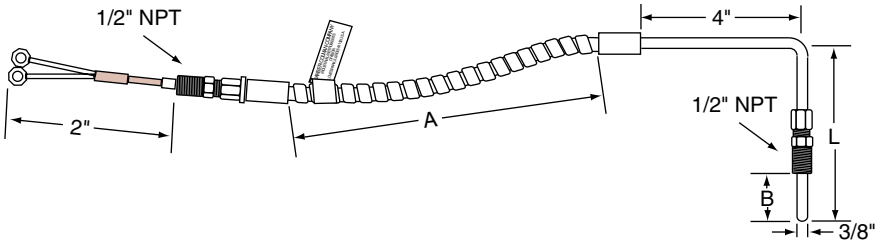
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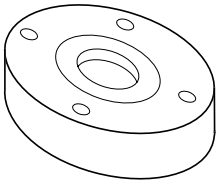
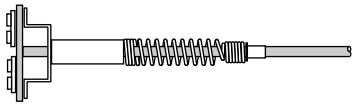
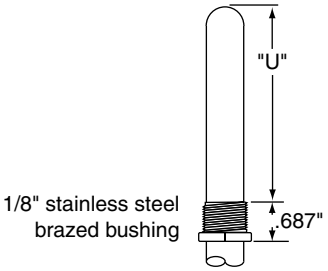
4"
2"
A
1/2" NPT
L
B
3/8"



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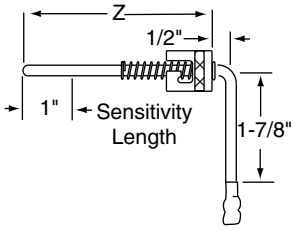
brazed bushing
.687"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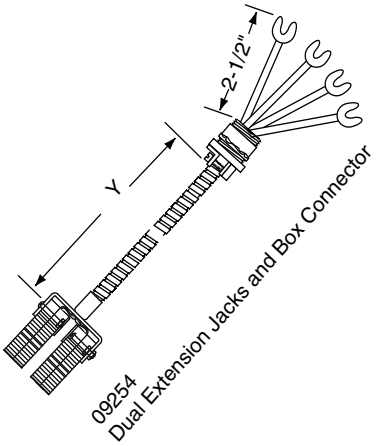
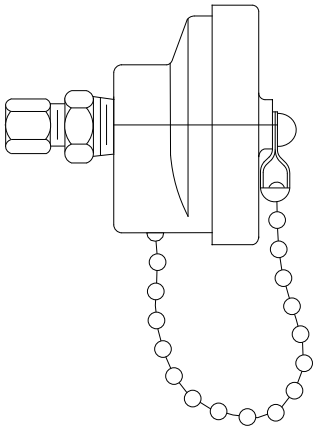
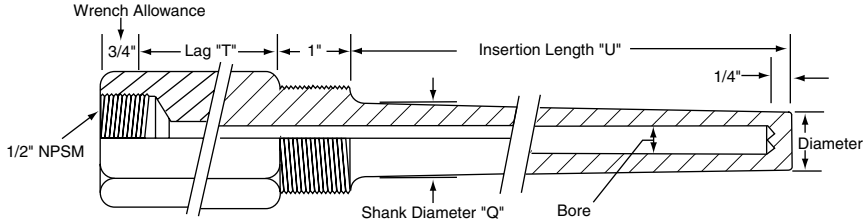
1"
Sensitivity
Length
1-7/8"


2-1/2"
Y
09254
Dual Extension Jacks and Box Connector

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Lag "T"
1"
Insertion Length "U"
1/4"
1/2" NPSM
Diameter
Shank Diameter "Q"
Bore

Identifying and Correcting Temperature Control Problems

Introduction

There are several methods of identifying and correcting temperature control problems without having special equipment or an electronics background. Usually visual indications provide clues of where the trouble may lie.

The first indication of trouble is usually when the process being controlled is either being overheated, not heating, or is alternately too hot, then too cold (wide temperature cycling).

In any of these cases, the problem may be due to the temperature sensing circuit, an indicator, or the controller.

In troubleshooting, the complete system must be considered. This includes the "thermocouple", which senses the temperature, the "indicator" which indicates the temperature and compares it with a controller, the "instrument chassis" that amplifies the error signal (difference between the setpoint and the temperature indicated) and the "final control" device. The final control device may be a contactor, SCR power controller or an electric actuator.

Since the instrument is in the control system between the temperature sensing device or thermocouple and the final control device, it's a good place to begin troubleshooting. Further, the indicator and pilot lights give a visual indication of events occuring in the control system, and may provide a clue to the exact location of the problem.

First, to eliminate the control instrument as the source of trouble, interchange it with another. If the trouble follows the instrument, the thermocouple or sensor and the final control device have been eliminated. If the trouble stays with the same zone or location, then the problem must exist outside the instrument.

The two most common sources of trouble in a typical control system are the thermocouple in the sensing portion and contactor in the control portion.

If the trouble did follow the instrument when it was interchanged with another, the instrument should be replaced with a spare and the faulty unit returned to the manufacturer for repair.

If the problem stayed at the location where it was first observed, the instrument should be observed for clues to the trouble. The indicator may be at room temperature, at control setpoint, above control point and, if observed for a time, the indicator may move up and down the scale erratically. This erratic motion may or may not be continuous. These observations can lead to a quick solution to the problem.

Troubleshooting

The following troubleshooting guide will assist in interpreting the clues furnished by the instrument, to locate problems in the temperature control system.

Corrective Action

Deteriorated Thermocouples

A deteriorated thermocouple will always cause a low reading. With base metal couples, evidence of deterioration is often visible at the hot junction. The metal may have a scaly, cracked appearance, usually accompanied by considerable discoloration or swelling. In some cases, the metal will be eroded, or partially eaten away. High temperature thermocouples of a noble metal (platinum) or the exotic type usually do not exhibit much visible

Corrective Action (continued)

evidence of deterioration (or contamination as it is sometimes called). However, platinum type thermocouples will sometimes have a frosty texture rather than a shiny surface on the wires of the element. The deteriorated couple must be replaced.

Problem	Symptom	Possible Cause
Process Overheating	Temperature indicator showing above setpoint. Heat "on" light not lit.	• Contactor • Solenoid Valve • Power Controller • Reactor • Heating Element • Current to Position Converter • Motor Operator • Valve • Burner
	Temperature indicator showing above setpoint. Heat "on" light is lit.	• Temperature Controller
	Temperature indicator showing setpoint. Heat "on" light cycling on and off. Temperature indicator showing below setpoint. Heat "on" light is lit.	• Thermocouple and Leadwire • Temperature Controller
Process Insufficiently Heating	Temperature indicator showing below setpoint. Heat "on" light is not lit.	• Temperature Controller
	Temperature indicator showing below setpoint. Heat "on" light is lit.	• Controller • Contactor • Solenoid Valve • Power Controller • Reactor • Heating Element • Current to Position Converter • Motor Operator • Valve • Burner
	Temperature indicator showing setpoint. Heat "on" light cycling on and off.	• Controller • Thermocouple and Leadwire
Process Control Temperature Wide Cycling	Temperature indicator showing setpoint. Heat "on" light cycling on and off.	• Thermocouple and Leadwire • Controller • Contactor • Solenoid Valve • Power Controller • Reactor • Heating Element • Current to Position Converter • Motor Operator • Valve • Burner

Corrective Action (continued)

Deteriorated Protection Tube

A protection tube may not exhibit visible damage, but porosity or very small holes may permit furnace atmospheres or molten metal to contaminate the thermocouple element inside. In the case of molten metal applications, the metal in the tube will be visible. In the case of atmospheric furnaces, should the thermocouple exhibit symptoms of swelling, color change (in the case of Type K couples) and crystallizing, the protection tube may be suspected of leaking. Both the protection tube and the thermocouple should be replaced.

Incorrect Thermocouple

A thermocouple of a type other than that for which the instrument is calibrated will always cause an error. Use of the wrong type leadwire will also cause an error. The amount and direction of the error will depend on the particular combination of equipment under consideration (i.e., instrument calibration, type of thermocouple and type of leadwire). The type of thermocouple for which the instrument is calibrated is marked on the scale. Identification of the thermocouple and leadwire type is not quite so simple, but they can be identified by visual examination, testing with a magnet, or both. The foremost common base metal thermocouple pairs are: Iron/Constantan, Chromel/Alumel, Copper/Constantan and Chromel/Constantan. Except for Copper, the above metals have a silvery gray appearance when surface discolorations are scraped away. This makes visual identification difficult. However, Iron is strongly magnetic, Alumel somewhat less so, and Chromel and Constantan are not magnetic at all. Therefore, a magnet can be used as follows:

1. If the positive leg is magnetic, it is Iron/Constantan.
2. If the negative leg is magnetic, it is Chromel/Alumel.
3. If neither leg is magnetic, it is most likely another type.

Incorrect Leadwire

The amount and direction of an error caused by incorrect leadwire depends on the particular combination of thermocouple and leadwire that is involved. Identification of leadwire type is usually easy since, in most cases, the I.S.A. Color Code, which is given below, will be used on the insulation.

Reversed Thermocouple Leadwire Connections

If the thermocouple leadwire connections are reversed at the thermocouple head or at the instrument, the instrument will indicate downscale when heat is applied to the thermocouple.

Any error caused by reverse connected (incorrectly polarized) leadwire will be on the low side. The amount of error may vary but it will always be a minus error. An indication that is higher than true temperature cannot be caused by incorrectly polarized leadwire.

Most leadwire is polarity color coded according to I.S.A. Standards. Regardless of the alloy type, these standards call for red insulation on a negative (-) conductor. Insulation color on the positive (+) conductor and the color of the overall sheath, if any, will vary with the type of wire. Since a few types of insulation do not lend themselves to color coding, or the original colors may have become indistinct, it is advisable not to depend entirely on the code for the determination of polarity.

If there is any doubt of polarity, use the following test:

Step 1. Disconnect the leadwire from the thermocouple, leaving the opposite end connected to the instrument.
Step 2. Twist the free ends of the wire together as if making a temporary splice.
Step 3. Heat this junction for a moment with a match, soldering iron, or other source of heat and observe which way the instrument indicator moves. If it moves upscale, the connections at the thermocouple were correct and may be replaced as they were.

Corrective Action (continued)

If the terminal connections are correct, use the following test:

Step 1. Trace thermocouple leadwire back to the instrument. Check at junction boxes for splices.
Note: Leadwire reversals which cause low readings always exist in pairs. If one reversal connection is found, look for a second.
Step 2. When a splice is found, break it and repeat the procedures in steps 1, 2 and 3 above.
Step 3. Continue to work back to the instrument. Repeat the checks until all junctions or splices have been checked and reconnected in proper polarity.

Loose Connections

Check all terminal screws to insure that they are tight. Check wires for corrosion or any varnish and clean where necessary.

Short in Thermocouple or Leadwire

When a thermocouple or its leadwire is shorted, the short becomes the new hot junction, and the instrument will record the temperature at this point.

A short in the thermocouple is usually caused by broken ceramic insulator beads, metal in the protection tube or by broken thermocouple connection heads.

A short in the thermocouple leadwire may be caused by pinched wires where they are unprotected. Frayed insulation on leadwire may be an indication that a short is present.

A partially shorted thermocouple leadwire may be caused by moisture soaked leadwire insulation. Readings will always be low. Trouble is easily identified by disconnecting the instrument and the thermocouple from the leadwire and checking for leakage between the leadwires and the conductors with an ohmmeter. If leakage is found, the wire and the conduit in which it is installed must be checked to determine the cause. Moisture inside the conduit is one possibility when non-moisture proof leadwire insulation is used. Moisture in conduit may be present in applications where high humidity exists or where conduit is run underground. If this is the case, the leadwire should be replaced with wire having moisture resistant insulation, such as polyvinyl.

Two Grounds in a Thermocouple Circuit

A thermocouple may be grounded in one place. However, when a thermocouple is grounded at two different locations, the instrument will indicate an average temperature of these two locations.

A visual inspection should be made for bad insulation, broken terminal blocks or pinched wires. Make a continuity check after ungrounding the thermocouple to see if further grounds exist. If so, remove the ground or replace defective wire or thermocouple.

Wired to Wrong Terminals

Instruments with thermocouple break protection will read upscale and can never be made to coincide with the setpoint. This is also a symptom of an open in the thermocouple circuit.

A check of the wiring in the thermocouple circuit or a continuity check should determine where the open circuit exists.

Wired to Wrong Instrument

In new installations, the thermocouple wire may be wired to the wrong instrument. In this case, the control may be erratic or the control of one instrument may be overheating while another instrument on the same application will be considerably different and that zone may be cold.

The wiring should be traced or continuity checked to insure that the wiring is correct.

Corrective Action (continued)

Thermocouple Location

The thermocouple may not be touching the bottom of the protection tube. This will result in an air gap between the thermocouple and the protection tube and will tend to insulate it somewhat. Thermocouples should be checked to insure that they are not close to a heating element nor too remote from the load.

Care should be taken in relocating thermocouples that have been installed by an equipment manufacturer. The manufacturer may have a specific reason for placing the thermocouple in the installed location.

Stray Signal Pickup

The indicator may go upscale or downscale when power is turned on to the process. First, insure that this is not a TCB offset as may occur in millivoltmeter type instruments.

Check for, and remove, all grounds except those that may occur at the thermocouple hot junction. A check should be made to insure that the thermocouple leadwire is not run in the same conduit with power wiring. If possible, the source of the stray pickup should be isolated from the thermocouple and its leadwire.

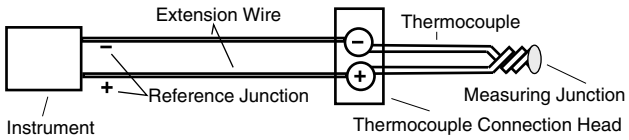
If it is found that the stray pickup cannot be isolated from the thermocouple leadwire or thermocouple, a 2 mf capacitor may be used between the thermocouple, either plus or minus and ground. It may also be found necessary to place a 2 mf capacitor between plus and minus. These capacitors should be located at the instrument terminals.

In the case of d-c voltage pickup in the thermocouple or its leadwire, all grounds should be removed from the thermocouple circuit and then the thermocouple itself grounded to eliminate the effects of this d-c pickup.

Thermocouple Applications

Thermocouple Types

A thermocouple is a temperature sensor. In its most common form it consists of two wires of different composition. The two wires are joined together at two points which have different temperatures.



One of the points is at a known temperature. This point is the reference junction. The reference junction is also often, but less preferably, called the “cold” junction. The temperature of the reference junction is held constant, or its variation is electrically compensated for in the associated measuring instrumentation.

The second junction is the measuring junction. The measuring junction is also often, but less preferably, called the “hot” junction. The measuring junction is often at an unknown temperature requiring measurement, or at a temperature at which control is required.

A thermocouple is useful for temperature sensing because a measurable electrical signal is produced. The signal is a function of the difference in temperature between the measuring and reference junctions. Numerous combinations of dissimilar metals are used as thermocouples. Some of these combinations have become relatively standard and widely accepted for a large segment of industrial temperature measurements. A specific combination is generally referred to as a type, or calibration. Most of the common calibrations have American National Standards Institute (ANSI) letter codes. These letter codes were originally established by the Instrument Society of America.

The recommended temperature range for each type is that for which limits of error are established. No guarantee is made, or implied, regarding the successful use of any of the above calibrations in their recommended range. Use of a thermocouple outside its recommended temperature range may adversely affect its reliability over its recommended range.

Numerous factors combine to determine the successful application of a particular thermocouple. Some of these factors are temperature, cycling, chemical exposure, degree of protection provided, and mechanical abuse given to the thermocouple.

Thermocouple calibrations are maintained by proper manufacturing control of each of the thermoelements. Elemental constituents are controlled to a high degree. Homogeneity must be maintained, and all wire must be properly annealed.

Extension Wire

To reduce costs when long thermocouple lengths are required, especially with the noble metal calibrations, extension leadwire extends the reference junction of the thermocouple to the instrument. For the base metal calibrations the extension wire is nominally of the same composition as the thermocouple grade material. Control in manufacturing is not to the same degree as thermocouple grade wire. With lessening rigidity of manufacturing control considerable expense can be saved. There is a limitation on the maximum temperature to which the junction of extension wire and thermocouple wire should be exposed. For the base metal calibration except Type T the maximum temperature is 400°F (204°C). For type T it is 200°F (93°C).

Extension Wire (continued)

Noble metal types R, S, B, Platinel, the Tungsten-Rhenium calibrations are used with "compensating alternate" extension wire, which means the extension wire is made of material differing in composition from the thermocouple wire, but at temperatures encountered at the thermocouple extension junction, has corresponding temperature-EMF characteristics. The maximum temperature limitations for the thermocouple extension junction for calibration types R, S, B, and Platinel is 400°F (204°C). For Tungsten/Tungsten — 26% Rhenium (W/W — 26% Re), Tungsten — 3% Rhenium/Tungsten — 25% Rhenium (W — 3% Re/W - 25% Re) it is 500°F (260°C). For W- 5% Re/W- 26% Re it is 1600°F (871°C). The reason for the temperature limitation is that the thermocouple and extension wire junction is one of the materials of differing composition, and hence another thermocouple.

Whenever extension wire is used, precautions should be taken to insure a uniform temperature exists across both thermocouple and extension wire junctions. If there is sufficient temperature gradient between the temperature and extension wire junctions and the terminals at the instrument when copper extension wire is used, appreciable error may be produced.

Thermocouple extension wires should be installed in conduit whenever possible, and the conduit should be well grounded. Never run other electrical wires in the same conduit with extension wires. Keep the extension wires at least a foot away from any AC line.

Limits of Error

Mention has been made to "limits of error" applicable to thermocouple calibrations. Limits of error pertain to the temperature deviation tolerance acceptable for the calibration. Limits of error are stated either in degrees or as a percentage of the temperature measured. Limits of error of the extension wire for the Tungsten-Rhenium calibrations are presently given in millivolts. Two levels of limits of error are published for the common calibrations: standard and special. Special limits of error are generally one-half the magnitude of standard limits of error except for calibration Type E.

Limits of error are additive. For example, when a thermocouple-extension wire junction for Type J calibration exists, the standard limits of error for the thermocouple wire below 530°F (277°C) are ±4°F (2.2°C) and for the extension wire below 400°F are ±4°F. Combined standard limits of error are ±8°F (4.4°C) and deviation from temperature-EMF tables for this combination within standard limits of error could be from 0 to Limits of error are only stated for common gauge sizes, and do not consider system errors.

Color Coding and Insulations

It is convenient to color code to identify the more common positive and negative legs of calibration. The negative thermoelement is identified by red, perhaps as a sleeving, paint, tag, or tracer in a layer of insulation.

Thermocouple and extension wire are available with either fibrous or plastic type insulation in "duplex construction." The features of this construction are that the individual thermoelements are insulated and the pair of insulated thermoelements are combined under an outer layer of insulation. Color coding is often utilized with this method of insulating, and as follows:

Color Coding and Insulations (continued)

Insulation Color Codes

Calibration	Positive Thermo-element	Negative Thermo-element	Tracer* Duplex Thermo-couple Grade Wire	Outer Insulation Duplex Extension grade Wire
J, JX	White	Red	Black	Black
K, KX	Yellow	Red	Yellow	Yellow
T, TX	Blue	Red	Blue	Blue
E, EX	Purple	Red	Purple	Purple
RS, SX	Black	Red	–	Green

*Where insulation type permits, the outer insulation layer for thermocouple grade wire is brown, the tracer is threaded through the outer layer.

All of the information related so far has been concerned with the thermoelements and their characteristics. In the normal usage of a thermocouple the thermoelements must be protected from various environments that are detrimental to the materials comprising them. Effects of attack from the environment, temperature cycling, and aging all work toward producing errors from a thermocouple.

In addition to the environmental protection required, the thermoelements must be electrically insulated from one another at all points except the measuring junction.

Electrical insulation is accomplished by various dielectric materials such as varnish, plastic, inorganic fibers, and ceramic. General temperature ratings for these insulation materials are:

Temperature Ratings for Insulation

General Insulation Type	General Maximum Temperature Rating °F
Kapton	+ 700
Nylon	+ 350
Teflon	+ 400
PVC	+ 210
Fiberglass	+ 900
Ceramic-Cordierite or Mullite	+ 1800
Ceramic-Alumina	+ 3000
Compacted Magnesia (MgO)	+ 2500

The plastic type insulations provide protection to the thermoelements from moisture or fluid contamination. They have relatively lower temperature applications compared to the inorganic fiber types. The inorganic fiber types of insulation often are furnished with moisture proofing impregnations which are burned off with exposure above 400 to 500°F Hard fired ceramic insulators are used on both base metal and noble metal calibrations. Above 2400°F alumina insulators are recommended for the noble metal calibrations. Beryllia and thoria insulators can be used with proper precautions to 4000 to 4200°F.

If wire insulation degrades to the degree that electrical contact of the two thermoelements is at a point other than the measuring junction, the signal produced by the thermocouple will be one based on the temperature difference between the reference junction and the new junction which is a secondary junction.

Protection Tubes

Additional protection of the thermoelements is often required. Numerous materials are available for the protection of a thermocouple in various industrial applications. A table listing the more readily available thermocouple protection tube materials and application data is presented in the Industrial Sensors section of this document. Data of this nature is at best only usable as a general guide. This information cannot be taken as a guarantee of adequate or successful use of any of the listed materials in any specific application because of numerous variables possible such as impurities, concentration, temperature cycling, vibration, etc.

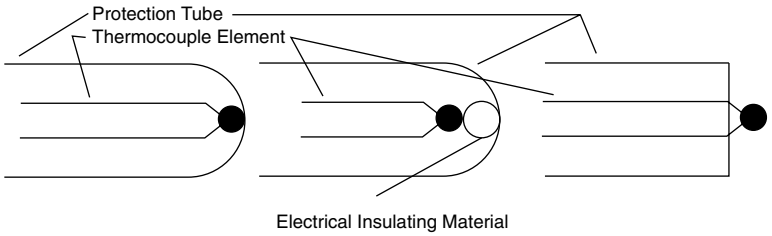
General Considerations

Numerous other materials are available that provide protection for a thermocouple. Factors such as machinability, ductility, and cost determine the availability of any of the listed materials in protection tube form. Some of these materials are available in a restricted number of tubing or pipe sizes. Others are readily available in many sizes. As mentioned earlier, the reference to a usable maximum temperature in no way insures satisfactory usage of a material in a specific application to that temperature.

In addition to the many considerations relating to calibration and protection tube material choice, a thermocouple must be located properly with respect to a work load and energy source being controlled whenever the thermocouple is used with controlling instrumentation. Considerations to keep in mind are the minimization of flow disruption caused by the sensor if it protrudes into a stream of liquid or gas; insertion into the medium being measured, either a fluid or a solid, to a sufficient depth to enable the measuring junction to respond to temperature changes of this medium rather than having it swamped by a temperature of a surrounding medium; and, under some conditions, awareness of heat flow into or out of the measuring junction due to the heat conductivity of the thermoelements and protecting materials.

In most industrial applications errors from heat flow through the sensor are negligible; but insertion depth, power source, sensor and work load placement are factors readily controllable at the system design stage. A “rule of thumb”: minimum immersion of the sensor into the fluid or medium measured should be 4 to 10 times the OD of the protection tube.

Thermocouple assemblies provided with protection tubes are available with three types of junction styles: grounded, ungrounded (isolated), and exposed.



The grounded junction is most common. This style is available on assemblies having electrically conductive protection tubes, and means the thermocouple measuring junction is in electrical contact with the protection tube. In the ungrounded junction steps are taken in manufacture to electrically isolate the measuring junction from an electrically conductive protection tube. This junction style is required when the thermocouple is used with instrumentation which is itself not internally electrically isolated. The ungrounded style junction is slower to respond than the grounded style for a given junction end mass, but it can be the most reliable and rugged style junction. The exposed junction is where the measuring junction of the thermocouple is not protected by any material. It is the fastest responding junction, but most subject to corrosive failure.

Protection Tubes (continued)

Pipe vs Tube Sizes

Pipe dimensions of 12 inches and smaller have outside diameters numerically larger than the corresponding nominal sizes, whereas outside diameters of tubes are identical to nominal sizes. Pipe is identified by its nominal size. The manufacture of pipe in the nominal sizes of 1/8" to 12", inclusive, is based on a standardized outside diameter.

Wall Thickness

Wall thickness designations of "standard," "extra strong," and "double extra strong" have been commercially used for years. Schedule numbers were subsequently added as a convenient designation for ordering pipe. Standard and Schedule 40 are identical for nominal pipe sizes up to 10", inclusive. Larger standard sizes have 3/8" wall thickness.

Extra strong and Schedule 80 are idential for nominal pipe sizes up to 8", inclusive. Larger sizes of extra strong have 1/2" wall thickness.

		Wall Thickness	
Nominal	O.D.	40	80
1/4"	0.540"	0.088"	0.119"
1/2"	0.840"	0.109"	0.147"
3/4"	1.050"	0.113"	0.154"
1"	1.315"	0.133"	0.179"

Differential Temperature (△T) Measurement with Thermocouples

Introduction

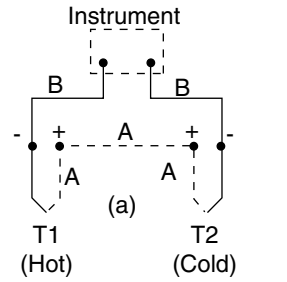
Thermocouples are often used for differential temperature (ΔT) measurement in industrial processes where the differential is of a span sufficient to generate the required signal for the associated instrumentation. Thermocouples provide a possible advantage over other sensor types where small size and ease of interchangeability are important.

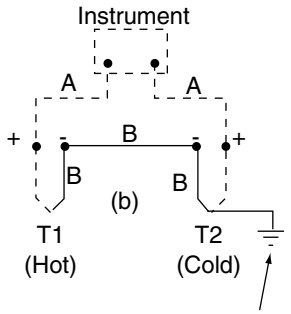
Linearity

The output of a given span is not linear for the common thermocouple calibrations. See Table 1. When the process requires ΔT measurement over only a restricted range of working temperatures, the non-linearity may not be significant. The combined limits of error in degrees for two thermocouples in ΔT measurement is equal to the square root of the sum of the squares of the individual thermocouple limits of error. For J and K calibrations, and standard limits of error for thermocouples below 530°F, the combined thermocouple error is $\pm\%\sqrt{(4)^2+(4)^2} = \pm 5.640$°F. See Table 2. Intermediate connections should be minimized in the AT thermocouple circuit to lessen the introduction of parasitic EMF's and the reduction of accuracy that can result. One, or both, of the thermocouples should be ungrounded.

Wiring

Schematic Wiring for ΔT with Thermocouples





One thermocouple grounded

Thermocouple Wire:
A (Positive) - - - - - - -
B (Negative) ————

When two thermocouples are connected for ΔT measurement either the positive or negative legs of the thermocouples are connected together, with the remaining legs connected to the instrument. There is a reversal in polarity of the differential temperature signal when the thermocouple junctions change relationship regarding the "hot' and "cold" designations. If a zero-centered span is not available on the associated instrument, then provisions must be made to reverse polarity at the instrument. Reference junction compensation is not utilized for the individual thermocouples when they are connected for ΔT measurement.

A ΔT measurement is not absolute and, as such, will not give an indication of undesirable over-temperature condition in a process. For safety considerations, an absolute temperature measurement and/or indication may be necessary when measuring a ΔT condition. In any temperature measurement, attention should be provided to selection of sensors sufficiently rugged for the environment of the process, location of the sensors, and installation details.

Table 1. Output (mV) for a 10°F Span at Various Temperatures for Common Calibrations

	Temperature Span					
Calibration	-110 to -100°F	1100 to 110°F	300 to 310°F	500 to 510°F	700 to 710°F	1000 to 1010°F
J	0.245	0.291	0.306	0.308	0.306	0.316
K	0.184	0.228	0.224	0.227	0.234	0.237
T	0.172	0.234	0.279	0.313	0.339	-—
E	0.272	0.346	0.395	0.426	0.442	0.449

Table 2. Output (mV) for a 30°F Span at Various Temperatures for Common Calibrations

	Temperature Span					
Calibration	-130 to -100°F	100 to 130°F	300 to 330°F	500 to 5300°F	700 to 730°F	1000 to -1030°F
J	0.723	0.878	0.920	0.924	0.919	0.949
K	0.543	0.686	0.669	0.683	0.702	0.710
T	0.508	0.708	0.843	1.044	1.021	—
E	0.801	1.048	1.293	1.281	1.329	1.348

REFERENCE R.B. Crawford, "Industrial Applications of Temperature Difference Measurements~ Temperature, Its Measurement and Control in Science and Industry" (Reinhold Publishing Corporation, New York, 1962. Volume 3, Part 2, PP. 91 3-925.

Type B — Platinum-6% Rhodium vs Platinum-30% Rhodium ITS-90

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	-0.002	-0.003	-0.002	0.000	0.002	0.006	0.011	0.017	0.025	0.033
100	0.033	0.043	0.053	0.065	0.078	0.092	0.107	0.123	0.141	0.159	0.178
200	0.178	0.199	0.220	0.243	0.267	0.291	0.317	0.344	0.372	0.401	0.431
300	0.431	0.462	0.494	0.527	0.561	0.596	0.632	0.669	0.707	0.746	0.787
400	0.787	0.828	0.870	0.913	0.957	1.002	1.048	1.095	1.143	1.192	1.242
500	1.242	1.293	1.344	1.397	1.451	1.505	1.561	1.617	1.675	1.733	1.792
600	1.792	1.852	1.913	1.975	2.037	2.101	2.165	2.230	2.296	2.363	2.431
700	2.431	2.499	2.569	2.639	2.710	2.782	2.854	2.928	3.002	3.078	3.154
800	3.154	3.230	3.308	3.386	3.466	3.546	3.626	3.708	3.790	3.873	3.957
900	3.957	4.041	4.127	4.213	4.299	4.387	4.475	4.564	4.653	4.743	4.834
1000	4.834	4.926	5.018	5.111	5.205	5.299	5.394	5.489	5.585	5.682	5.780
1100	5.780	5.878	5.976	6.075	6.175	6.276	6.377	6.478	6.580	6.683	6.786
1200	6.786	6.890	6.995	7.100	7.205	7.311	7.417	7.524	7.632	7.740	7.848
1300	7.848	7.957	8.066	8.176	8.286	8.397	8.508	8.620	8.731	8.844	8.956
1400	8.956	9.069	9.182	9.296	9.410	9.524	9.639	9.753	9.868	9.984	10.099
1500	10.099	10.215	10.331	10.447	10.563	10.679	10.796	10.913	11.029	11.146	11.263
1600	11.263	11.380	11.497	11.614	11.731	11.848	11.965	12.082	12.199	12.316	12.433
1700	12.433	12.549	12.666	12.782	12.898	13.014	13.130	13.246	13.361	13.476	13.591
1800	13.591	13.706	13.820								

°F	0	10	20	30	40	50	60	70	80	90	100
0				0.000	-0.001	-0.002	-0.002	-0.003	-0.002	-0.002	-0.001
100	-0.001	0.000	0.002	0.004	0.006	0.009	0.012	0.015	0.019	0.023	0.027
200	0.027	0.032	0.037	0.043	0.049	0.055	0.061	0.068	0.075	0.083	0.090
300	0.090	0.099	0.107	0.116	0.125	0.135	0.145	0.155	0.165	0.176	0.187
400	0.187	0.199	0.211	0.223	0.235	0.248	0.261	0.275	0.288	0.303	0.317
500	0.317	0.332	0.347	0.362	0.378	0.394	0.411	0.427	0.444	0.462	0.479
600	0.479	0.497	0.516	0.534	0.553	0.572	0.592	0.612	0.632	0.653	0.673
700	0.673	0.694	0.716	0.738	0.760	0.782	0.805	0.828	0.851	0.875	0.898
800	0.898	0.923	0.947	0.972	0.997	1.022	1.048	1.074	1.100	1.127	1.154
900	1.154	1.181	1.208	1.236	1.264	1.293	1.321	1.350	1.379	1.409	1.439
1000	1.439	1.469	1.499	1.530	1.561	1.592	1.624	1.655	1.687	1.720	1.752
1100	1.752	1.785	1.818	1.852	1.886	1.920	1.954	1.988	2.023	2.058	2.094
1200	2.094	2.129	2.165	2.201	2.237	2.274	2.311	2.348	2.385	2.423	2.461
1300	2.461	2.499	2.538	2.576	2.615	2.654	2.694	2.734	2.774	2.814	2.854
1400	2.854	2.895	2.936	2.978	3.019	3.061	3.103	3.145	3.188	3.230	3.273
1500	3.273	3.317	3.360	3.404	3.448	3.492	3.537	3.581	3.626	3.672	3.717
1600	3.717	3.763	3.809	3.855	3.901	3.948	3.994	4.041	4.089	4.136	4.184
1700	4.184	4.232	4.280	4.328	4.377	4.426	4.475	4.524	4.574	4.623	4.673
1800	4.673	4.723	4.774	4.824	4.875	4.926	4.977	5.028	5.080	5.132	5.184
1900	5.184	5.236	5.288	5.341	5.394	5.447	5.500	5.553	5.607	5.661	5.715
2000	5.715	5.769	5.823	5.878	5.932	5.987	6.042	6.098	6.153	6.209	6.264
2100	6.264	6.320	6.377	6.433	6.490	6.546	6.603	6.660	6.718	6.775	6.833
2200	6.833	6.890	6.948	7.006	7.065	7.123	7.182	7.240	7.299	7.358	7.417
2300	7.417	7.477	7.536	7.596	7.656	7.716	7.776	7.836	7.897	7.957	8.018
2400	8.018	8.079	8.140	8.201	8.262	8.323	8.385	8.446	8.508	8.570	8.632
2500	8.632	8.694	8.756	8.819	8.881	8.944	9.006	9.069	9.132	9.195	9.258
2600	9.258	9.321	9.385	9.448	9.511	9.575	9.639	9.702	9.766	9.830	9.894
2700	9.894	9.958	10.022	10.086	10.150	10.215	10.279	10.344	10.408	10.473	10.537
2800	10.537	10.602	10.666	10.731	10.796	10.861	10.925	10.990	11.055	11.120	11.185
2900	11.185	11.250	11.315	11.380	11.445	11.510	11.575	11.640	11.705	11.770	11.835
3000	11.835	11.900	11.965	12.030	12.095	12.160	12.225	12.290	12.355	12.420	12.484
3100	12.484	12.549	12.614	12.679	12.743	12.808	12.872	12.937	13.001	13.066	13.130
3200	13.130	13.194	13.259	13.323	13.387	13.451	13.515	13.579	13.642	13.706	13.769

Type E — Chromel vs. Constantan ITS-90

°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-8.825	-9.063	-9.274	-9.455	-9.604	-9.718	-9.797	-9.835			
-100	-5.237	-5.681	-6.107	-6.516	-6.907	-7.279	-7.632	-7.963	-8.273	-8.561	-8.825
0	0.000	-0.582	-1.152	-1.709	-2.255	-2.787	-3.306	-3.811	-4.302	-4.777	-5.237

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.591	1.192	1.801	2.420	3.048	3.685	4.330	4.985	5.648	6.319
100	6.319	6.998	7.685	8.379	9.081	9.789	10.503	11.224	11.951	12.684	13.421
200	13.421	14.164	14.912	15.664	16.420	17.181	17.945	18.713	19.484	20.259	21.036
300	21.036	21.817	22.600	23.386	24.174	24.964	25.757	26.552	27.348	28.146	28.946
400	28.946	29.747	30.550	31.354	32.159	32.965	33.772	34.579	35.387	36.196	37.005
500	37.005	37.815	38.624	39.434	40.243	41.053	41.862	42.671	43.479	44.286	45.093
600	45.093	45.900	46.705	47.509	48.313	49.116	49.917	50.718	51.517	52.315	53.112
700	53.112	53.908	54.703	55.497	56.289	57.080	57.870	58.659	59.446	60.232	61.017
800	61.017	61.801	62.583	63.364	64.144	64.922	65.698	66.473	67.246	68.017	68.787
900	68.787	69.554	70.319	71.082	71.844	72.603	73.360	74.115	74.869	75.621	76.373

°F	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-400	-9.604	-9.672	-9.729	-9.775	-9.809	-9.830					
-300	-8.404	-8.561	-8.710	-8.852	-8.986	-9.112	-9.229	-9.338	-9.436	-9.525	-9.604
-200	-6.472	-6.692	-6.907	-7.116	-7.319	-7.516	-7.707	-7.891	-8.069	-8.240	-8.404
-100	-3.976	-4.248	-4.515	-4.777	-5.035	-5.287	-5.535	-5.777	-6.014	-6.246	-6.472
0	-1.026	-1.339	-1.648	-1.953	-2.255	-2.552	-2.846	-3.135	-3.420	-3.700	-3.976

°F	0	10	20	30	40	50	60	70	80	90	100
0	-1.026	-0.709	-0.389	-0.065	0.262	0.591	0.924	1.259	1.597	1.938	2.281
100	2.281	2.628	2.977	3.330	3.685	4.042	4.403	4.766	5.131	5.500	5.871
200	5.871	6.244	6.620	6.998	7.379	7.762	8.147	8.535	8.924	9.316	9.710
300	9.710	10.106	10.503	10.903	11.305	11.708	12.113	12.520	12.929	13.339	13.751
400	13.751	14.164	14.579	14.995	15.413	15.831	16.252	16.673	17.096	17.520	17.945
500	17.945	18.371	18.798	19.227	19.656	20.086	20.517	20.950	21.383	21.817	22.252
600	22.252	22.687	23.124	23.561	23.999	24.437	24.876	25.316	25.757	26.198	26.640
700	26.640	27.082	27.525	27.969	28.413	28.857	29.302	29.747	30.193	30.639	31.086
800	31.086	31.533	31.980	32.427	32.875	33.323	33.772	34.220	34.669	35.118	35.567
900	35.567	36.016	36.466	36.915	37.365	37.815	38.265	38.714	39.164	39.614	40.064
1000	40.064	40.513	40.963	41.412	41.862	42.311	42.760	43.209	43.658	44.107	44.555
1100	44.555	45.004	45.452	45.900	46.347	46.794	47.241	47.688	48.135	48.581	49.027
1200	49.027	49.472	49.917	50.362	50.807	51.251	51.695	52.138	52.581	53.024	53.466
1300	53.466	53.908	54.350	54.791	55.232	55.673	56.113	56.553	56.992	57.431	57.870
1400	57.870	58.308	58.746	59.184	59.621	60.058	60.494	60.930	61.366	61.801	62.236
1500	62.236	62.670	63.104	63.538	63.971	64.403	64.835	65.267	65.698	66.129	66.559
1600	66.559	66.989	67.418	67.846	68.274	68.701	69.128	69.554	69.979	70.404	70.828
1700	70.828	71.252	71.675	72.097	72.518	72.939	73.360	73.780	74.199	74.618	75.036

Type C Tungsten- 5% Rhenium vs Tungsten-26% Rhenium ITS-90

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.135	0.273	0.413	0.555	0.699	0.846	0.994	1.145	1.297	1.451
100	1.451	1.608	1.766	1.926	2.087	2.251	2.415	2.582	2.750	2.919	3.090
200	3.090	3.262	3.436	3.610	3.786	3.963	4.141	4.321	4.501	4.682	4.865
300	4.865	5.048	5.232	5.417	5.603	5.789	5.976	6.164	6.353	6.542	6.732
400	6.732	6.922	7.113	7.305	7.497	7.689	7.882	8.075	8.269	8.463	8.657
500	8.657	8.851	9.046	9.241	9.436	9.631	9.827	10.022	10.218	10.413	10.609
600	10.609	10.804	10.999	11.195	11.390	11.585	11.780	11.974	12.169	12.364	12.559
700	12.559	12.753	12.947	13.141	13.335	13.529	13.723	13.916	14.109	14.301	14.494
800	14.494	14.686	14.878	15.069	15.260	15.451	15.641	15.831	16.021	16.210	16.398
900	16.398	16.587	16.775	16.962	17.149	17.335	17.521	17.707	17.892	18.076	18.260
1000	18.260	18.444	18.627	18.809	18.991	19.172	19.353	19.533	19.713	19.892	20.071
1100	20.071	20.249	20.426	20.603	20.779	20.955	21.130	21.305	21.479	21.652	21.825
1200	21.825	21.997	22.169	22.340	22.510	22.680	22.849	23.018	23.186	23.353	23.520
1300	23.520	23.686	23.852	24.017	24.181	24.345	24.508	24.671	24.833	24.994	25.155
1400	25.155	25.315	25.475	25.633	25.792	25.949	26.107	26.263	26.419	26.574	26.729
1500	26.729	26.883	27.037	27.190	27.342	27.493	27.645	27.795	27.945	28.094	28.243
1600	28.243	28.391	28.538	28.685	28.831	28.977	29.122	29.266	29.410	29.553	29.696
1700	29.696	29.838	29.979	30.120	30.260	30.399	30.538	30.676	30.813	30.950	31.087
1800	31.087	31.222	31.357	31.491	31.625	31.758	31.890	32.022	32.153	32.283	32.413
1900	32.413	32.542	32.670	32.797	32.924	33.050	33.175	33.300	33.424	33.547	33.669
2000	33.669	33.791	33.911	34.031	34.151	34.269	34.387	34.503	34.619	34.734	34.849
2100	34.849	34.962	35.074	35.186	35.296	35.406	35.515	35.623	35.730	35.836	35.940
2200	35.940	36.044	36.147	36.249	36.350	36.449	36.548	36.645	36.742	36.837	36.931
2300	36.931	37.024									

Type C Tungsten- 5% Rhenium vs Tungsten-26% Rhenium ITS-90

°F	0	10	20	30	40	50	60	70	80	90	100
0					0.060	0.135	0.211	0.288	0.366	0.444	0.523
100	0.523	0.603	0.683	0.764	0.846	0.928	1.011	1.094	1.178	1.263	1.348
200	1.348	1.434	1.521	1.608	1.695	1.784	1.872	1.962	2.051	2.142	2.232
300	2.232	2.324	2.415	2.508	2.600	2.694	2.787	2.881	2.976	3.071	3.166
400	3.166	3.262	3.358	3.455	3.552	3.649	3.747	3.845	3.943	4.042	4.141
500	4.141	4.241	4.341	4.441	4.541	4.642	4.743	4.844	4.946	5.048	5.150
600	5.150	5.252	5.355	5.458	5.620	5.721	5.822	5.924	6.026	6.128	6.231
700	6.185	6.290	6.395	6.500	6.605	6.711	6.817	6.922	7.028	7.135	7.241
800	7.241	7.347	7.454	7.561	7.668	7.775	7.882	7.989	8.097	8.204	8.312
900	8.312	8.420	8.527	8.635	8.743	8.851	8.960	9.068	9.176	9.284	9.393
1000	9.393	9.501	9.610	9.718	9.827	9.935	10.044	10.153	10.261	10.370	10.478
1100	10.478	10.587	10.696	10.804	10.913	11.021	11.130	11.238	11.346	11.455	11.563
1200	11.563	11.671	11.780	11.888	11.996	12.104	12.213	12.321	12.429	12.537	12.645
1300	12.645	12.753	12.861	12.969	13.077	13.185	13.292	13.400	13.508	13.615	13.723
1400	13.723	13.830	13.937	14.044	14.152	14.259	14.366	14.472	14.579	14.686	14.792
1500	14.792	14.899	15.005	15.112	15.218	15.324	15.430	15.535	15.641	15.747	15.852
1600	15.852	15.957	16.063	16.168	16.273	16.377	16.482	16.587	16.691	16.795	16.899
1700	16.899	17.003	17.107	17.211	17.315	17.418	17.521	17.624	17.727	17.830	17.933
1800	17.933	18.035	18.138	18.240	18.342	18.444	18.545	18.647	18.748	18.849	18.951
1900	18.951	19.051	19.152	19.253	19.353	19.453	19.553	19.653	19.753	19.852	19.952
2000	19.952	20.051	20.150	20.249	20.347	20.446	20.544	20.642	20.740	20.838	20.936
2100	20.936	21.033	21.130	21.227	21.324	21.421	21.517	21.614	21.710	21.806	21.902
2200	21.902	21.997	22.093	22.188	22.283	22.378	22.472	22.567	22.661	22.755	22.849
2300	22.849	22.943	23.037	23.130	23.223	23.316	23.409	23.502	23.594	23.686	23.778
2400	23.778	23.870	23.962	24.053	24.145	24.236	24.327	24.418	24.508	24.599	24.689
2500	24.689	24.779	24.869	24.958	25.048	25.137	25.226	25.315	25.404	25.492	25.581
2600	25.581	25.669	25.757	25.844	25.932	26.019	26.107	26.194	26.280	26.367	26.454
2700	26.454	26.540	26.626	26.712	26.798	26.883	26.968	27.054	27.139	27.223	27.308
2800	27.308	27.392	27.477	27.561	27.645	27.728	27.812	27.895	27.978	28.061	28.144
2900	28.144	28.226	28.309	28.391	28.473	28.555	28.636	28.718	28.799	28.880	28.961
3000	28.961	29.041	29.122	29.202	29.282	29.362	29.442	29.521	29.601	29.680	29.759
3100	29.759	29.838	29.916	29.995	30.073	30.151	30.229	30.306	30.384	30.461	30.538
3200	30.538	30.615	30.691	30.768	30.844	30.920	30.996	31.071	31.147	31.222	31.297
3300	31.297	31.372	31.447	31.521	31.595	31.669	31.743	31.817	31.890	31.963	32.036
3400	32.036	32.109	32.182	32.254	32.326	32.398	32.470	32.542	32.613	32.684	32.755
3500	32.755	32.825	32.896	32.966	33.036	33.106	33.175	33.245	33.314	33.383	33.451
3600	33.451	33.520	33.588	33.656	33.723	33.791	33.858	33.925	33.992	34.058	34.124
3700	34.124	34.190	34.256	34.321	34.387	34.452	34.516	34.581	34.645	34.709	34.772
3800	34.772	34.836	34.899	34.962	35.024	35.087	35.149	35.211	35.272	35.333	35.394
3900	35.394	35.455	35.515	35.575	35.635	35.694	35.753	35.812	35.871	35.929	35.987
4000	35.987	36.044	36.102	36.159	36.215	36.271	36.327	36.383	36.438	36.493	36.548
4100	36.548	36.602	36.656	36.710	36.763	36.816	36.868	36.921	36.972	37.024	37.075

Type J — *Iron vs Constantan ITS-90*

°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-7.890	-8.095									
-100	-4.633	-5.037	-5.426	-5.801	-6.159	-6.500	-6.821	-7.123	-7.403	-7.659	-7.890
0	0.000	-0.501	-0.995	-1.482	-1.961	-2.431	-2.893	-3.344	-3.786	-4.215	-4.633

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.507	1.019	1.537	2.059	2.585	3.116	3.650	4.187	4.726	5.269
100	5.269	5.814	6.360	6.909	7.459	8.010	8.562	9.115	9.669	10.224	10.779
200	10.779	11.334	11.889	12.445	13.000	13.555	14.110	14.665	15.219	15.773	16.327
300	16.327	16.881	17.434	17.986	18.538	19.090	19.642	20.194	20.745	21.297	21.848
400	21.848	22.400	22.952	23.504	24.057	24.610	25.164	25.720	26.276	26.834	27.393
500	27.393	27.953	28.516	29.080	29.647	30.216	30.788	31.362	31.939	32.519	33.102
600	33.102	33.689	34.279	34.873	35.470	36.071	36.675	37.284	37.896	38.512	39.132
700	39.132	39.755	40.382	41.012	41.645	42.281	42.919	43.559	44.203	44.848	45.494
800	45.494	46.141	46.786	47.431	48.074	48.715	49.353	49.989	50.622	51.251	51.877
900	51.877	52.500	53.119	53.735	54.347	54.956	55.561	56.164	56.763	57.360	57.953
1000	57.953	58.545	59.134	59.721	60.307	60.890	61.473	62.054	62.634	63.214	63.792
1100	63.792	64.370	64.948	65.525	66.102	66.679	67.255	67.831	68.406	68.980	69.553

°F	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-300	-7.519	-7.659	-7.791	-7.915	-8.030						
-200	-5.760	-5.962	-6.159	-6.351	-6.536	-6.716	-6.890	-7.058	-7.219	-7.373	-7.519
-100	-3.493	-3.737	-3.978	-4.215	-4.449	-4.678	-4.903	-5.125	-5.341	-5.553	-5.760
0	-0.886	-1.158	-1.428	-1.695	-1.961	-2.223	-2.483	-2.740	-2.994	-3.245	-3.493

°F	0	10	20	30	40	50	60	70	80	90	100
0	-0.886	-0.611	-0.334	-0.056	0.225	0.507	0.791	1.076	1.364	1.652	1.942
100	1.942	2.234	2.527	2.821	3.116	3.412	3.709	4.007	4.306	4.606	4.907
200	4.907	5.209	5.511	5.814	6.117	6.421	6.726	7.031	7.336	7.642	7.949
300	7.949	8.255	8.562	8.869	9.177	9.485	9.793	10.101	10.409	10.717	11.025
400	11.025	11.334	11.642	11.951	12.260	12.568	12.877	13.185	13.494	13.802	14.110
500	14.110	14.418	14.727	15.035	15.343	15.650	15.958	16.266	16.573	16.881	17.188
600	17.188	17.495	17.802	18.109	18.416	18.722	19.029	19.336	19.642	19.949	20.255
700	20.255	20.561	20.868	21.174	21.480	21.787	22.093	22.400	22.706	23.013	23.320
800	23.320	23.627	23.934	24.241	24.549	24.856	25.164	25.473	25.781	26.090	26.400
900	26.400	26.710	27.020	27.330	27.642	27.953	28.266	28.579	28.892	29.206	29.521
1000	29.521	29.836	30.153	30.470	30.788	31.106	31.426	31.746	32.068	32.390	32.713
1100	32.713	33.037	33.363	33.689	34.016	34.345	34.674	35.005	35.337	35.670	36.004
1200	36.004	36.339	36.675	37.013	37.352	37.692	38.033	38.375	38.718	39.063	39.408
1300	39.408	39.755	40.103	40.452	40.801	41.152	41.504	41.856	42.210	42.564	42.919
1400	42.919	43.274	43.631	43.988	44.346	44.705	45.064	45.423	45.782	46.141	46.500
1500	46.500	46.858	47.216	47.574	47.931	48.288	48.644	48.999	49.353	49.707	50.060
1600	50.060	50.411	50.762	51.112	51.460	51.808	52.154	52.500	52.844	53.188	53.530
1700	53.530	53.871	54.211	54.550	54.888	55.225	55.561	55.896	56.230	56.564	56.896
1800	56.896	57.227	57.558	57.888	58.217	58.545	58.872	59.199	59.526	59.851	60.177
1900	60.177	60.501	60.826	61.149	61.473	61.796	62.118	62.441	62.763	63.085	63.406
2000	63.406	63.728	64.049	64.370	64.691	65.012	65.333	65.654	65.974	66.295	66.615
2100	66.615	66.935	67.255	67.575	67.895	68.214	68.534	68.853	69.171	69.490	

Type K — *Chromel vs Alumel ITS-90*

°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-5.891	-6.035	-6.158	-6.262	-6.344	-6.404	-6.441	-6.458			
-100	-3.554	-3.852	-4.138	-4.411	-4.669	-4.913	-5.141	-5.354	-5.550	-5.730	-5.891
0	0.000	-0.392	-0.778	-1.156	-1.527	-1.889	-2.243	-2.587	-2.920	-3.243	-3.554

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.397	0.798	1.203	1.612	2.023	2.436	2.851	3.267	3.682	4.096
100	4.096	4.509	4.920	5.328	5.735	6.138	6.540	6.941	7.340	7.739	8.138
200	8.138	8.539	8.940	9.343	9.747	10.153	10.561	10.971	11.382	11.795	12.209
300	12.209	12.624	13.040	13.457	13.874	14.293	14.713	15.133	15.554	15.975	16.397
400	16.397	16.820	17.243	17.667	18.091	18.516	18.941	19.366	19.792	20.218	20.644
500	20.644	21.071	21.497	21.924	22.350	22.776	23.203	23.629	24.055	24.480	24.905
600	24.905	25.330	25.755	26.179	26.602	27.025	27.447	27.869	28.289	28.710	29.129
700	29.129	29.548	29.965	30.382	30.798	31.213	31.628	32.041	32.453	32.865	33.275
800	33.275	33.685	34.093	34.501	34.908	35.313	35.718	36.121	36.524	36.925	37.326
900	37.326	37.725	38.124	38.522	38.918	39.314	39.708	40.101	40.494	40.885	41.276
1000	41.276	41.665	42.053	42.440	42.826	43.211	43.595	43.978	44.359	44.740	45.119
1100	45.119	45.497	45.873	46.249	46.623	46.995	47.367	47.737	48.105	48.473	48.838
1200	48.838	49.202	49.565	49.926	50.286	50.644	51.000	51.355	51.708	52.060	52.410
1300	52.410	52.759	53.106	53.451	53.795	54.138	54.479	54.819			

°F	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-400	-6.344	-6.380	-6.409	-6.431	-6.446	-6.456	-6.459	-6.458	-6.455	-6.451	-6.450
-300	-5.632	-5.730	-5.822	-5.908	-5.989	-6.064	-6.133	-6.195	-6.251	-6.301	-6.344
-200	-4.381	-4.527	-4.669	-4.806	-4.939	-5.067	-5.190	-5.308	-5.421	-5.529	-5.632
-100	-2.699	-2.884	-3.065	-3.243	-3.417	-3.587	-3.754	-3.917	-4.076	-4.231	-4.381
0	-0.692	-0.905	-1.114	-1.322	-1.527	-1.729	-1.929	-2.126	-2.320	-2.511	-2.699

°F	0	10	20	30	40	50	60	70	80	90	100
0	-0.692	-0.478	-0.262	-0.044	0.176	0.397	0.619	0.843	1.068	1.294	1.521
100	1.521	1.749	1.977	2.207	2.436	2.667	2.897	3.128	3.359	3.590	3.820
200	3.820	4.050	4.280	4.509	4.738	4.965	5.192	5.419	5.644	5.869	6.094
300	6.094	6.317	6.540	6.763	6.985	7.207	7.429	7.650	7.872	8.094	8.316
400	8.316	8.539	8.761	8.985	9.208	9.432	9.657	9.882	10.108	10.334	10.561
500	10.561	10.789	11.017	11.245	11.474	11.703	11.933	12.163	12.393	12.624	12.855
600	12.855	13.086	13.318	13.549	13.782	14.014	14.247	14.479	14.713	14.946	15.179
700	15.179	15.413	15.647	15.881	16.116	16.350	16.585	16.820	17.055	17.290	17.526
800	17.526	17.761	17.997	18.233	18.469	18.705	18.941	19.177	19.414	19.650	19.887
900	19.887	20.123	20.360	20.597	20.834	21.071	21.308	21.544	21.781	22.018	22.255
1000	22.255	22.492	22.729	22.966	23.203	23.439	23.676	23.913	24.149	24.386	24.622
1100	24.622	24.858	25.094	25.330	25.566	25.802	26.037	26.273	26.508	26.743	26.978
1200	26.978	27.213	27.447	27.681	27.915	28.149	28.383	28.616	28.849	29.082	29.315
1300	29.315	29.548	29.780	30.012	30.243	30.475	30.706	30.937	31.167	31.398	31.628
1400	31.628	31.857	32.087	32.316	32.545	32.774	33.002	33.230	33.458	33.685	33.912
1500	33.912	34.139	34.365	34.591	34.817	35.043	35.268	35.493	35.718	35.942	36.166
1600	36.166	36.390	36.613	36.836	37.059	37.281	37.504	37.725	37.947	38.168	38.389
1700	38.389	38.610	38.830	39.050	39.270	39.489	39.708	39.927	40.145	40.363	40.581
1800	40.581	40.798	41.015	41.232	41.449	41.665	41.881	42.096	42.311	42.526	42.741
1900	42.741	42.955	43.169	43.382	43.595	43.808	44.020	44.232	44.444	44.655	44.866
2000	44.866	45.077	45.287	45.497	45.706	45.915	46.124	46.332	46.540	46.747	46.954
2100	46.954	47.161	47.367	47.573	47.778	47.983	48.187	48.391	48.595	48.798	49.000
2200	49.000	49.202	49.404	49.605	49.806	50.006	50.206	50.405	50.604	50.802	51.000
2300	51.000	51.198	51.395	51.591	51.787	51.982	52.177	52.371	52.565	52.759	52.952
2400	52.952	53.144	53.336	53.528	53.719	53.910	54.100	54.289	54.479	54.668	54.856

Technical Information

Type N — *Nicrosil vs. Nisil ITS-90*

°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-3.990	-4.083	-4.162	-4.226	-4.277	-4.313	-4.336	-4.345			
-100	-2.407	-2.612	-2.808	-2.994	-3.171	-3.336	-3.491	-3.634	-3.766	-3.884	-3.990
0	0.000	-0.260	-0.518	-0.772	-1.023	-1.269	-1.509	-1.744	-1.972	-2.193	-2.407

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.261	0.525	0.793	1.065	1.340	1.619	1.902	2.189	2.480	2.774
100	2.774	3.072	3.374	3.680	3.989	4.302	4.618	4.937	5.259	5.585	5.913
200	5.913	6.245	6.579	6.916	7.255	7.597	7.941	8.288	8.637	8.988	9.341
300	9.341	9.696	10.054	10.413	10.774	11.136	11.501	11.867	12.234	12.603	12.974
400	12.974	13.346	13.719	14.094	14.469	14.846	15.225	15.604	15.984	16.366	16.748
500	16.748	17.131	17.515	17.900	18.286	18.672	19.059	19.447	19.835	20.224	20.613
600	20.613	21.003	21.393	21.784	22.175	22.566	22.958	23.350	23.742	24.134	24.527
700	24.527	24.919	25.312	25.705	26.098	26.491	26.883	27.276	27.669	28.062	28.455
800	28.455	28.847	29.239	29.632	30.024	30.416	30.807	31.199	31.590	31.981	32.371
900	32.371	32.761	33.151	33.541	33.930	34.319	34.707	35.095	35.482	35.869	36.256
1000	36.256	36.641	37.027	37.411	37.795	38.179	38.562	38.944	39.326	39.706	40.087
1100	40.087	40.466	40.845	41.223	41.600	41.976	42.352	42.727	43.101	43.474	43.846
1200	43.846	44.218	44.588	44.958	45.326	45.694	46.060	46.425	46.789	47.152	47.513

°F	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
\-400	-4.277	-4.299	-4.316	-4.330	-4.339	-4.344					
-300	-3.820	-3.884	-3.945	-4.001	-4.054	-4.102	-4.145	-4.185	-4.220	-4.251	-4.277
-200	-2.974	-3.074	-3.171	-3.264	-3.354	-3.441	-3.524	-3.604	-3.679	-3.752	-3.820
-100	-1.821	-1.947	-2.072	-2.193	-2.313	-2.430	-2.544	-2.656	-2.765	-2.871	-2.974
0	-0.461	-0.603	-0.744	-0.884	-1.023	-1.160	-1.296	-1.430	-1.562	-1.692	-1.821

°F	0	10	20	30	40	50	60	70	80	90	100
0	-0.461	-0.318	-0.174	-0.029	0.116	0.261	0.407	0.555	0.703	0.853	1.004
100	1.004	1.156	1.309	1.463	1.619	1.776	1.934	2.093	2.253	2.415	2.577
200	2.577	2.741	2.906	3.072	3.240	3.408	3.578	3.748	3.920	4.093	4.267
300	4.267	4.442	4.618	4.795	4.973	5.152	5.332	5.512	5.694	5.877	6.060
400	6.060	6.245	6.430	6.616	6.803	6.991	7.179	7.369	7.559	7.750	7.941
500	7.941	8.134	8.327	8.520	8.715	8.910	9.105	9.302	9.499	9.696	9.895
600	9.895	10.093	10.293	10.493	10.693	10.894	11.096	11.298	11.501	11.704	11.907
700	11.907	12.111	12.316	12.521	12.726	12.932	13.139	13.346	13.553	13.760	13.969
800	13.969	14.177	14.386	14.595	14.804	15.014	15.225	15.435	15.646	15.857	16.069
900	16.069	16.281	16.493	16.705	16.918	17.131	17.344	17.558	17.772	17.986	18.200
1000	18.200	18.414	18.629	18.844	19.059	19.274	19.490	19.705	19.921	20.137	20.353
1100	20.353	20.570	20.786	21.003	21.220	21.437	21.654	21.871	22.088	22.305	22.523
1200	22.523	22.740	22.958	23.176	23.393	23.611	23.829	24.047	24.265	24.483	24.701
1300	24.701	24.919	25.137	25.356	25.574	25.792	26.010	26.229	26.447	26.665	26.883
1400	26.883	27.102	27.320	27.538	27.756	27.975	28.193	28.411	28.629	28.847	29.065
1500	29.065	29.283	29.501	29.719	29.937	30.154	30.372	30.590	30.807	31.025	31.242
1600	31.242	31.459	31.677	31.894	32.111	32.328	32.545	32.761	32.978	33.195	33.411
1700	33.411	33.627	33.844	34.060	34.276	34.491	34.707	34.923	35.138	35.353	35.568
1800	35.568	35.783	35.998	36.213	36.427	36.641	36.855	37.069	37.283	37.497	37.710
1900	37.710	37.923	38.136	38.349	38.562	38.774	38.986	39.198	39.410	39.622	39.833
2000	39.833	40.044	40.255	40.466	40.677	40.887	41.097	41.307	41.516	41.725	41.935
2100	41.935	42.143	42.352	42.560	42.768	42.976	43.184	43.391	43.598	43.805	44.012
2200	44.012	44.218	44.424	44.629	44.835	45.040	45.245	45.449	45.653	45.857	46.060
2300	46.060	46.263	46.466	46.668	46.870	47.071	47.272	47.473			

Type — *Nickel-0.8% Cobalt vs. Nickel-18% Molybdenum ITS-90*

°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
0	0.000	-0.365	-0.720	-1.067	-1.404	-1.732					

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.373	0.756	1.146	1.545	1.951	2.365	2.787	3.215	3.650	4.092
100	4.092	4.539	4.993	5.451	5.915	6.383	6.855	7.331	7.811	8.293	8.778
200	8.778	9.266	9.755	10.245	10.736	11.227	11.718	12.208	12.696	13.182	13.665
300	13.665	13.182	12.696	12.208	11.718	11.227	10.736	10.245	17.314	17.746	18.181
400	18.181	18.618	19.059	19.502	19.949	20.399	20.853	21.310	21.771	22.235	22.703
500	22.703	23.174	23.649	24.127	24.610	25.095	25.584	26.077	26.573	27.072	27.574
600	27.574	28.080	28.589	29.101	29.616	30.135	30.656	31.180	31.707	32.237	32.769
700	32.769	33.304	33.842	34.382	34.925	35.470	36.017	36.567	37.119	37.672	38.228
800	38.228	38.786	39.346	39.907	40.471	41.036	41.602	42.171	42.740	43.312	43.884
900	43.884	44.459	45.034	45.611	46.189	46.768	47.348	47.929	48.512	49.095	49.680
1000	49.680	50.265	50.852	51.439	52.027	52.617	53.207	53.797	54.389	54.981	55.574
1100	55.574	56.168	56.762	57.357	57.953	58.549	59.146	59.743	60.341	60.939	61.537
1200	61.537	62.135	62.734	63.333	63.931	64.530	65.129	65.728	66.326	66.925	67.523
1300	67.523	68.121	68.719	69.317	69.914	70.511	71.109	71.707	72.305	72.903	73.503

°F	0	10	20	30	40	50	60	70	80	90	100
0	-0.642	-0.444	-0.244	-0.041	0.165	0.373	0.585	0.799	1.015	1.234	1.455
100	1.455	1.679	1.906	2.134	2.365	2.599	2.834	3.072	3.311	3.553	3.797
200	3.797	4.042	4.290	4.539	4.790	5.043	5.298	5.554	5.811	6.070	6.330
300	6.330	6.592	6.855	7.119	7.384	7.650	7.918	8.186	8.455	8.724	8.995
400	8.995	9.266	9.537	9.809	10.081	10.354	10.627	10.900	11.172	11.445	11.718
500	11.718	11.990	12.262	12.533	12.804	13.074	13.343	13.612	13.879	14.144	14.409
600	14.409	14.671	14.932	15.191	15.448	15.703	15.955	16.205	16.451	16.695	16.932
700	16.932	17.170	17.410	17.650	17.891	18.132	18.375	18.618	18.863	19.108	19.354
800	19.354	19.601	19.850	20.099	20.349	20.601	20.853	21.107	21.361	21.617	21.874
900	21.874	22.131	22.390	22.651	22.912	23.174	23.437	23.702	23.968	24.234	24.502
1000	24.502	24.771	25.041	25.312	25.584	25.857	26.132	26.407	26.683	26.961	27.239
1100	27.239	27.518	27.799	28.080	28.362	28.646	28.930	29.215	29.502	29.789	30.077
1200	30.077	30.366	30.656	30.947	31.239	31.531	31.825	32.119	32.414	32.710	33.007
1300	33.007	33.304	33.603	33.902	34.202	34.503	34.804	35.106	35.409	35.713	36.017
1400	36.017	36.322	36.628	36.934	37.241	37.549	37.857	38.166	38.476	38.786	39.097
1500	39.097	39.408	39.720	40.032	40.345	40.659	40.973	41.287	41.602	41.918	42.234
1600	42.234	42.550	42.867	43.185	43.502	43.821	44.139	44.459	44.778	45.098	45.418
1700	45.418	45.739	46.060	46.381	46.703	47.025	47.348	47.671	47.994	48.318	48.641
1800	48.641	48.966	49.290	49.615	49.940	50.265	50.591	50.917	51.243	51.570	51.897
1900	51.897	52.224	52.551	52.879	53.207	53.535	53.863	54.192	54.520	54.850	55.179
2000	55.179	55.508	55.838	56.168	56.498	56.829	57.159	57.490	57.821	58.152	58.483
2100	58.483	58.814	59.146	59.478	59.809	60.141	60.473	60.806	61.138	61.470	61.803
2200	61.803	62.135	62.468	62.800	63.133	63.466	63.798	64.131	64.464	64.796	65.129
2300	65.129	65.462	65.794	66.127	66.459	66.792	67.124	67.457	67.789	68.121	68.453
2400	68.453	68.785	69.117	69.449	69.781	70.113	70.445	70.777	71.109	71.441	71.773
2500	71.773	72.105	72.438	72.770	73.103	73.436	73.770	74.104			

Type Platinel II — *Alloy 5355 vs Alloy 7674 ITS-90*

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.302	0.610	0.925	1.247	1.575	1.908	2.248	2.593	2.944	3.300
100	3.300	3.661	4.028	4.399	4.774	5.154	5.538	5.926	6.319	6.715	7.115
200	7.115	7.518	7.924	8.334	8.747	9.163	9.581	10.003	10.427	10.853	11.281
300	11.281	11.712	12.145	12.580	13.016	13.454	13.894	14.335	14.778	15.222	15.667
400	15.667	16.113	16.560	17.008	17.456	17.905	18.355	18.806	19.256	19.707	20.158
500	20.158	20.610	21.061	21.512	21.963	22.414	22.865	23.315	23.765	24.214	24.663
600	24.663	25.111	25.558	26.005	26.450	26.895	27.338	27.781	28.222	28.662	29.101
700	29.101	29.538	29.974	30.408	30.841	31.272	31.702	32.130	32.557	32.982	33.406
800	33.406	33.828	34.249	34.668	35.086	35.502	35.916	36.328	36.739	37.148	37.556
900	37.556	37.961	38.365	38.767	39.167	39.565	39.962	40.356	40.749	41.140	41.529
1000	41.529	41.915	42.300	42.683	43.064	43.443	43.820	44.195	44.568	44.939	45.308
1100	45.308	45.675	46.040	46.403	46.764	47.123	47.480	47.835	48.187	48.538	48.887
1200	48.887	49.233	49.578	49.920	50.261	50.599	50.935	51.269	51.601	51.931	52.258
1300	52.258	52.584	52.907	53.228	53.546	53.863	54.177	54.488	54.798	55.104	

°F	0	10	20	30	40	50	60	70	80	90	100
0					0.133	0.302	0.472	0.645	0.820	0.996	1.175
100	1.175	1.355	1.538	1.722	1.908	2.096	2.286	2.478	2.671	2.866	3.062
200	3.062	3.260	3.460	3.661	3.864	4.069	4.274	4.482	4.690	4.900	5.111
300	5.111	5.324	5.538	5.753	5.970	6.188	6.406	6.626	6.848	7.070	7.293
400	7.293	7.518	7.743	7.970	8.197	8.426	8.655	8.885	9.117	9.349	9.581
500	9.581	9.815	10.050	10.285	10.521	10.758	10.995	11.234	11.473	11.712	11.952
600	11.952	12.193	12.434	12.676	12.919	13.162	13.405	13.649	13.894	14.139	14.384
700	14.384	14.630	14.876	15.123	15.370	15.617	15.865	16.113	16.361	16.609	16.858
800	16.858	17.107	17.356	17.606	17.855	18.105	18.355	18.605	18.856	19.106	19.356
900	19.356	19.607	19.858	20.108	20.359	20.610	20.860	21.111	21.362	21.613	21.863
1000	21.863	22.114	22.364	22.615	22.865	23.115	23.365	23.615	23.865	24.115	24.364
1100	24.364	24.613	24.862	25.111	25.360	25.608	25.856	26.104	26.351	26.599	26.845
1200	26.845	27.092	27.338	27.584	27.830	28.075	28.320	28.564	28.808	29.052	29.295
1300	29.295	29.538	29.780	30.022	30.264	30.505	30.745	30.985	31.225	31.463	31.702
1400	31.702	31.940	32.178	32.415	32.652	32.888	33.124	33.359	33.594	33.828	34.062
1500	34.062	34.296	34.529	34.761	34.993	35.225	35.456	35.686	35.916	36.145	36.374
1600	36.374	36.603	36.830	37.058	37.284	37.511	37.736	37.961	38.186	38.410	38.633
1700	38.633	38.856	39.078	39.300	39.521	39.742	39.962	40.181	40.400	40.618	40.836
1800	40.836	41.053	41.270	41.485	41.701	41.915	42.129	42.343	42.556	42.768	42.980
1900	42.980	43.191	43.401	43.611	43.820	44.029	44.237	44.444	44.651	44.857	45.063
2000	45.063	45.267	45.472	45.675	45.878	46.081	46.282	46.484	46.684	46.884	47.083
2100	47.083	47.282	47.480	47.677	47.874	48.070	48.265	48.460	48.654	48.848	49.041
2200	49.041	49.233	49.425	49.616	49.806	49.996	50.185	50.374	50.561	50.748	50.935
2300	50.935	51.121	51.306	51.490	51.674	51.858	52.040	52.222	52.403	52.584	52.763
2400	52.763	52.942	53.121	53.299	53.476	53.652	53.828	54.003	54.177	54.350	54.523
2500	54.523	54.695	54.866	55.036	55.206	55.375	55.543	55.710	55.876	56.042	56.207

Type R — *Platinum vs. Platinum-13% Rodium ITS-90*

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.054	0.111	0.171	0.232	0.296	0.363	0.431	0.501	0.573	0.647
100	0.647	0.723	0.800	0.879	0.959	1.041	1.124	1.208	1.294	1.381	1.469
200	1.469	1.558	1.648	1.739	1.831	1.923	2.017	2.112	2.207	2.304	2.401
300	2.401	2.498	2.597	2.696	2.796	2.896	2.997	3.099	3.201	3.304	3.408
400	3.408	3.512	3.616	3.721	3.827	3.933	4.040	4.147	4.255	4.363	4.471
500	4.471	4.580	4.690	4.800	4.910	5.021	5.133	5.245	5.357	5.470	5.583
600	5.583	5.697	5.812	5.926	6.041	6.157	6.273	6.390	6.507	6.625	6.743
700	6.743	6.861	6.980	7.100	7.220	7.340	7.461	7.583	7.705	7.827	7.950
800	7.950	8.073	8.197	8.321	8.446	8.571	8.697	8.823	8.950	9.077	9.205
900	9.205	9.333	9.461	9.590	9.720	9.850	9.980	10.111	10.242	10.374	10.506
1000	10.506	10.638	10.771	10.905	11.039	11.173	11.307	11.442	11.578	11.714	11.850
1100	11.850	11.986	12.123	12.260	12.397	12.535	12.673	12.812	12.950	13.089	13.228
1200	13.228	13.367	13.507	13.646	13.786	13.926	14.066	14.207	14.347	14.488	14.629
1300	14.629	14.770	14.911	15.052	15.193	15.334	15.475	15.616	15.758	15.899	16.040
1400	16.040	16.181	16.323	16.464	16.605	16.746	16.887	17.028	17.169	17.310	17.451
1500	17.451	17.591	17.732	17.872	18.012	18.152	18.292	18.431	18.571	18.710	18.849
1600	18.849	18.988	19.126	19.264	19.402	19.540	19.677	19.814	19.951	20.087	20.222
1700	20.222	20.356	20.488	20.620	20.749	20.877	21.003				

°F	0	10	20	30	40	50	60	70	80	90	100
0	-0.090	-0.063	-0.035	-0.006	0.024	0.054	0.086	0.118	0.151	0.184	0.218
100	0.218	0.254	0.289	0.326	0.363	0.400	0.439	0.478	0.517	0.557	0.598
200	0.598	0.639	0.681	0.723	0.766	0.809	0.853	0.897	0.941	0.986	1.032
300	1.032	1.078	1.124	1.171	1.218	1.265	1.313	1.361	1.410	1.459	1.508
400	1.508	1.558	1.607	1.658	1.708	1.759	1.810	1.861	1.913	1.965	2.017
500	2.017	2.070	2.122	2.175	2.229	2.282	2.336	2.390	2.444	2.498	2.553
600	2.553	2.608	2.663	2.718	2.773	2.829	2.885	2.941	2.997	3.054	3.110
700	3.110	3.167	3.224	3.281	3.339	3.396	3.454	3.512	3.570	3.628	3.686
800	3.686	3.745	3.803	3.862	3.921	3.980	4.040	4.099	4.159	4.219	4.279
900	4.279	4.339	4.399	4.459	4.520	4.580	4.641	4.702	4.763	4.824	4.886
1000	4.886	4.947	5.009	5.071	5.133	5.195	5.257	5.320	5.382	5.445	5.508
1100	5.508	5.571	5.634	5.697	5.761	5.824	5.888	5.952	6.016	6.080	6.144
1200	6.144	6.209	6.273	6.338	6.403	6.468	6.533	6.598	6.664	6.730	6.795
1300	6.795	6.861	6.927	6.994	7.060	7.126	7.193	7.260	7.327	7.394	7.461
1400	7.461	7.529	7.596	7.664	7.732	7.800	7.868	7.936	8.005	8.073	8.142
1500	8.142	8.211	8.280	8.349	8.418	8.488	8.557	8.627	8.697	8.767	8.837
1600	8.837	8.908	8.978	9.049	9.120	9.191	9.262	9.333	9.404	9.476	9.547
1700	9.547	9.619	9.691	9.763	9.835	9.908	9.980	10.053	10.126	10.198	10.271
1800	10.271	10.345	10.418	10.491	10.565	10.638	10.712	10.786	10.860	10.934	11.009
1900	11.009	11.083	11.158	11.233	11.307	11.382	11.457	11.533	11.608	11.683	11.759
2000	11.759	11.834	11.910	11.986	12.062	12.138	12.214	12.291	12.367	12.443	12.520
2100	12.520	12.597	12.673	12.750	12.827	12.904	12.981	13.058	13.135	13.213	13.290
2200	13.290	13.367	13.445	13.522	13.600	13.677	13.755	13.833	13.911	13.989	14.066
2300	14.066	14.144	14.222	14.300	14.379	14.457	14.535	14.613	14.691	14.770	14.848
2400	14.848	14.926	15.005	15.083	15.161	15.240	15.318	15.397	15.475	15.553	15.632
2500	15.632	15.710	15.789	15.867	15.946	16.024	16.103	16.181	16.260	16.338	16.417
2600	16.417	16.495	16.574	16.652	16.731	16.809	16.887	16.966	17.044	17.122	17.200
2700	17.200	17.279	17.357	17.435	17.513	17.591	17.669	17.747	17.825	17.903	17.981
2800	17.981	18.059	18.137	18.214	18.292	18.369	18.447	18.524	18.602	18.679	18.756
2900	18.756	18.834	18.911	18.988	19.065	19.141	19.218	19.295	19.372	19.448	19.525
3000	19.525	19.601	19.677	19.753	19.829	19.905	19.981	20.056	20.132	20.207	20.281
3100	20.281	20.356	20.430	20.503	20.576	20.649	20.721	20.792	20.863	20.933	21.003

Type S — Platinum vs. Platinum-10% Rhodium ITS-90

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.055	0.113	0.173	0.235	0.299	0.365	0.433	0.502	0.573	0.646
100	0.646	0.720	0.795	0.872	0.950	1.029	1.110	1.191	1.273	1.357	1.441
200	1.441	1.526	1.612	1.698	1.786	1.874	1.962	2.052	2.141	2.232	2.323
300	2.323	2.415	2.507	2.599	2.692	2.786	2.880	2.974	3.069	3.164	3.259
400	3.259	3.355	3.451	3.548	3.645	3.742	3.840	3.938	4.036	4.134	4.233
500	4.233	4.332	4.432	4.532	4.632	4.732	4.833	4.934	5.035	5.137	5.239
600	5.239	5.341	5.443	5.546	5.649	5.753	5.857	5.961	6.065	6.170	6.275
700	6.275	6.381	6.486	6.593	6.699	6.806	6.913	7.020	7.128	7.236	7.345
800	7.345	7.454	7.563	7.673	7.783	7.893	8.003	8.114	8.226	8.337	8.449
900	8.449	8.562	8.674	8.787	8.900	9.014	9.128	9.242	9.357	9.472	9.587
1000	9.587	9.703	9.819	9.935	10.051	10.168	10.285	10.403	10.520	10.638	10.757
1100	10.757	10.875	10.994	11.113	11.232	11.351	11.471	11.590	11.710	11.830	11.951
1200	11.951	12.071	12.191	12.312	12.433	12.554	12.675	12.796	12.917	13.038	13.159
1300	13.159	13.280	13.402	13.523	13.644	13.766	13.887	14.009	14.130	14.251	14.373
1400	14.373	14.494	14.615	14.736	14.857	14.978	15.099	15.220	15.341	15.461	15.582
1500	15.582	15.702	15.822	15.942	16.062	16.182	16.301	16.420	16.539	16.658	16.777
1600	16.777	16.895	17.013	17.131	17.249	17.366	17.483	17.600	17.717	17.832	17.947
1700	17.947	18.061	18.174	18.285	18.395	18.503	18.609				

°F	0	10	20	30	40	50	60	70	80	90	100
0	-0.092	-0.064	-0.035	-0.006	0.024	0.055	0.087	0.119	0.153	0.186	0.221
100	0.221	0.256	0.292	0.328	0.365	0.402	0.440	0.479	0.518	0.557	0.597
200	0.597	0.638	0.679	0.720	0.762	0.804	0.847	0.889	0.933	0.977	1.021
300	1.021	1.065	1.110	1.155	1.200	1.246	1.292	1.338	1.385	1.431	1.478
400	1.478	1.526	1.573	1.621	1.669	1.718	1.766	1.815	1.864	1.913	1.962
500	1.962	2.012	2.062	2.111	2.162	2.212	2.262	2.313	2.364	2.415	2.466
600	2.466	2.517	2.568	2.620	2.672	2.723	2.775	2.827	2.880	2.932	2.985
700	2.985	3.037	3.090	3.143	3.196	3.249	3.302	3.355	3.409	3.462	3.516
800	3.516	3.570	3.623	3.677	3.731	3.786	3.840	3.894	3.949	4.003	4.058
900	4.058	4.113	4.167	4.222	4.277	4.332	4.388	4.443	4.498	4.554	4.610
1000	4.610	4.665	4.721	4.777	4.833	4.889	4.945	5.001	5.058	5.114	5.171
1100	5.171	5.227	5.284	5.341	5.398	5.455	5.512	5.569	5.627	5.684	5.741
1200	5.741	5.799	5.857	5.915	5.972	6.030	6.089	6.147	6.205	6.264	6.322
1300	6.322	6.381	6.439	6.498	6.557	6.616	6.675	6.735	6.794	6.853	6.913
1400	6.913	6.973	7.032	7.092	7.152	7.212	7.273	7.333	7.393	7.454	7.514
1500	7.514	7.575	7.636	7.697	7.758	7.819	7.881	7.942	8.003	8.065	8.127
1600	8.127	8.189	8.250	8.312	8.375	8.437	8.499	8.562	8.624	8.687	8.749
1700	8.749	8.812	8.875	8.938	9.001	9.065	9.128	9.192	9.255	9.319	9.382
1800	9.382	9.446	9.510	9.574	9.638	9.703	9.767	9.831	9.896	9.961	10.025
1900	10.025	10.090	10.155	10.220	10.285	10.350	10.416	10.481	10.547	10.612	10.678
2000	10.678	10.743	10.809	10.875	10.941	11.007	11.073	11.139	11.205	11.272	11.338
2100	11.338	11.404	11.471	11.537	11.604	11.670	11.737	11.804	11.870	11.937	12.004
2200	12.004	12.071	12.138	12.205	12.272	12.339	12.406	12.473	12.540	12.607	12.675
2300	12.675	12.742	12.809	12.876	12.944	13.011	13.078	13.146	13.213	13.280	13.348
2400	13.348	13.415	13.483	13.550	13.617	13.685	13.752	13.820	13.887	13.955	14.022
2500	14.022	14.089	14.157	14.224	14.292	14.359	14.426	14.494	14.561	14.629	14.696
2600	14.696	14.763	14.830	14.898	14.965	15.032	15.099	15.166	15.233	15.300	15.367
2700	15.367	15.434	15.501	15.568	15.635	15.702	15.769	15.835	15.902	15.969	16.035
2800	16.035	16.102	16.168	16.235	16.301	16.367	16.434	16.500	16.566	16.632	16.698
2900	16.698	16.764	16.829	16.895	16.961	17.026	17.092	17.157	17.223	17.288	17.353
3000	17.353	17.418	17.483	17.548	17.613	17.678	17.742	17.807	17.871	17.935	17.998
3100	17.998	18.061	18.124	18.187	18.248	18.310	18.371	18.431	18.491	18.551	18.609
3200	18.609	18.667									

Type T — Copper vs. Constantan ITS-90

°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-200	-5.603	-5.753	-5.888	-6.007	-6.105	-6.180	-6.232	-6.258			
-100	-3.379	-3.657	-3.923	-4.177	-4.419	-4.648	-4.865	-5.070	-5.261	-5.439	-5.603
0	0.000	-0.383	-0.757	-1.121	-1.475	-1.819	-2.153	-2.476	-2.788	-3.089	-3.379

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.391	0.790	1.196	1.612	2.036	2.468	2.909	3.358	3.814	4.279
100	4.279	4.750	5.228	5.714	6.206	6.704	7.209	7.720	8.237	8.759	9.288
200	9.288	9.822	10.362	10.907	11.458	12.013	12.574	13.139	13.709	14.283	14.862
300	14.862	15.445	16.032	16.624	17.219	17.819	18.422	19.030	19.641	20.255	20.872

°F	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-400	-6.105	-6.150	-6.187	-6.217	-6.240	-6.254					
-300	-5.341	-5.439	-5.532	-5.620	-5.705	-5.785	-5.860	-5.930	-5.994	-6.053	-6.105
-200	-4.149	-4.286	-4.419	-4.548	-4.673	-4.794	-4.912	-5.025	-5.135	-5.240	-5.341
-100	-2.581	-2.754	-2.923	-3.089	-3.251	-3.410	-3.565	-3.717	-3.865	-4.009	-4.149
0	-0.675	-0.879	-1.081	-1.279	-1.475	-1.667	-1.857	-2.043	-2.225	-2.405	-2.581

°F	0	10	20	30	40	50	60	70	80	90	100
0	-0.675	-0.467	-0.256	-0.043	0.173	0.391	0.611	0.834	1.060	1.288	1.519
100	1.519	1.752	1.988	2.227	2.468	2.712	2.958	3.207	3.459	3.712	3.968
200	3.968	4.227	4.487	4.750	5.015	5.282	5.551	5.823	6.096	6.371	6.648
300	6.648	6.928	7.209	7.492	7.777	8.064	8.352	8.643	8.935	9.229	9.525
400	9.525	9.822	10.122	10.423	10.725	11.029	11.335	11.643	11.951	12.262	12.574
500	12.574	12.887	13.202	13.518	13.836	14.155	14.476	14.797	15.121	15.445	15.771
600	15.771	16.098	16.426	16.756	17.086	17.418	17.752	18.086	18.422	18.759	19.097
700	19.097	19.437	19.777	20.118	20.460	20.803					

Type Tungsten-3% Rhenium vs Tungsten-25% Rhenium ITS-90

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.098	0.200	0.305	0.415	0.528	0.645	0.765	0.888	1.015	1.145
100	1.145	1.278	1.415	1.554	1.696	1.841	1.988	2.138	2.290	2.445	2.603
200	2.603	2.762	2.924	3.088	3.253	3.421	3.591	3.762	3.936	4.111	4.287
300	4.287	4.465	4.645	4.826	5.009	5.192	5.378	5.564	5.752	5.940	6.130
400	6.130	6.321	6.513	6.706	6.899	7.094	7.289	7.485	7.682	7.880	8.078
500	8.078	8.277	8.476	8.676	8.877	9.078	9.279	9.481	9.683	9.885	10.088
600	10.088	10.291	10.494	10.698	10.901	11.105	11.309	11.512	11.716	11.921	12.125
700	12.125	12.329	12.533	12.737	12.942	13.146	13.351	13.555	13.760	13.965	14.170
800	14.170	14.375	14.580	14.784	14.989	15.193	15.398	15.602	15.805	16.009	16.212
900	16.212	16.415	16.618	16.821	17.023	17.225	17.427	17.628	17.829	18.029	18.230
1000	18.230	18.430	18.629	18.828	19.027	19.225	19.423	19.621	19.818	20.014	20.211
1100	20.211	20.406	20.602	20.797	20.991	21.185	21.379	21.572	21.765	21.957	22.149
1200	22.149	22.340	22.531	22.721	22.911	23.100	23.289	23.477	23.665	23.853	24.040
1300	24.040	24.226	24.412	24.598	24.783	24.967	25.151	25.335	25.517	25.700	25.882
1400	25.882	26.063	26.244	26.425	26.605	26.784	26.963	27.141	27.319	27.497	27.673
1500	27.673	27.850	28.026	28.201	28.375	28.550	28.723	28.896	29.069	29.241	29.412
1600	29.412	29.583	29.753	29.923	30.092	30.260	30.428	30.595	30.762	30.928	31.093
1700	31.093	31.258	31.422	31.586	31.749	31.911	32.072	32.233	32.393	32.553	32.712
1800	32.712	32.870	33.027	33.183	33.339	33.494	33.648	33.802	33.954	34.106	34.257
1900	34.257	34.407	34.556	34.705	34.852	34.999	35.144	35.289	35.433	35.575	35.717
2000	35.717	35.858	35.997	36.136	36.273	36.409	36.544	36.678	36.811	36.942	37.073
2100	37.073	37.202	37.329	37.456	37.580	37.704	37.826	37.947	38.066	38.183	38.299
2200	38.299	38.414	38.527	38.638	38.747	38.855	38.961	39.065	39.167	39.267	39.365

Type Tungsten-3% Rhenium vs Tungsten-25% Rhenium ITS-90

°F	0	10	20	30	40	50	60	70	80	90	100
0					0.043	0.098	0.154	0.211	0.270	0.329	0.390
100	0.390	0.452	0.515	0.579	0.645	0.711	0.778	0.847	0.916	0.987	1.058
200	1.058	1.131	1.204	1.278	1.354	1.430	1.507	1.585	1.664	1.744	1.824
300	1.824	1.906	1.988	2.071	2.155	2.239	2.325	2.411	2.497	2.585	2.673
400	2.673	2.762	2.852	2.942	3.033	3.124	3.216	3.309	3.402	3.496	3.591
500	3.591	3.686	3.781	3.878	3.974	4.071	4.169	4.267	4.366	4.465	4.565
600	4.565	4.665	4.766	4.866	4.968	5.070	5.172	5.275	5.378	5.481	5.585
700	5.585	5.689	5.793	5.898	6.003	6.109	6.215	6.321	6.427	6.534	6.641
800	6.641	6.749	6.856	6.964	7.072	7.181	7.289	7.398	7.507	7.617	7.726
900	7.726	7.836	7.946	8.056	8.167	8.277	8.388	8.499	8.610	8.721	8.832
1000	8.832	8.944	9.055	9.167	9.279	9.391	9.503	9.616	9.728	9.840	9.953
1100	9.953	10.066	10.178	10.291	10.404	10.517	10.630	10.743	10.856	10.969	11.082
1200	11.082	11.195	11.309	11.422	11.535	11.648	11.762	11.875	11.989	12.102	12.215
1300	12.215	12.329	12.442	12.556	12.669	12.783	12.896	13.010	13.123	13.237	13.351
1400	13.351	13.464	13.578	13.692	13.806	13.920	14.033	14.147	14.261	14.375	14.489
1500	14.489	14.603	14.716	14.830	14.944	15.057	15.171	15.284	15.398	15.511	15.624
1600	15.624	15.737	15.851	15.964	16.077	16.190	16.303	16.415	16.528	16.641	16.753
1700	16.753	16.866	16.978	17.090	17.203	17.315	17.427	17.538	17.650	17.762	17.873
1800	17.873	17.985	18.096	18.207	18.319	18.430	18.540	18.651	18.762	18.872	18.983
1900	18.983	19.093	19.203	19.313	19.423	19.533	19.643	19.752	19.861	19.971	20.080
2000	20.080	20.189	20.298	20.406	20.515	20.624	20.732	20.840	20.948	21.056	21.164
2100	21.164	21.271	21.379	21.486	21.593	21.700	21.807	21.914	22.021	22.127	22.234
2200	22.234	22.340	22.446	22.552	22.658	22.763	22.869	22.974	23.079	23.184	23.289
2300	23.289	23.394	23.498	23.603	23.707	23.811	23.915	24.019	24.123	24.226	24.330
2400	24.330	24.433	24.536	24.639	24.742	24.844	24.947	25.049	25.151	25.253	25.355
2500	25.355	25.457	25.558	25.659	25.761	25.862	25.963	26.063	26.164	26.264	26.365
2600	26.365	26.465	26.565	26.665	26.764	26.864	26.963	27.062	27.161	27.260	27.359
2700	27.359	27.457	27.556	27.654	27.752	27.850	27.947	28.045	28.142	28.240	28.337
2800	28.337	28.434	28.530	28.627	28.723	28.819	28.915	29.011	29.107	29.202	29.298
2900	29.298	29.393	29.488	29.583	29.677	29.772	29.866	29.960	30.054	30.148	30.241
3000	30.241	30.335	30.428	30.521	30.614	30.706	30.799	30.891	30.983	31.075	31.167
3100	31.167	31.258	31.349	31.440	31.531	31.622	31.713	31.803	31.893	31.983	32.072
3200	32.072	32.162	32.251	32.340	32.429	32.517	32.606	32.694	32.782	32.870	32.957
3300	32.957	33.044	33.131	33.218	33.305	33.391	33.477	33.563	33.648	33.734	33.819
3400	33.819	33.904	33.988	34.073	34.157	34.240	34.324	34.407	34.490	34.573	34.655
3500	34.655	34.738	34.820	34.901	34.983	35.064	35.144	35.225	35.305	35.385	35.464
3600	35.464	35.544	35.623	35.701	35.780	35.858	35.935	36.013	36.090	36.166	36.243
3700	36.243	36.319	36.394	36.469	36.544	36.619	36.693	36.767	36.840	36.913	36.986
3800	36.986	37.058	37.130	37.202	37.273	37.343	37.414	37.483	37.553	37.622	37.690
3900	37.690	37.758	37.826	37.893	37.960	38.026	38.092	38.157	38.222	38.287	38.351
4000	38.351	38.414	38.477	38.539	38.601	38.662	38.723	38.783	38.843	38.902	38.961
4100	38.961	39.019	39.076	39.133	39.189	39.245	39.300	39.354	39.408	39.461	39.514

Type *Tungsten vs Tungsten-26% Rhenium* *ITS-90*

°C	0	10	20	30	40	50	60	70	80	90	100
0	0.000	0.015	0.034	0.058	0.085	0.117	0.152	0.192	0.235	0.282	0.333
100	0.333	0.388	0.446	0.508	0.573	0.642	0.715	0.790	0.869	0.951	1.037
200	1.037	1.125	1.217	1.311	1.409	1.509	1.613	1.719	1.828	1.940	2.055
300	2.055	2.172	2.292	2.414	2.539	2.666	2.796	2.928	3.063	3.200	3.339
400	3.339	3.480	3.624	3.769	3.917	4.067	4.219	4.372	4.528	4.685	4.845
500	4.845	5.006	5.169	5.334	5.500	5.668	5.837	6.008	6.181	6.355	6.531
600	6.531	6.707	6.886	7.065	7.246	7.428	7.611	7.796	7.982	8.169	8.357
700	8.357	8.546	8.737	8.928	9.120	9.314	9.508	9.704	9.900	10.097	10.295
800	10.295	10.494	10.694	10.894	11.095	11.297	11.500	11.703	11.907	12.111	12.316
900	12.316	12.522	12.728	12.934	13.141	13.349	13.557	13.765	13.974	14.183	14.392
1000	14.392	14.602	14.812	15.022	15.232	15.443	15.654	15.865	16.076	16.287	16.498
1100	16.498	16.710	16.921	17.133	17.345	17.556	17.768	17.979	18.191	18.402	18.614
1200	18.614	18.825	19.036	19.247	19.458	19.669	19.880	20.090	20.300	20.510	20.720
1300	20.720	20.929	21.138	21.347	21.556	21.764	21.972	22.180	22.387	22.594	22.800
1400	22.800	23.006	23.212	23.417	23.622	23.826	24.030	24.234	24.437	24.639	24.841
1500	24.841	25.042	25.243	25.444	25.643	25.843	26.041	26.239	26.437	26.633	26.829
1600	26.829	27.025	27.220	27.414	27.607	27.800	27.992	28.184	28.374	28.564	28.753
1700	28.753	28.942	29.129	29.316	29.502	29.688	29.872	30.056	30.239	30.421	30.602
1800	30.602	30.782	30.962	31.140	31.318	31.495	31.671	31.846	32.020	32.193	32.365
1900	32.365	32.536	32.707	32.876	33.044	33.212	33.378	33.543	33.708	33.871	34.033
2000	34.033	34.195	34.355	34.514	34.672	34.829	34.985	35.140	35.294	35.447	35.598
2100	35.598	35.749	35.898	36.046	36.193	36.339	36.484	36.627	36.770	36.911	37.051
2200	37.051	37.189	37.327	37.463	37.598	37.732	37.864	37.995	38.125	38.253	38.380
2300	38.380	38.506									

Type *Tungsten vs Tungsten-26% Rhenium* *ITS-90*

°F	0	10	20	30	40	50	60	70	80	90	100
0					0.006	0.015	0.025	0.037	0.049	0.063	0.079
100	0.079	0.095	0.113	0.132	0.152	0.174	0.196	0.220	0.245	0.272	0.299
200	0.299	0.327	0.357	0.388	0.420	0.453	0.487	0.522	0.559	0.596	0.634
300	0.634	0.674	0.715	0.756	0.799	0.842	0.887	0.933	0.979	1.027	1.076
400	1.076	1.125	1.176	1.227	1.279	1.333	1.387	1.442	1.498	1.555	1.613
500	1.613	1.672	1.731	1.792	1.853	1.915	1.978	2.042	2.106	2.172	2.238
600	2.238	2.305	2.373	2.442	2.511	2.581	2.652	2.724	2.796	2.869	2.943
700	2.943	3.018	3.093	3.169	3.246	3.323	3.401	3.480	3.560	3.640	3.721
800	3.721	3.802	3.884	3.967	4.050	4.134	4.219	4.304	4.389	4.476	4.563
900	4.563	4.650	4.738	4.827	4.916	5.006	5.096	5.187	5.278	5.370	5.463
1000	5.463	5.556	5.649	5.743	5.837	5.932	6.027	6.123	6.220	6.316	6.413
1100	6.413	6.511	6.609	6.707	6.806	6.905	7.005	7.105	7.206	7.306	7.408
1200	7.408	7.509	7.611	7.714	7.816	7.920	8.023	8.127	8.231	8.336	8.441
1300	8.441	8.546	8.652	8.758	8.864	8.971	9.078	9.185	9.292	9.400	9.508
1400	9.508	9.617	9.725	9.834	9.944	10.053	10.163	10.273	10.383	10.494	10.605
1500	10.605	10.716	10.827	10.939	11.051	11.162	11.275	11.387	11.500	11.612	11.725
1600	11.725	11.839	11.952	12.066	12.179	12.293	12.407	12.522	12.636	12.751	12.865
1700	12.865	12.980	13.095	13.210	13.326	13.441	13.557	13.672	13.788	13.904	14.020
1800	14.020	14.136	14.252	14.369	14.485	14.602	14.718	14.835	14.952	15.069	15.185
1900	15.185	15.302	15.419	15.536	15.654	15.771	15.888	16.005	16.123	16.240	16.357
2000	16.357	16.475	16.592	16.710	16.827	16.945	17.062	17.180	17.298	17.415	17.533
2100	17.533	17.650	17.768	17.885	18.003	18.120	18.238	18.355	18.473	18.590	18.708
2200	18.708	18.825	18.942	19.060	19.177	19.294	19.411	19.528	19.646	19.763	19.880
2300	19.880	19.996	20.113	20.230	20.347	20.463	20.580	20.696	20.813	20.929	21.045
2400	21.045	21.162	21.278	21.394	21.509	21.625	21.741	21.857	21.972	22.087	22.203
2500	22.203	22.318	22.433	22.548	22.663	22.777	22.892	23.006	23.121	23.235	23.349
2600	23.349	23.463	23.577	23.690	23.804	23.917	24.030	24.143	24.256	24.369	24.482
2700	24.482	24.594	24.707	24.819	24.931	25.042	25.154	25.266	25.377	25.488	25.599
2800	25.599	25.710	25.820	25.931	26.041	26.151	26.261	26.371	26.480	26.590	26.699
2900	26.699	26.808	26.916	27.025	27.133	27.241	27.349	27.457	27.564	27.672	27.779
3000	27.779	27.886	27.992	28.099	28.205	28.311	28.416	28.522	28.627	28.732	28.837
3100	28.837	28.942	29.046	29.150	29.254	29.358	29.461	29.564	29.667	29.770	29.872
3200	29.872	29.974	30.076	30.178	30.279	30.380	30.481	30.582	30.682	30.782	30.882
3300	30.882	30.982	31.081	31.180	31.279	31.377	31.475	31.573	31.671	31.768	31.865
3400	31.865	31.962	32.058	32.154	32.250	32.346	32.441	32.536	32.631	32.725	32.820
3500	32.820	32.913	33.007	33.100	33.193	33.286	33.378	33.470	33.562	33.653	33.744
3600	33.744	33.835	33.925	34.015	34.105	34.195	34.284	34.373	34.461	34.549	34.637
3700	34.637	34.725	34.812	34.899	34.985	35.072	35.157	35.243	35.328	35.413	35.497
3800	35.497	35.582	35.665	35.749	35.832	35.915	35.997	36.079	36.161	36.242	36.323
3900	36.323	36.404	36.484	36.564	36.643	36.722	36.801	36.880	36.958	37.035	37.113
4000	37.113	37.189	37.266	37.342	37.418	37.493	37.568	37.643	37.717	37.791	37.864
4100	37.864	37.937	38.009	38.082	38.153	38.225	38.296	38.366	38.436	38.506	38.575

100Ω RTD *0.00385 Ω / Ω /°C ITS-90*

°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-100	60.26	56.19	52.11	48.00	43.88	39.72	35.54	31.34	27.10	22.83	18.52
0	100.00	96.09	92.16	88.22	84.27	80.31	76.33	72.33	68.33	64.30	60.26

°C	0	10	20	30	40	50	60	70	80	90	100
0	100.00	103.90	107.79	111.67	115.54	119.40	123.24	127.08	130.90	134.71	138.51
100	138.51	142.29	146.07	149.83	153.58	157.33	161.05	164.77	168.48	172.17	175.86
200	175.86	179.53	183.19	186.84	190.47	194.10	197.71	201.31	204.90	208.48	212.05
300	212.05	215.61	219.15	222.68	226.21	229.72	233.21	236.70	240.18	243.64	247.09
400	247.09	250.53	253.96	257.38	260.78	264.18	267.56	270.93	274.29	277.64	280.98
500	280.98	284.30	287.62	290.92	294.21	297.49	300.75	304.01	307.25	310.49	313.71
600	313.71	316.92	320.12	323.30	326.48	329.64					

°F	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-300	25.20	22.83	20.44								
-200	48.46	46.17	43.88	41.57	39.26	36.94	34.61	32.27	29.93	27.57	25.20
-100	71.00	68.77	66.54	64.30	62.06	59.81	57.55	55.29	53.02	50.74	48.46
0	93.03	90.85	88.66	86.47	84.27	82.07	79.86	77.66	75.44	73.22	71.00

°F	0	10	20	30	40	50	60	70	80	90	100
0	93.03	95.21	97.39	99.57	101.74	103.90	106.07	108.23	110.38	112.53	114.68
100	114.68	116.83	118.97	121.11	123.24	125.37	127.50	129.62	131.74	133.86	135.97
200	135.97	138.08	140.19	142.29	144.39	146.49	148.58	150.67	152.75	154.83	156.91
300	156.91	158.98	161.05	163.12	165.18	167.24	169.30	171.35	173.40	175.45	177.49
400	177.49	179.53	181.56	183.59	185.62	187.65	189.67	191.68	193.70	195.71	197.71
500	197.71	199.71	201.71	203.71	205.70	207.69	209.67	211.66	213.63	215.61	217.58
600	217.58	219.55	221.51	223.47	225.42	227.38	229.33	231.27	233.21	235.15	237.09
700	237.09	239.02	240.95	242.87	244.79	246.71	248.62	250.53	252.44	254.34	256.24
800	256.24	258.14	260.03	261.92	263.80	265.68	267.56	269.44	271.31	273.17	275.04
900	275.04	276.90	278.75	280.61	282.46	284.30	286.14	287.98	289.82	291.65	293.48
1000	293.48	295.30	297.12	298.94	300.75	302.56	304.37	306.17	307.97	309.77	311.56
1100	311.56	313.35	315.14	316.92	318.70	320.47	322.24	324.01	325.77	327.53	329.29

100Ω RTD *0.003911 Ω / Ω /°C IPTS-68*

°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-100	59.64	55.51	51.37	47.20	43.01	38.79	34.54	30.27	25.97	21.63	17.26
0	100.00	96.03	92.04	88.04	84.03	80.00	75.96	71.91	67.83	63.75	59.64

°C	0	10	20	30	40	50	60	70	80	90	100
0	100.00	103.96	107.92	111.86	115.78	119.70	123.60	127.50	131.38	135.25	139.11
100	139.11	142.95	146.79	150.61	154.42	158.22	162.01	165.79	169.55	173.30	177.04
200	177.04	180.77	184.49	188.20	191.89	195.57	199.24	202.90	206.55	210.19	213.81
300	213.81	217.42	221.02	224.61	228.19	231.76	235.31	238.85	242.38	245.90	249.41
400	249.41	252.90	256.39	259.86	263.32	266.77	270.21	273.63	277.04	280.45	283.84
500	283.84	287.21	290.58	293.94	297.28	300.61	303.93	307.24	310.54	313.82	317.09
600	317.09	320.36	323.61	326.84	330.07	333.28					

°F	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-300	24.04	21.63	19.21								
-200	47.66	45.34	43.01	40.67	38.32	35.96	33.60	31.22	28.84	26.45	24.04
-100	70.55	68.29	66.02	63.75	61.47	59.18	56.89	54.59	52.29	49.98	47.66
0	92.93	90.71	88.48	86.26	84.03	81.79	79.55	77.31	75.06	72.81	70.55

°F	0	10	20	30	40	50	60	70	80	90	100
0	92.93	95.14	97.35	99.56	101.76	103.96	106.16	108.35	110.54	112.73	114.91
100	114.91	117.09	119.27	121.44	123.61	125.77	127.93	130.09	132.24	134.39	136.54
200	136.54	138.68	140.82	142.95	145.08	147.21	149.34	151.46	153.58	155.69	157.80
300	157.80	159.91	162.01	164.11	166.20	168.30	170.38	172.47	174.55	176.63	178.70
400	178.70	180.77	182.84	184.90	186.96	189.02	191.07	193.12	195.16	197.21	199.24
500	199.24	201.28	203.31	205.34	207.36	209.38	211.40	213.41	215.42	217.42	219.42
600	219.42	221.42	223.42	225.41	227.40	229.38	231.36	233.34	235.31	237.28	239.24
700	239.24	241.21	243.17	245.12	247.07	249.02	250.96	252.90	254.84	256.77	258.70
800	258.70	260.63	262.55	264.47	266.39	268.30	270.21	272.11	274.01	275.91	277.80
900	277.80	279.69	281.58	283.46	285.34	287.21	289.09	290.95	292.82	294.68	296.54
1000	296.54	298.39	300.24	302.09	303.93	305.77	307.61	309.44	311.27	313.09	314.91
1100	314.91	316.73	318.55	320.36	322.16	323.97	325.77	327.56	329.35	331.14	332.93

NOTES

NOTES

SUPPLEMENTAL INFORMATION SPECIAL SENSORS

Continental Industries International
741-F Miller Drive
Leesburg, Virginia 20175

PH: 703-669-1306 Fax: 703-669-1357

Date_____
Distributor_____
Customer_____

DESCRIPTION _____

_____

APPLICATION _____

_____

_____

SPECIFICATIONS

Calibration: T/C Type_____ Gauge_____ Solid_____ Stranded_____
MgO_____ RTD:_____ ohms TCR_____ohm/ohm/°C_____ 2 wire____ 3 wire____
Other_____
Insulation Material: Mulite____ Aluminum Oxide____ Fiberglass____ Ceramic Fiber____ Nylon____ Teflon____
S. S. Overbraid____ Other_____
Lead Wire: Wire part no. or description_____
Protection Tube: Material or Code_____O.D. or NPT_____Length_____
Connection Device: Head_____ Plug____ Jack____ Lugs____
Other_____
Mounting Device: Flange____ Sleeve____ Bushing_____ Nipple_____ Other_____
Environmental: Operating Temperature: Maximum_____°F Normal_____°F
Atmosphere or Media: Oxidizing___ Inert___ Reducing___ Vacuum___ Other_____
Press. Range_____psi Vibration_____Shock_____
Ordering Information: Quantities_____ Annual usage_____Delivery Required_____
Similar to catalog number_____
Make a sketch showing details and dimensions. Include component part numbers where possible.