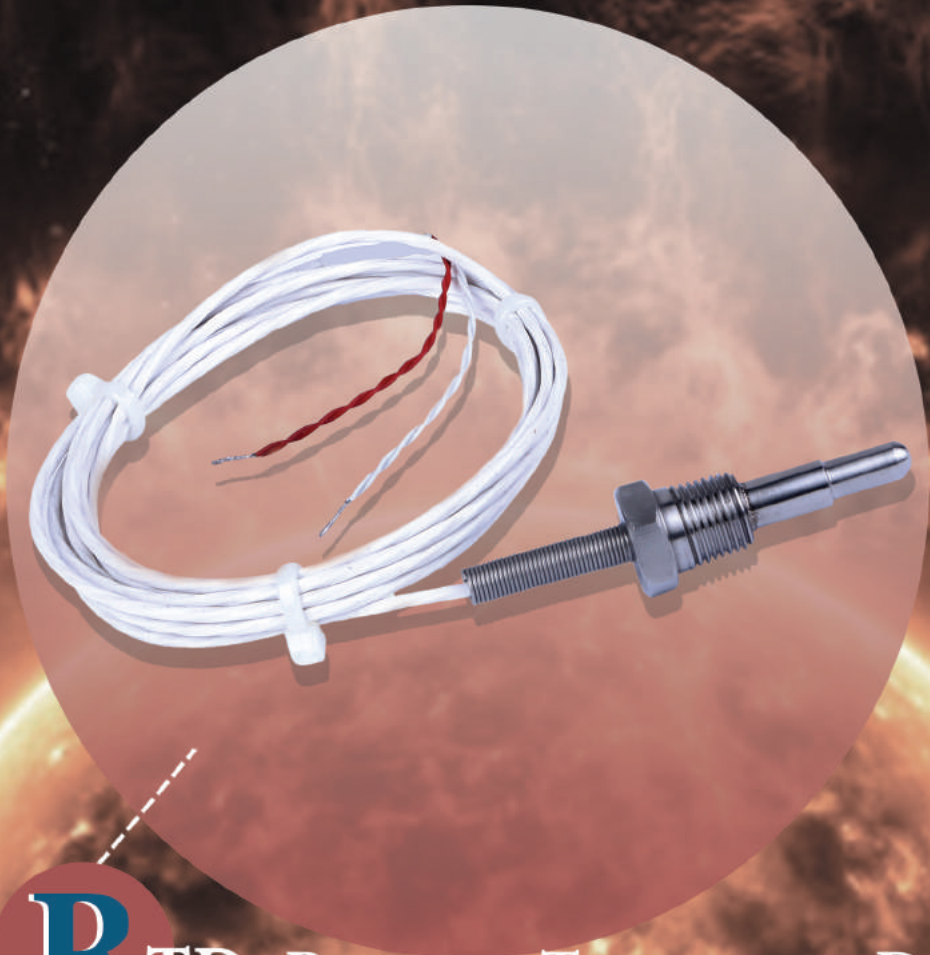




# ETRO DAVVAR ENERGY



## RTD :Resistance Thermometer Detectors

Rev E  
2021/08/24



If there is a will, there is a way...



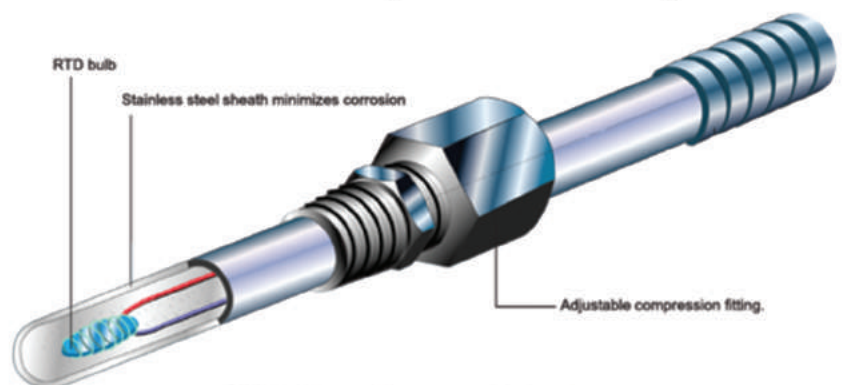
# Resistance Thermometer Detectors

## Introduction To RTD

The resistance that an electrical conductor exhibits to the flow of an electric current is related to its temperature, essentially because of electron scattering effects and atomic lattice vibration. The basis of this theory is that free electrons travel through the metal as plane waves modified by a function having the periodicity of the crystal lattice. The only little snag here is that impurities and what are termed lattice defects can also result in scattering, giving resistance variation. Fortunately, however, this effect is largely temperature-independent, so it does not pose too much of a problem; we just need to be aware of it. In fact, the concept of detecting temperature using resistance is considerably easier to work with in practice than is thermocouple thermometry. Firstly, the measurement is absolute, so no reference junction or cold junction compensation is required. Secondly, straightforward copper wires can be used between the sensor and your instrumentation since there are no special requirements in this respect.

## IEC 60751: RTD Standards And Tolerances

For the purposes of the IEC 60751: 1983 (BS EN 60751: 1996) standard, the RTD itself comprises the sensing resistor within its protective sheath (if applicable), internal connecting wires and external terminals for onward connection. Mounting equipment and connection heads can also be included. IEC 60751 actually applies to industrial devices, primarily sheathed, over the temperature range -200°C to 850°C, and offers two tolerance classes, A and B - these defining the maximum deviation in degrees Celsius from the nominal temperature relationship table figures. Class A RTD's can show deviation of  $\pm 0.06$  ohms ( $\pm 0.15^\circ\text{C}$ ) at  $0^\circ\text{C}$ , while class B sensors can be within  $\pm 0.12$  ohms ( $\pm 0.3^\circ\text{C}$ ) at  $0^\circ\text{C}$ . Standard thermometers are constructed from platinum having an  $\alpha$  coefficient of  $3.85 \times 10^{-3}/^\circ\text{C}$ , and have nominal resistances of 100 ohms or 10 ohms at  $0^\circ\text{C}$ , the latter harnessing heavier gauge wire, and being aimed at use in the range above  $600^\circ\text{C}$ . With 100 ohm devices, Class A only applies up to  $650^\circ\text{C}$ ; also the A classification is not applicable to two-wire devices. Clearly, devices which conform to the standard as defined can be interchanged - always useful! See the reference and tolerance tables in this guide. The standard also covers a range of other factors - but not construction. For example, the RTD's have to be suitable for DC and AC current measuring systems - the latter up to 500Hz. So there are certain inductance and coupling constraints on design. Insulation resistance, response times, self-heating effects, immersion errors, thermo-electric effects, tests for temperature limits and temperature cycling, mechanical vibration and pressure effects are also specified. IEC 60751 also says that manufacturers can reveal electrical characteristics, like thermometer capacitance, capacitance to earth, and inductance, as well as the ohmic resistance of the internal connecting wires. Also, calibration immersion depth, minimum usable depth, thermal response time and self-heating effects can be stated.



RTD (Resistance Temperature Detector)

# Style R1

## MI cable With Adujustable Connection



Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Sheath Length $L_1$ (mm)	Wire Length $L_2$ (mm)	End Seal (Table 4)	Lead Wire (Table 5)	Temperature Rating (Table 6)	Compression Fitting or Nut Nipple (Table 7)
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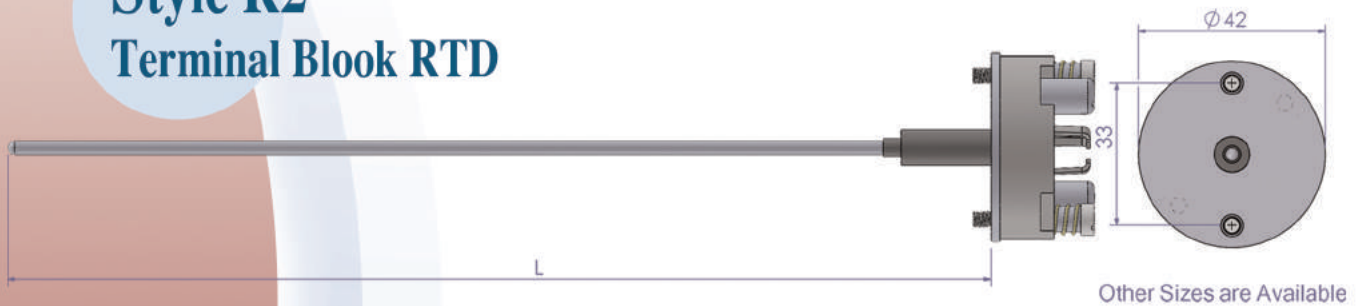
R<sub>1</sub>

### How to order

Sample: R1-2-PT100-6Wire-Class A-316-6mm-220mm-100mm-P2 -21-HT-02

# Style R2

## Terminal Blook RTD



Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Sheath Length L (mm)	Temperature Rating (Table 6)
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R<sub>2</sub>

### How to Order

Sample: R2-2 x P T100-6Wire-Class B-304-6mm-200mm-UT

# Style R3

## Capsule RTD



Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Probe Diameter $D_1$	End Trij Diameter $D_2$ (mm)	MI Cable Length $L_1$ (mm)	Capsule Length $L_2$	End Seal (Table 4)	Wire Length $L_3$	Lead Wire (Table 5)	Temperature Rating (Table 6)
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R<sub>3</sub>

### How to order

Sample: R3-2 x PT100-6Wire-Class A-316-6mm-8mm-220mm-20mm-P2 -60mm-21-HT



# Style R4 Spring Loaded RTD



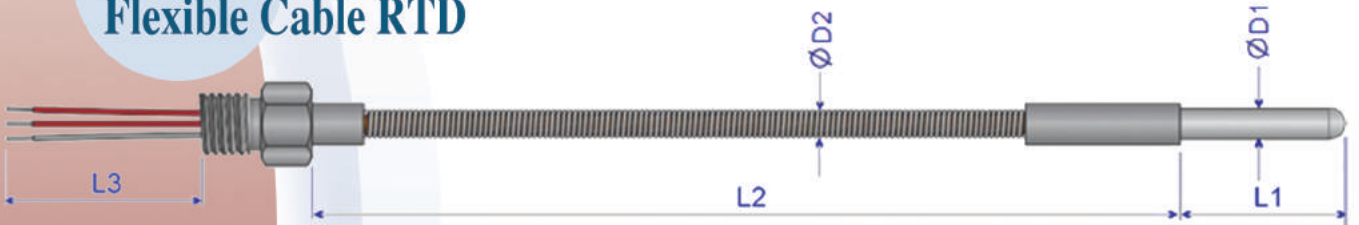
Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Sheath Length L <sub>1</sub> (mm)	Conduit Connection Thread	Insert Connection Thread	Wire Length L <sub>2</sub> (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
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R<sub>4</sub>

### How to order

Sample: R4-2 x PT100-6Wire-Class A-316-6mm-150 mm-1/2" BSPP-1/2" NPT-100 mm-21-LT

# Style R5 Flexible Cable RTD



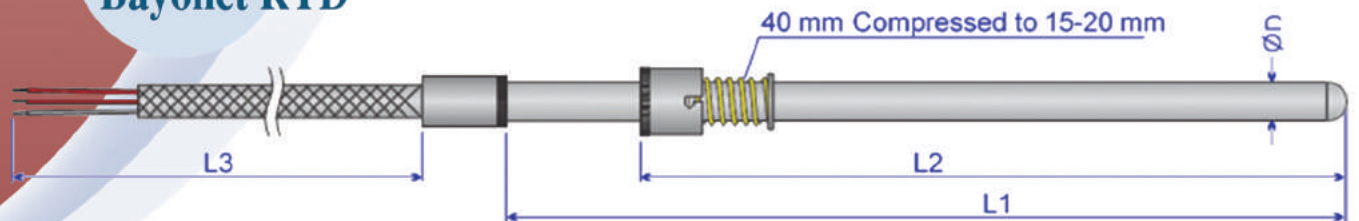
Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Probe Length L <sub>1</sub> (mm)	Flexible Diameter D <sub>2</sub> (mm)	Flexible Length L <sub>2</sub> (mm)	Connection Type	Wire Length L <sub>3</sub> (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
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R<sub>5</sub>

### How to order

Sample: R5-2 x PT100-6Wire-Class A-316-6mm-100 mm-6mm-1200mm-1/2" BSPP-100 mm-21-LT

# Style R6 Bayonet RTD



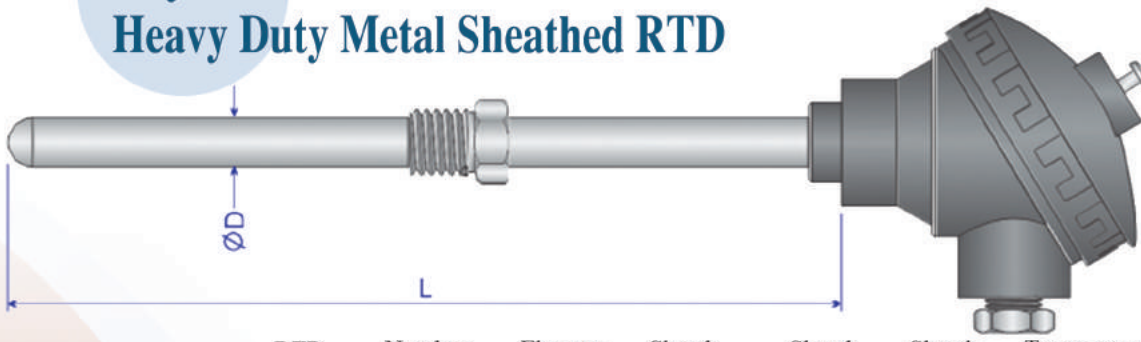
Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Probe Length L <sub>1</sub> (mm)	Probe Length L <sub>2</sub> (mm)	Wire Length L <sub>3</sub> (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
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R<sub>6</sub>

### How to order

Sample: R6-2 x PT100-6Wire-Class A-316-6mm-100 mm-150mm-500 mm-21-HT

## Style R7 Heavy Duty Metal Sheathed RTD



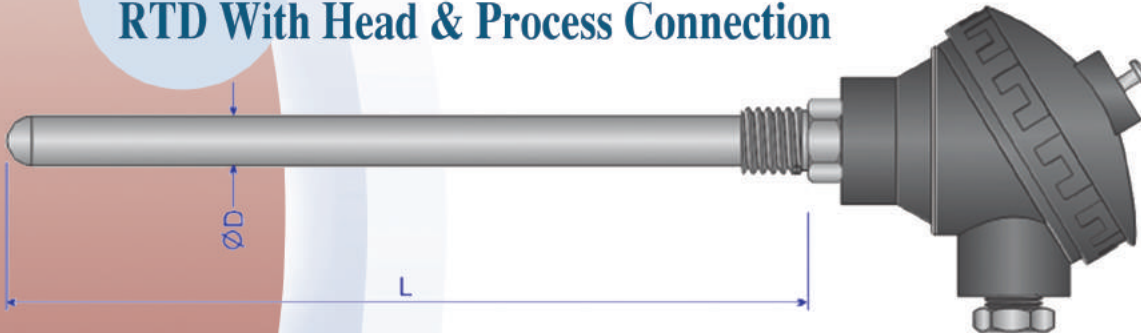
Style No	No of Element	RTD Type (Table 1)	Number of Wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Sheath Length L (mm)	Temperature Rating (Table 6)	Compression Fitting or Nut Nipple Size (Table 7)
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R<sub>7</sub>

### How to order

Sample: R7-PT100-3Wire-Class A-304-6mm-200mm-LT-01

## Style R8 RTD With Head & Process Connection



Style No	No of Element	RTD Type (Table 1)	Number of Wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Sheath Length L (mm)	Temperature Rating (Table 6)	Process Connection (Table 7)
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R<sub>8</sub>

### How to order

Sample: R8-PT100-3Wire-Class A-304-6mm-200mm-LT-01

## Style R9 Bearing RTD (Stepped Tip)



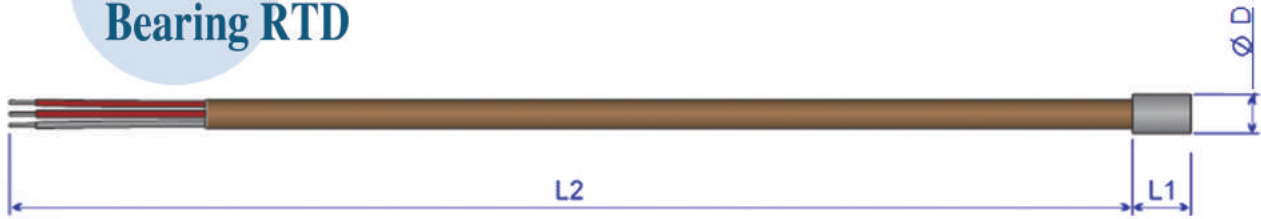
Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Tip Material (Table 3)	D <sub>1</sub> (mm)	L <sub>1</sub> (mm)	D <sub>2</sub> (mm)	Cable Length L <sub>2</sub> (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
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R<sub>9</sub>

### How to order

Sample: R9-PT100-3Wire-Class A-304-8mm-10 mm-6mm-500 mm-21-HT

# Style R10 Bearing RTD



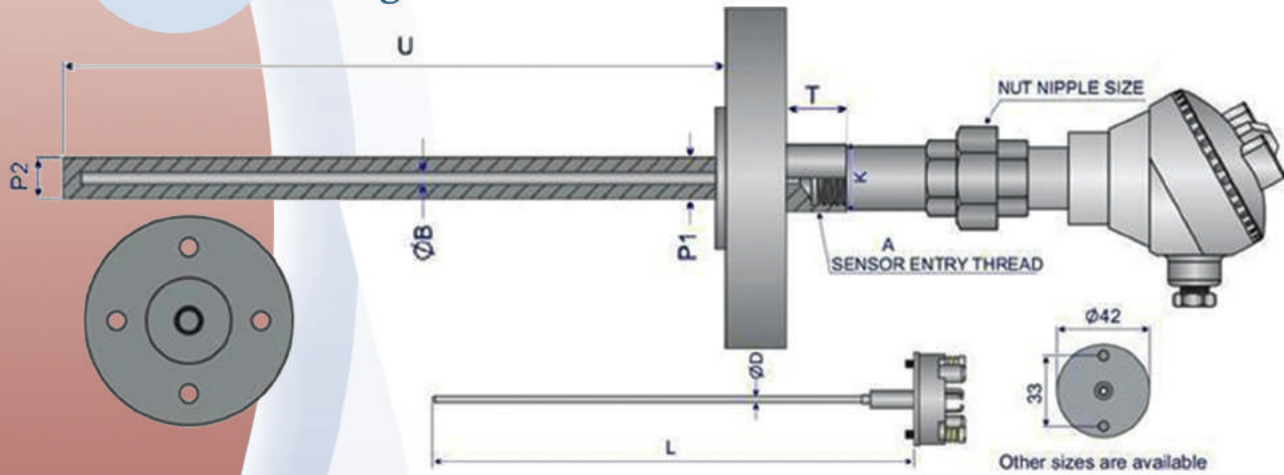
Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Tip Material (Table 3)	Sheath Material D (mm)	$L_1$ (mm)	Cable Length $L_2$ (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
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R10

### How to order

Sample: R10-PT100-3Wire-Class A-304-8mm-10mm-500mm-21-HT

# Style R11 RTD with Flanged Thermowell



StyleNo	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Sheath Length L(mm)	Temperature Rating (Table 6)	Compression Fitting or Nut Nipple (Table 7)
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R11

Thermowell Cap	Flange size & class	Sheath Material (Table 3)	Sensor Entry Thread (A)	Insertion Length (U)	Thermowell Bore diameter (B)	Hex Length (T)	Hex diameter (K)	Root diameter (P1)	Tip diameter (P2)
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### How to Order

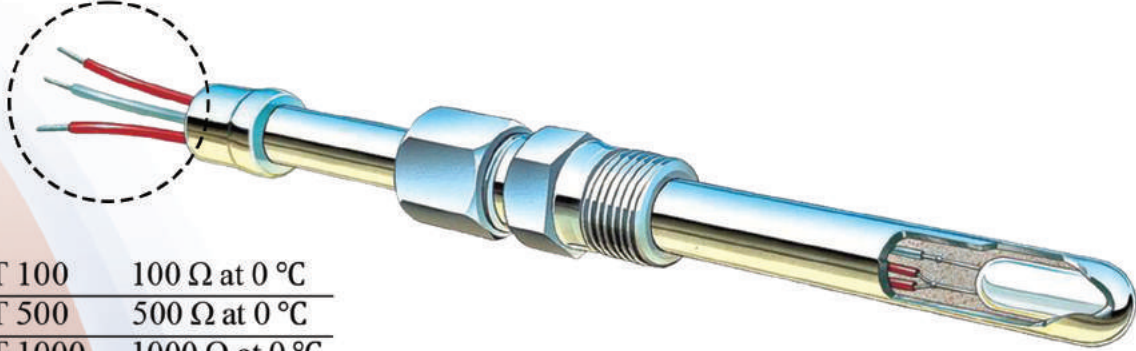
Sample: R11-PT100-6Wire-Class A-316-6mm-220mm-100mm-P2 -21-HT-02

W-1 1/2"#300-310-3/4 NPT-350mm-8mm-32mm-32mm-22mm-19mm



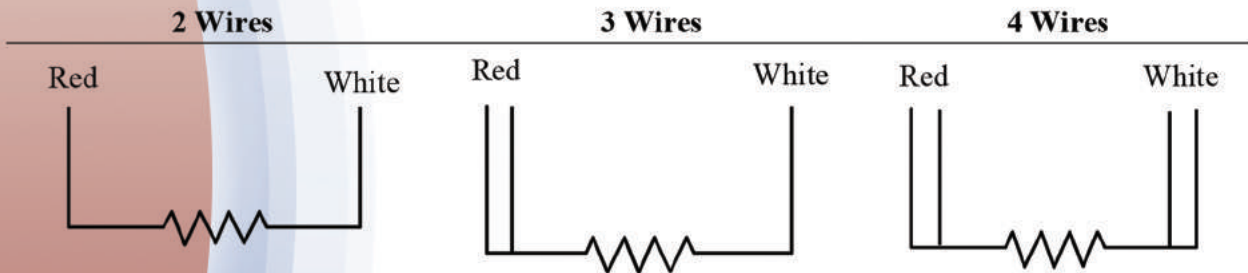
# RTD Wires

RTD sensors use ordinary copper instrumentation cable to send the resistance signal back to the recording, readout or control device. If a transmitter is installed within the RTD sensor assembly, copper wire is typically used to send the scalable (4 to 20) mA signal back to the process control equipment.



PT 100	100 Ω at 0 °C
PT 500	500 Ω at 0 °C
PT 1000	1000 Ω at 0 °C
NI 120	120 Ω at 0 °C

**Table1:** Guide To RTD



**Table2:** RTD Wire Configuration

Code	Lead Wire Table	Description
01		PVC Sheathed Wire With PVC Jacket rated to 105 °C
02		PTFE Sheathed Cable With PTFE Jacket rated to 250 °C
03		PTFE Sheathed Cable With Armor PTFE Jacket Rated to 250 °C
04		Fiberglass Sheathed Wire With Overall Fiber Armor Jacket rated to 480°C

**Table1:** RTD 'S Lead Wire

# Number of RTD Wires

Code	Number Of Wire
02	2 Core, RTD 7/0.2 mm Diameter Cable (1 Red, 1 White)
03	3 Core, RTD 7/0.2 mm Diameter Cable (2 Red, 1 White)
04	4 Core, RTD 7/0.2 mm Diameter Cable (2 Red, 2 White)
06	6 Core, RTD 7/0.2 mm Diameter Cable (4 Red, 2 White)

**Table2**

Note 2: Standard AWG Size for RTD Wire: AWG 24 (IF Not Please Specify)

RTDC	Lead Wire Material	Number & Type of wire
	TABLE3	TABLE2

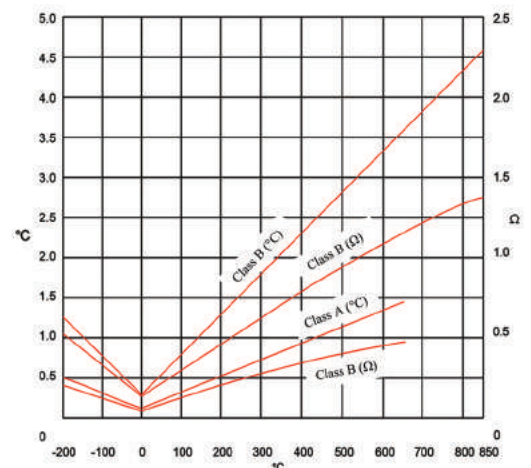
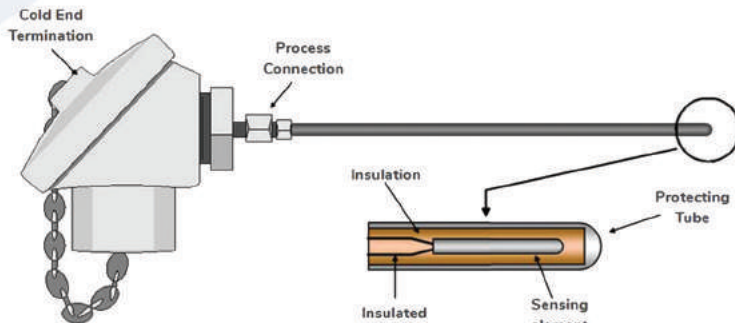
## How to Order

Sample: RTDC-02-04 for PTFE-PTFE Wire, 4 Core (2 Red, 2 White)

# RTD Sheath Material Description

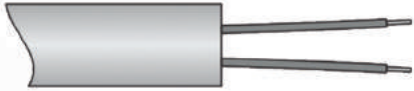
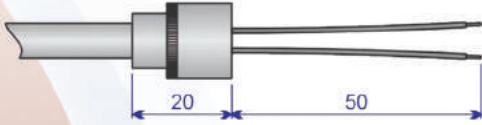
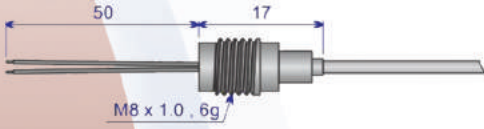
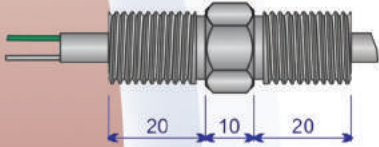
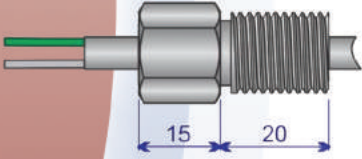
Standard	Material Specifications	Operational Properties	Max. Temp.
304	<b>Grade 304 Stainless Steel</b> WN : 1.4304	Good Corrosion Resistance about Water	<b>700 °C</b>
321	<b>Grade 321 Stainless Steel</b> WN : 1.4321	Heat Resisting	<b>900 °C</b>
316 L	<b>Grade 316L Stainless Steel</b> WN : 1.4404	Very good corrosion resistance high ductility.	<b>800 °C</b>
310	<b>Grade 310 Stainless Steel</b> WN : 1.4845	Good high temperature corrosion resistance and suitable for use in Sulphur bearing atmospheres. High oxidation resistance.	<b>1100 °C</b>
600	<b>Inconel 600</b> WN : 2.4816	Used in severely corrosive atmospheresto elevated temperatures. Good resistanceto oxidation.	<b>1100 °C</b>

**Table3** :RTD Sheath Material Description





# Types of RTD End Seal Configuration

Code	Photo	Description
P1		Supplied as standard with bare conductors as long as customer needs. Plain internal epoxy resin seal.
P2		Crimp on stainless steel pot seal with PTFE sleeved solid tails 50 mmlong. Potted with resin.
P3		Crimp on stainless steel pot seal (M8 x 1mm) with PTFE sleeved solid tails 50 mm long. Potted with resin.
P4		Stainless Steel Double Connection Welded Pot seal With Screw (1/2 x 1/2 Standard size With 50mm PTFE Cable)
P5		Stainless Steel Compression Gland Pot seal (Standard size 1/2 Inch With 50 mm PTFE Cable)

**Table4** :RTD End Seal Configuration

<b>LT</b>	Low Temperature Max 200 °C
<b>HT</b>	High Temperature Max 450 °C
<b>UT</b>	Ultra High Temperature Max 600 °C

**Table6** :RTD's Temperature

Code	Compression fitting or nut & nipple
01	M8
02	M10
03	M12
04	M16
05	1/2 NPT

**Table7** :Compression Fitting

# Calibration Report



## RTD Calibration Report

Date: 1400/04/13  
Report No: 211072-C  
Page: 1

<b>Project No:</b> PD-MF211072	<b>Client:</b> AZARW-PPT
<b>Part Name:</b> RTD PT100, 6Wire	<b>Serial No:</b> 2102146
<b>Petro P/N:</b> PD-RTD-00050	<b>Order No.:</b> 1400/910/4133

**Calibration Range:** 50 to 115 (°C)

**Ambient Temperature:** 21 (°C)

**Measurement Standard Used:** To IEC60751

**Humidity:** 10% RH

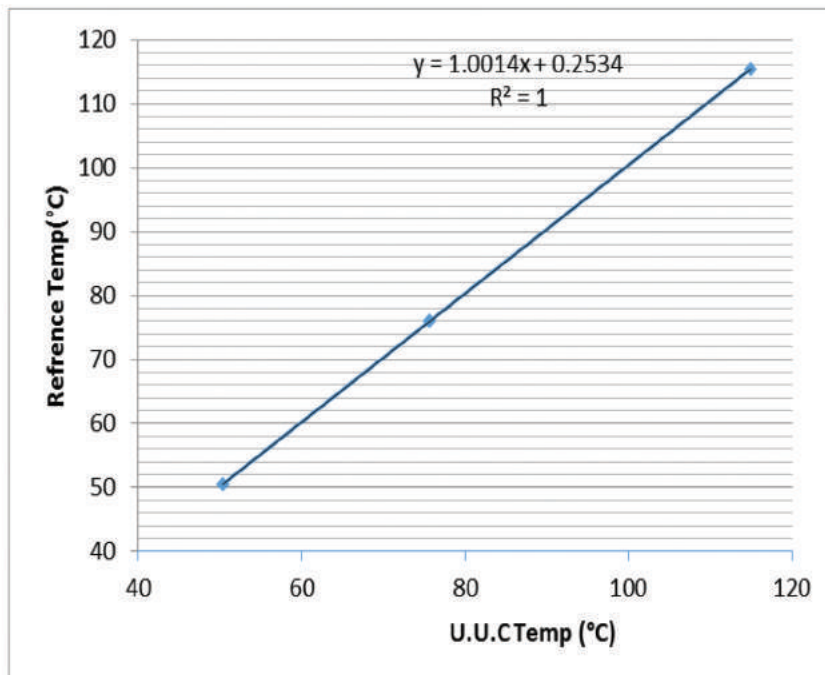
**Calibration Device:** Dry Block Calibrator BX-150  
& Thermocouple Calibrator (UT 713) & INSTEC  
GOM 801H

**Measurement Uncertainty:** Measurement  
uncertainty is estimated according to EA-4/02

**Traceability:** To IEC60751, 60751 (ITS-90)

The International Temperature Scale of 1990  
(ITS-90)

Set Point (°C)	Reference (°C)	U.U.C. (°C)	Error (°C)
50	50.0	50.3	0.3
75	75.0	75.4	0.4
115	114.9	115.4	0.5



$R^2$  پارامتری است بین 0 تا 1 که هر چه به 1 نزدیک تر باشد نشانه این است که معادله حاصل رفتار مقادیر واقعی را بهتر بیان می کند.

Instrument Manager:

Date:





# RETRO DAVVAR ENERGY



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