | 30 |

## Metric — Single Element Standard Size List

| O.D. (mm.) | Part Number | ANSI Calibration | Insulation (Min. Purity) | Sheath Material | Nom. Wall Thickness (mm.) | Nom. Wire Dia. (mm) | Max. Operating Temp. (°C) | Max. Stock Length (m.) |
|---|---|---|---|---|---|---|---|---|
| 1.5 ±.03 | MTC00148 | J | 99.4% MgO | Alloy 600 | 0.20 | 0.28 | 815 | 167 |
| | MTC00149 | K | 99.4% MgO | Alloy 600 | 0.20 | 0.28 | 1093 | 167 |
| | MTC00150 | J | 99.4% MgO | 304 | 0.20 | 0.28 | 815 | 167 |
| | MTC00151 | K | 99.4% MgO | 304 | 0.20 | 0.28 | 898 | 167 |
| 2.0 ±.03 | MTC00152 | J | 96.0% MgO | Alloy 600 | 0.25 | 0.36 | 815 | 93 |
| | MTC00153 | K | 96.0% MgO | Alloy 600 | 0.25 | 0.36 | 1093 | 93 |
| | MTC00154 | J | 96.0% MgO | 304 | 0.25 | 0.36 | 815 | 93 |
| | MTC00155 | K | 96.0% MgO | 304 | 0.25 | 0.36 | 898 | 93 |
| | MTC00156 | J | 96.0% MgO | 316 | 0.25 | 0.36 | 815 | 93 |
| | MTC00157 | K | 96.0% MgO | 316 | 0.25 | 0.36 | 898 | 93 |
| 3.0 ±.05 | MTC00158 | J | 96.0% MgO | Alloy 600 | 0.33 | 0.46 | 815 | 84 |
| | MTC00159 | K | 96.0% MgO | Alloy 600 | 0.33 | 0.46 | 1093 | 84 |
| | MTC00160 | J | 96.0% MgO | 304 | 0.33 | 0.46 | 815 | 84 |
| | MTC00161 | K | 96.0% MgO | 304 | 0.33 | 0.46 | 898 | 84 |
| | MTC00162 | E | 96.0% MgO | 304 | 0.33 | 0.46 | 871 | 84 |
| | MTC00163 | T | 96.0% MgO | 304 | 0.33 | 0.46 | 343 | 84 |
| | MTC00164 | J | 96.0% MgO | 316 | 0.33 | 0.46 | 815 | 84 |
| | MTC00165 | K | 96.0% MgO | 316 | 0.33 | 0.46 | 898 | 84 |
| 4.5 ±.05 | MTC00166 | J | 96.0% MgO | Alloy 600 | 0.53 | 0.69 | 815 | 37 |
| | MTC00167 | K | 96.0% MgO | Alloy 600 | 0.53 | 0.69 | 1093 | 37 |
| | MTC00168 | J | 96.0% MgO | 304 | 0.53 | 0.69 | 815 | 37 |
| | MTC00169 | K | 96.0% MgO | 304 | 0.53 | 0.69 | 898 | 37 |
| 6.0 +.07 −.05 | MTC00170 | J | 96.0% MgO | Alloy 600 | 0.69 | 0.94 | 815 | 21 |
| | MTC00171 | K | 96.0% MgO | Alloy 600 | 0.69 | 0.94 | 1093 | 21 |
| | MTC00172 | J | 96.0% MgO | 304 | 0.69 | 0.94 | 815 | 21 |
| | MTC00173 | K | 96.0% MgO | 304 | 0.69 | 0.94 | 898 | 21 |
| 8.0 +.07 −.05 | MTC00174 | J | 96.0% MgO | Alloy 600 | 0.91 | 1.22 | 815 | 12 |
| | MTC00175 | K | 96.0% MgO | Alloy 600 | 0.91 | 1.22 | 1093 | 12 |
| | MTC00176 | J | 96.0% MgO | 304 | 0.91 | 1.22 | 815 | 12 |
| | MTC00177 | K | 96.0% MgO | 304 | 0.91 | 1.22 | 898 | 12 |

## Ordering Information

### Standard Thermocouple Cable

Order by Part Number from the Lists on Pages 14-120 through 14-123.

Thermocouple wire is sold by the foot and is subject to minimum billing.

Tempco-Pak is stocked in random lengths with the maximum stock lengths listed in the tables showing the varieties of commonly available material. Tempco reserves the right to supply random lengths of our choice unless specific lengths are indicated on your order. Tempco-Pak can be furnished in coil form or in straight lengths. Normally .375" diameter and .312" diameter are shipped in straight lengths. Longer lengths are available on special order.

### Custom Manufactured Thermocouple Cables

For sizes and specifications not listed, Tempco will design and manufacture a Mineral Insulated Thermocouple Cable to meet your requirements. Please refer to the ordering worksheet on page 14-119 and follow the model as diagrammed to specify your requirements with the Tempco code number.

In addition, refer to page 14-124 and ***specify the following***:

- ❑ Configuration type
- ❑ Conductor Configuration and Size
- ❑ Sheath wall thickness
- ❑ Minimum acceptable lengths and total length required

⚠ **WARNING:** Cancer and Reproductive Harm - www.P65Warnings.ca.gov.

## Mineral Insulated Thermocouple Cable

Made in USA

# Made-To-Order Mineral-Insulated Cable

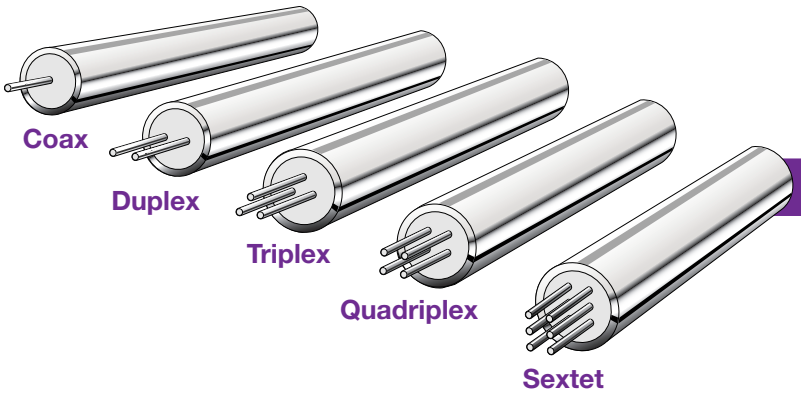
In addition to the standard line of Tempco-Pak Thermocouple Cables, we can also manufacture metal sheathed, mineral insulated cable in special configurations using a wide variety of sheath materials and conductor alloys such as copper, nickel, alloy 600, CHROMEL-A®, nickel clad copper, 304 SS and virtually any other malleable metal.

Properly selected combinations of materials (sheath, insulation and wire) will exhibit the same outstanding qualities and performance as our standard Tempco-Pak.

Shown below are standard and special Tempco-Pak configurations.

***Consult Tempco with your specific requirements.***

## Standard Tempco-Pak Configurations




## Special Tempco-Pak Configurations


## Ordering Information

**Made-To-Order Mineral-Insulated Cable**

### Custom Manufactured Mineral-Insulated Cable

Supply the following information when requesting a quotation on made-to-order mineral-insulated cable:

- ❑ Configuration type
- ❑ Sheath material
- ❑ Insulation type and purity
- ❑ Calibration type or conductor material
- ❑ Conductor configuration and size
- ❑ Sheath wall thickness
- ❑ Minimum acceptable lengths and total length required

⚠ **WARNING:** Cancer and Reproductive Harm - www.P65Warnings.ca.gov.