PETRO DAVVAR ENERGY

RTD :Resistance Temperature Detectors

Rev E
2021/09/05

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

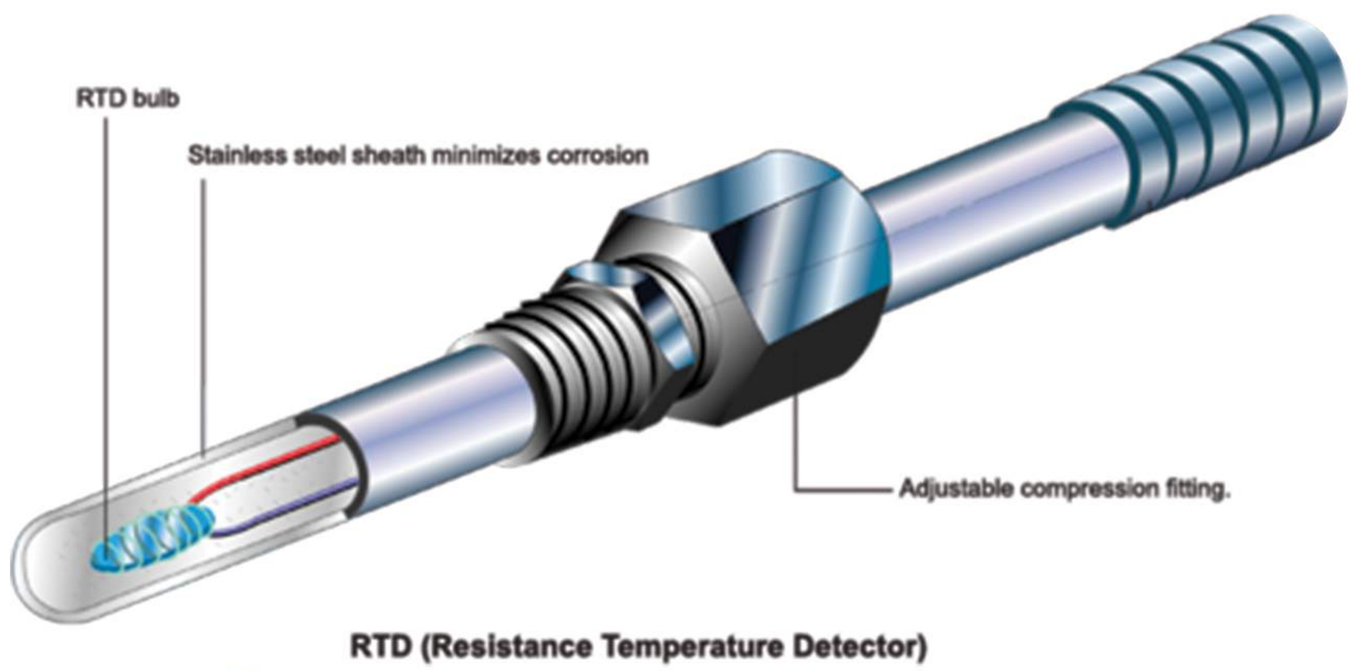
ResistanceTemperatureDetectors

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 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 therm--ometry. firstly, the measurement is absolute, so no reference junction or cold junction compensation is required. secondly, 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.

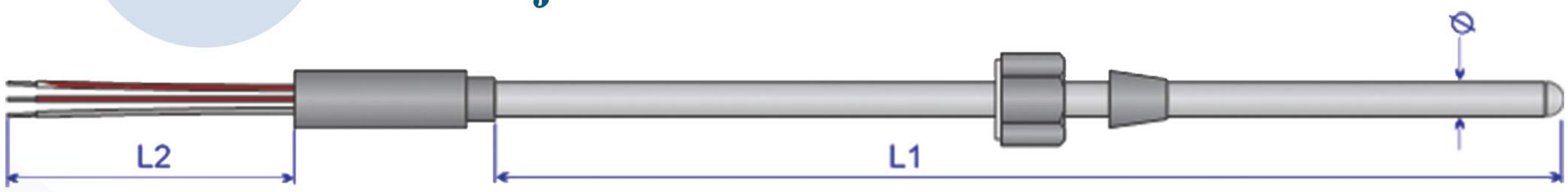
IEC 60751: RTD Standards And Tolerances

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 ±0.06 ohms (±0.15°C) at 0°C, while class B sensors can be within ±0.12 ohms (±0.3°C) at 0°C. Standard thermometers are constructed from platinum having an α coefficient of 3.85* 10-3/°C,and have nominal resistances of 100 ohms or 10 ohms at 0°C, the latter harnessing heavier gaugewire, and being aimed at use in the range above 600°C. with 100 ohm devices, Class A only applies up to 650°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 inthis 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 specfied. 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 responsetime 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)
R_1												

How to order

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

Style R2
Terminal Blook RTD

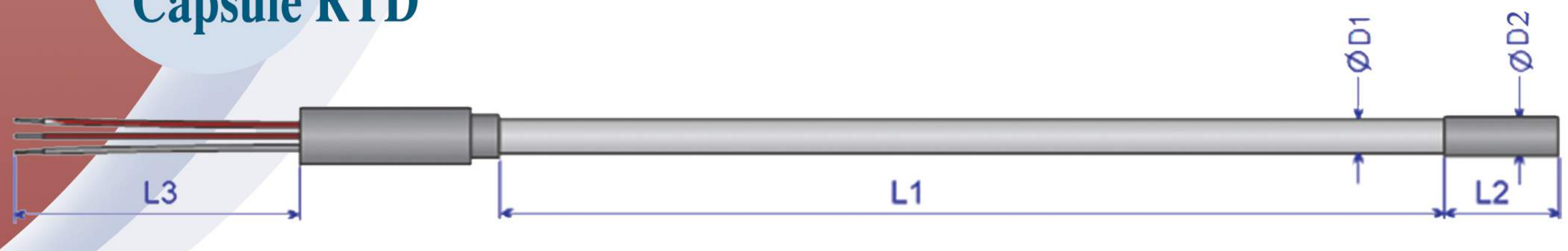
Other Sizes are Available

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 LengthL (mm)	Temperature Rating (Table 6)
R_2								

How to Order

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

Style R3
Capsule RTD

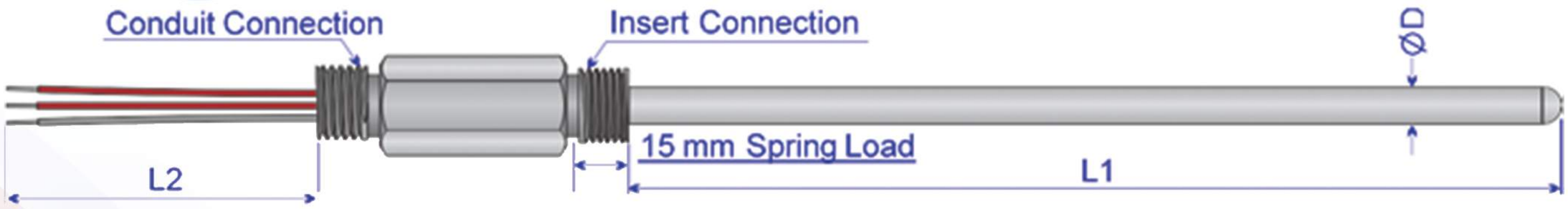


Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Probe Diameter D_1	End Diameter D_2 (mm)	Trip MI Cable Length L_1 (mm)	Capsule Length L_2	End Seal (Table 4)	Wire Length L_3	Lead Wire (Table 5)	Temperature Rating (Table 6)
R_3													

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

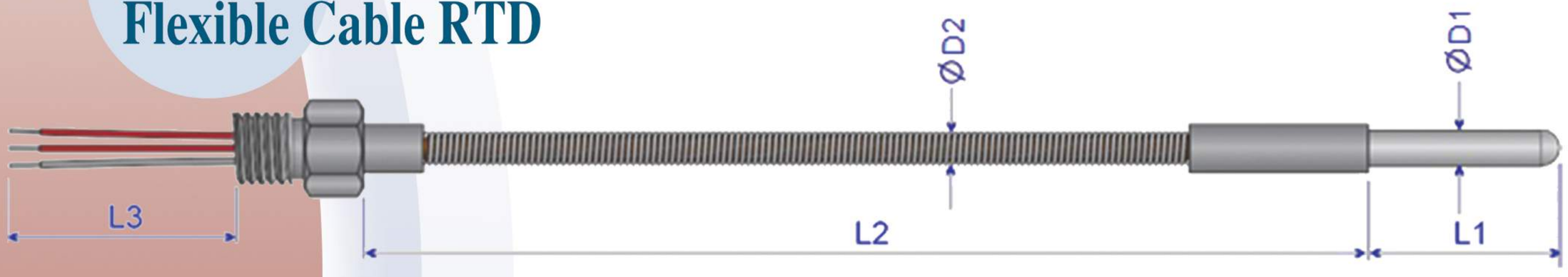


Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Sheath Length L_1 (mm)	Conduit Connection Thread	Insert Connection Thread	Wire Length L_2 (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
R_4												

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

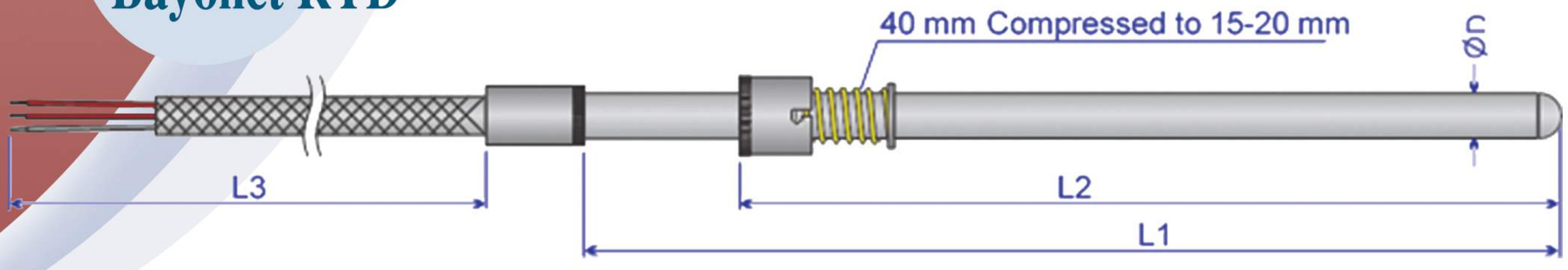


Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D_1 (mm)	Probe Length L_1 (mm)	Flexible Diameter D_2 (mm)	Flexible Length L_2 (mm)	Connection Type	Wire Length L_3 (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
R_5													

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

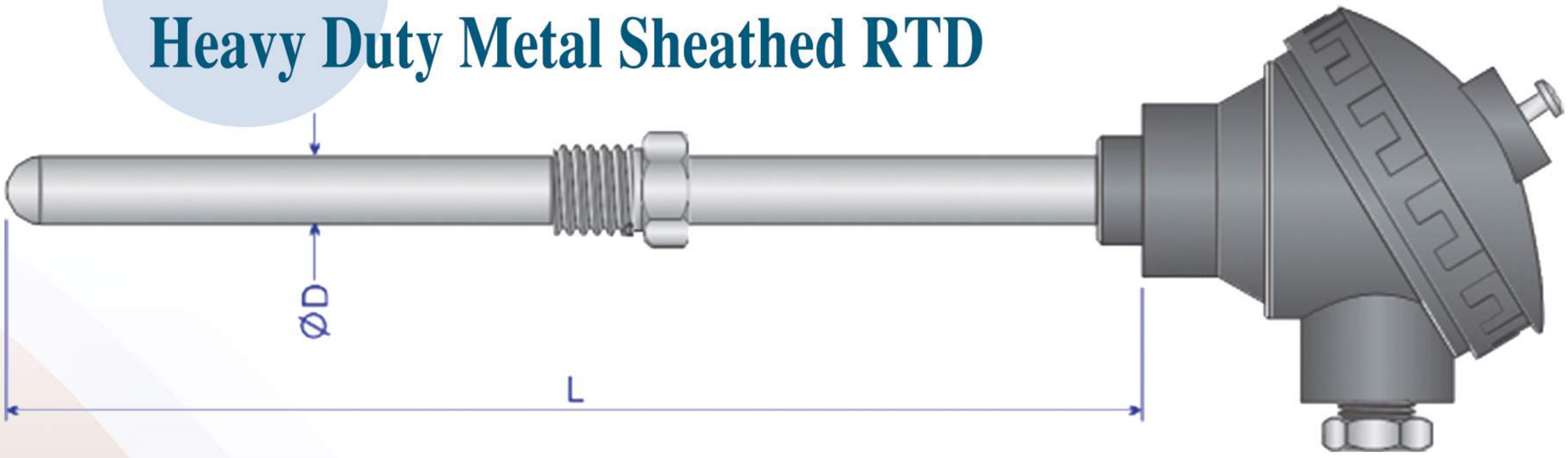


Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Probe Length L_1 (mm)	Probe Length L_2 (mm)	Wire Length L_3 (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
R_6											

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 LengthL (mm)	Temperature Rating (Table 6)	Compression Fitting or Nut Nipple Size (Table 7)
R_7									

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 LengthL (mm)	Temperature Rating (Table 6)	Process Connection (Table 7)
R_8									

How to order

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

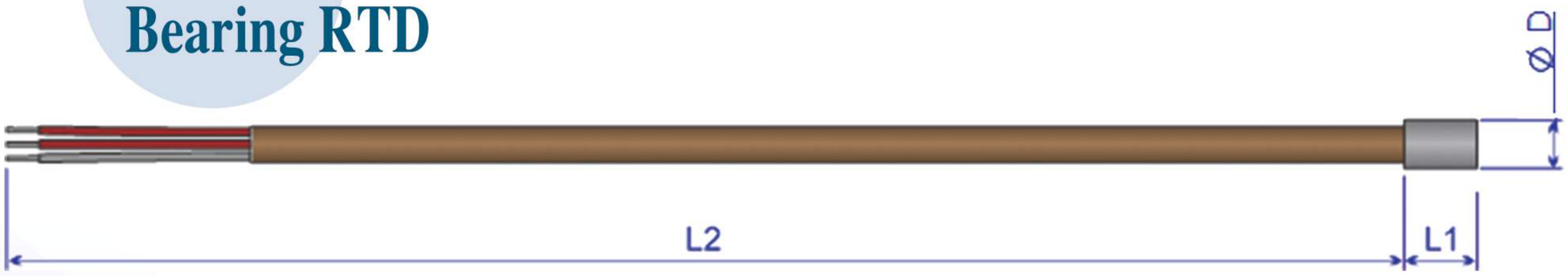
Style R9
Bearing RTD (Stepped Tip)

Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Tip Material (Table 3)	D_1 (mm)	L_1 (mm)	D_2 (mm)	Cable Length L_2 (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
R_9											

How to order

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

Style R10
Bearing RTD

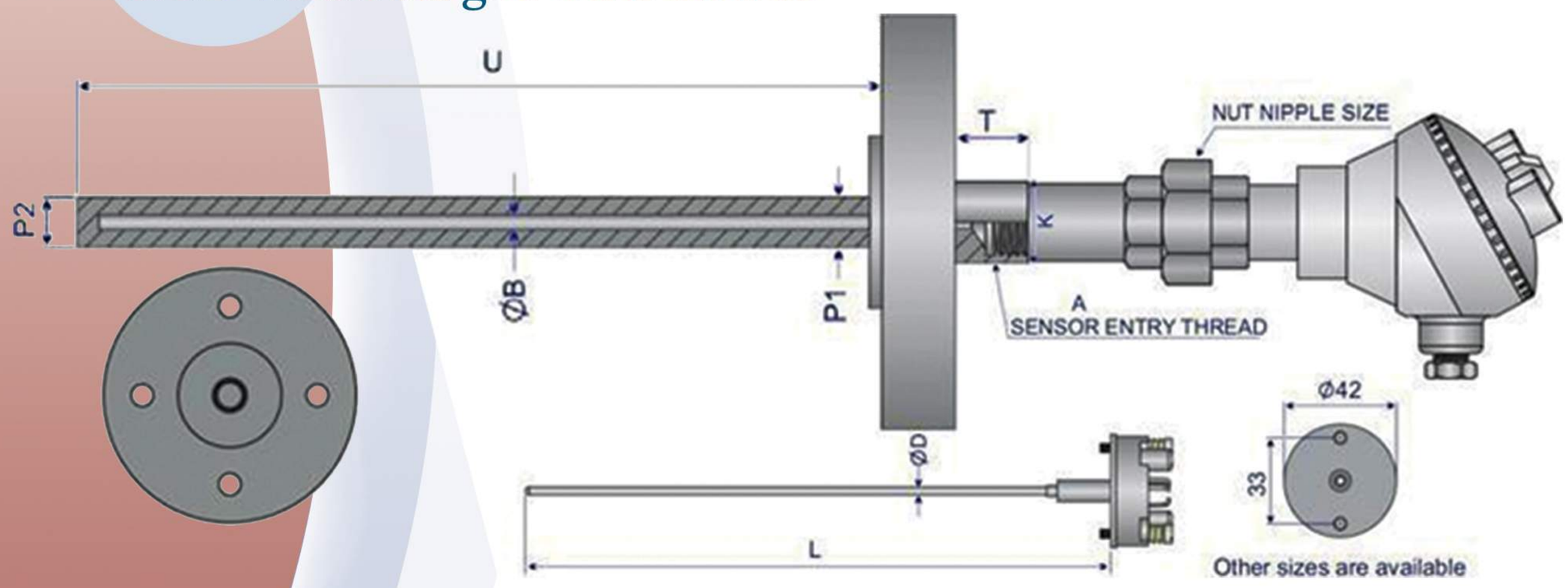


Style No	No of Element	RTD Type (Table 1)	Number of wire (Table 2)	Element Class (Table 8)	Tip Material (Table 3)	Sheath Material D (mm)	$L1$ (mm)	Cable Length L_2 (mm)	Lead Wire (Table 4)	Temperature Rating (Table 6)
R_{10}										

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)	Numberof wire (Table 2)	Element Class (Table 8)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Sheath Length L(mm)	TemperatureRating (Table 6)	Compression Fitting or NutNipple (Table 7)
R_{11}								

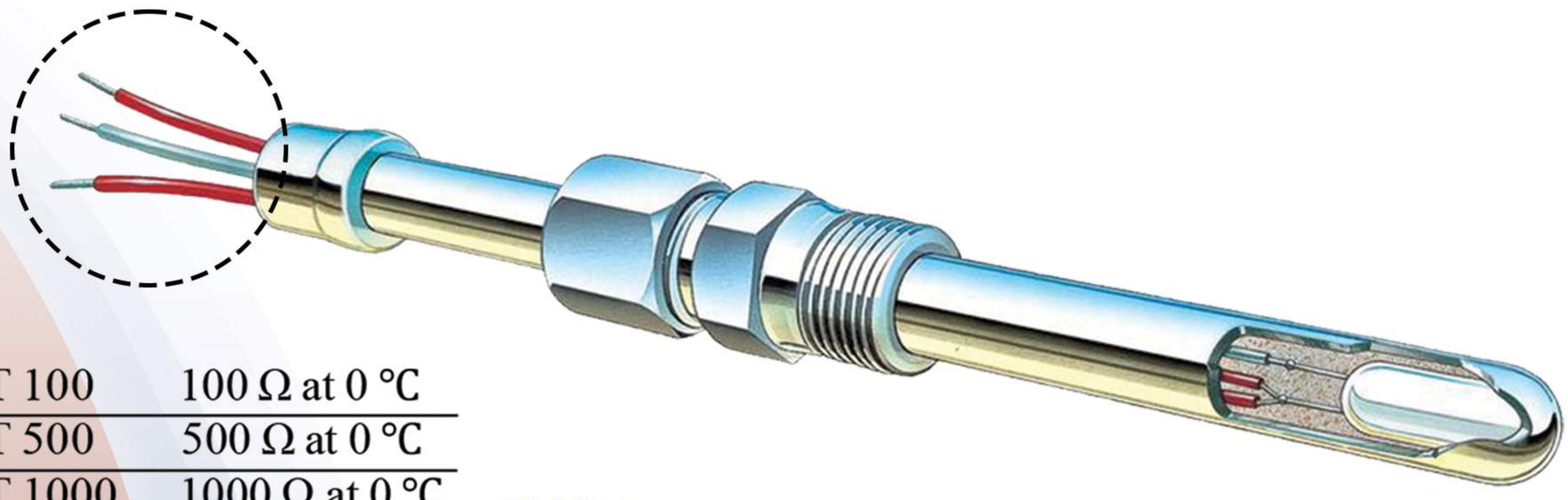
Thermowell Cap	Flange size &class	Sheath Material (Table 3)	Sensor Entry Thread (A)	Insertion Length (U)	Thermowell Bore diameter (B)	Hex Length (T)	Hex diameter (K)	Root diameter (P1)	Tip diameter (P2)
...									

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

2 Wires	3 Wires	4 Wires
Red White	Red White	Red White

Table2: RTD Wire Configuration

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

Table1: RTD 'S Lead Wire

Number of RTDWires

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)

	Lead Wire Material	Number & Type of wire
RTDC	TABLE3	TABLE2

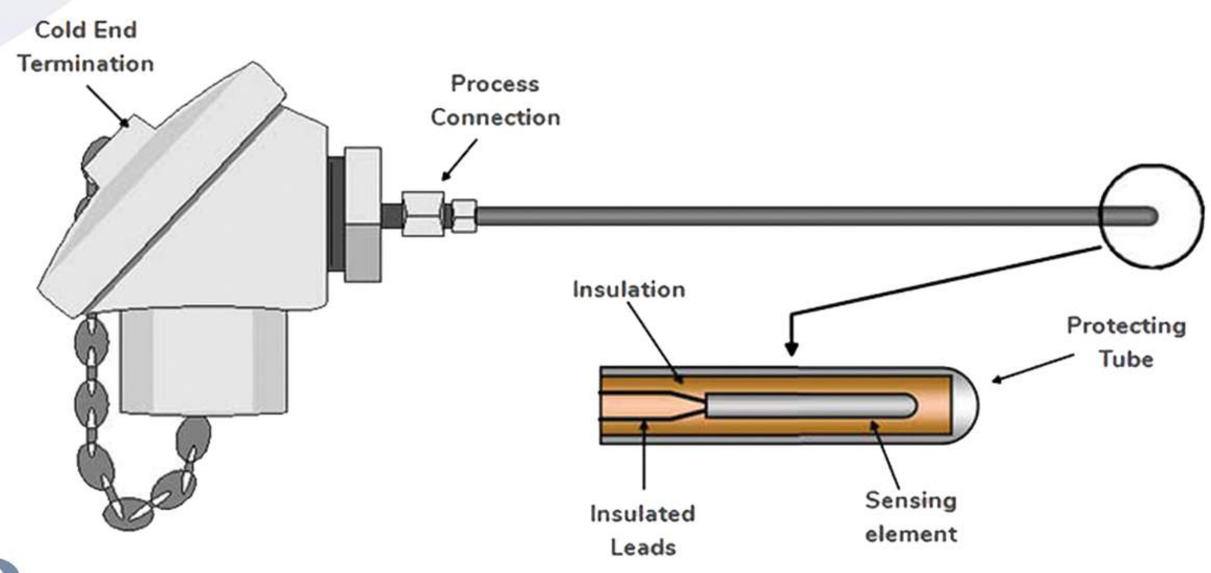
How to Order

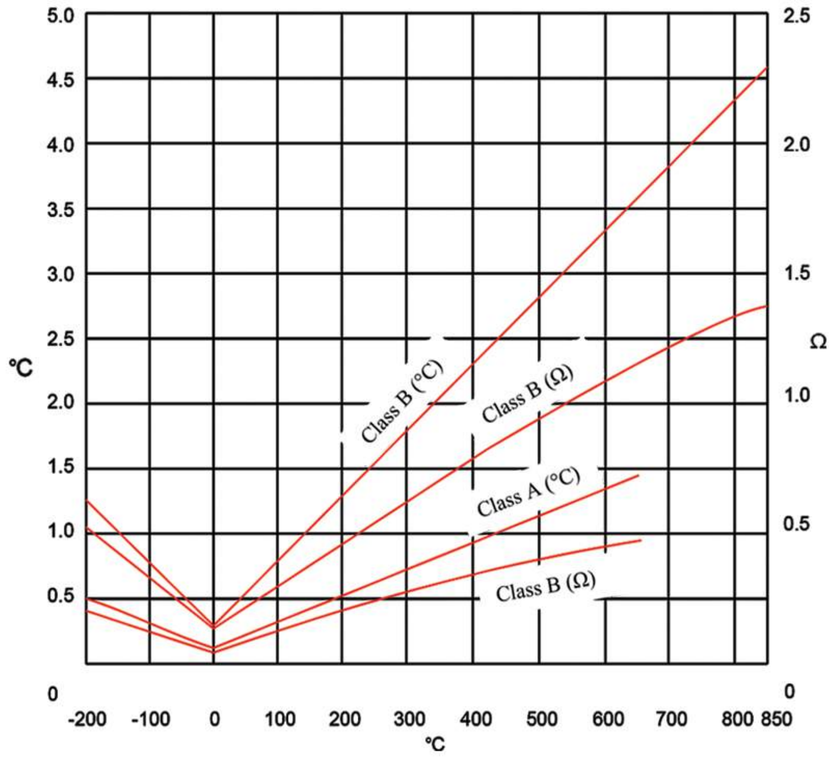
Sample: RTDC-02-04 for PTFE-PTFE Wire, 4 Core (2 Red, 2 White)

RTD Sheath Material Description

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

Table3 :RTD Sheath Material Description





Types of RTD End Seal Configuration

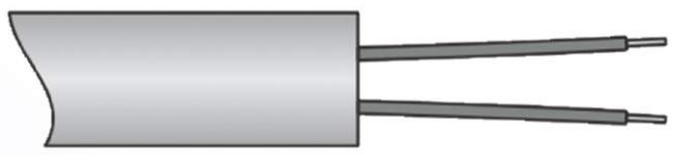
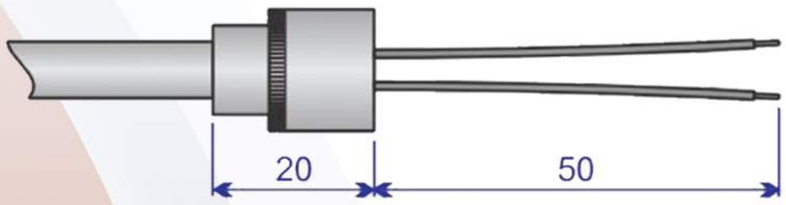
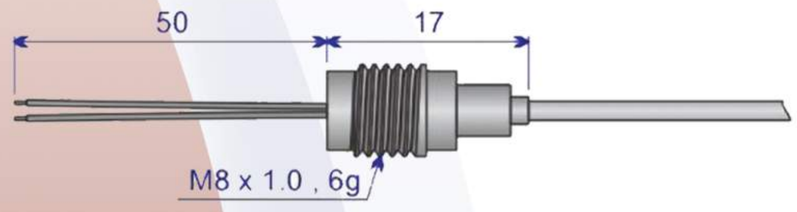
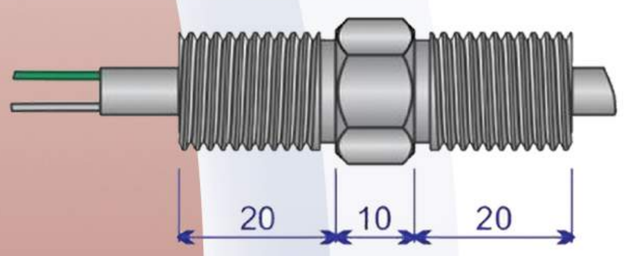
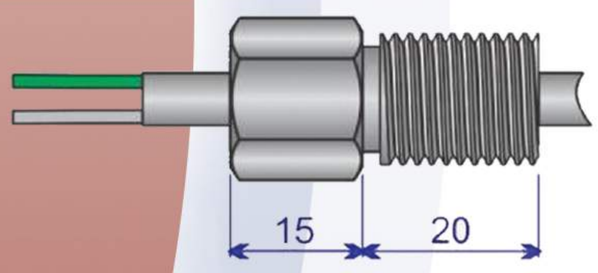
Code	Photo	Description
P1		Supplied as standard with bare conductors as long as customer needs. Plain internal epoxy resin seal.
P2		Crimp on stainless steel pot seal with PTFE sleeved solid tails 50 mmlong. Potted with resin.
P3		Crimp on stainless steel pot seal (M8 x 1mm) with PTFE sleeved solid tails 50 mm long. Potted with resin.
P4		Stainless SteelDouble Connection Welded Pot seal With Screw(½ × ½ Standard size With 50mm PTFE Cable)
P5		Stainless Steel Compression Gland Pot seal (Standard size ½ Inch With 50 mmPTFE Cable)

Table4 :RTD End Seal Configuration

LT	Low Temperature Max 200 °C
HT	High Temperature Max 450 °C
UT	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

PETRO DAVVAR ENERGY	**RTD Calibration Report**	Date: 1400/04/13 Report No: 211072-C Page: 1

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

Calibration Range: 50 to 115 (ºC)

Measurement Standard Used: To IEC60751

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

The International Temperature Scale of 1990 (ITS-90)

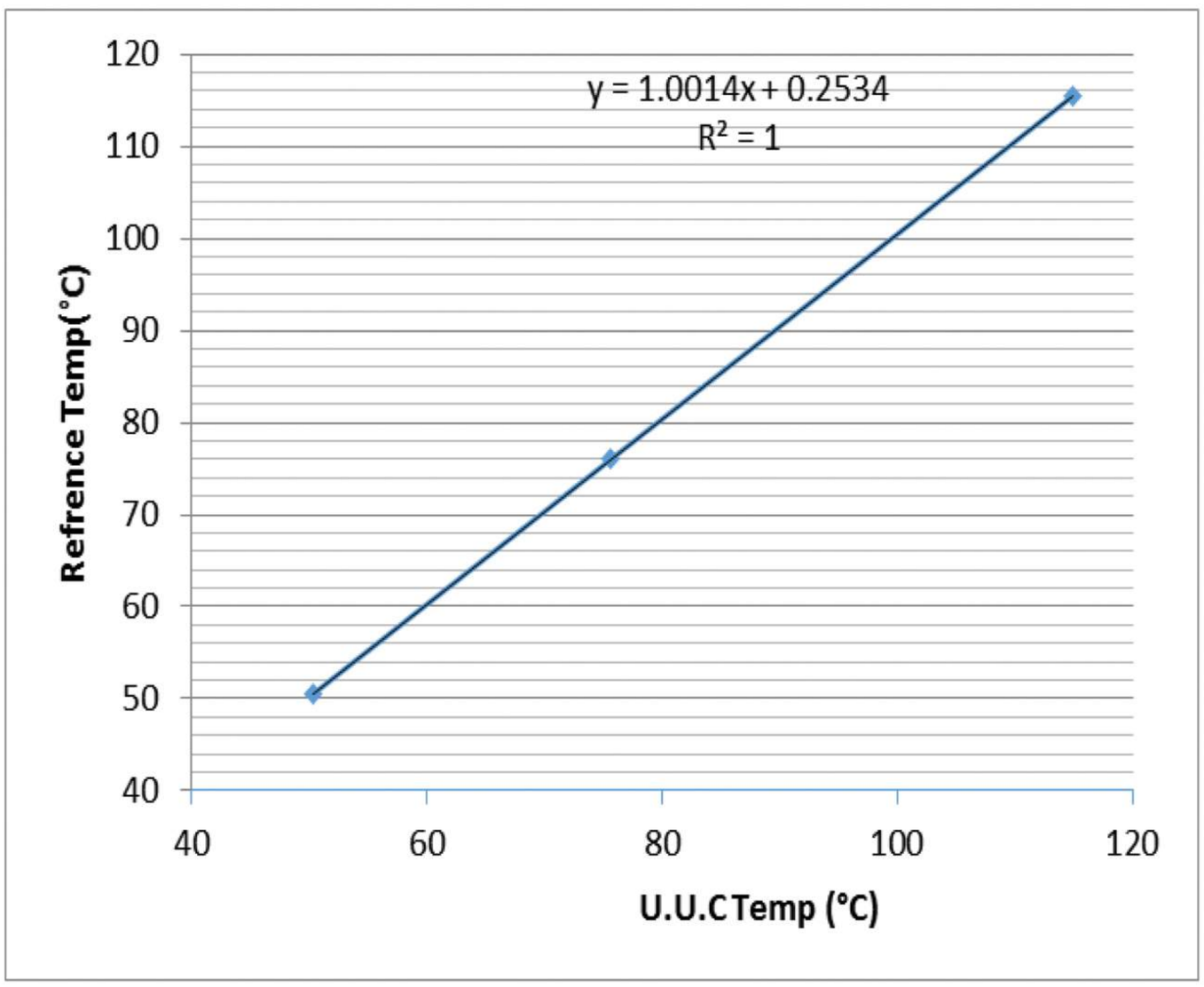
Ambient Temperature: 21 (ºC)

Humidity: 10% RH

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

Traceability: To IEC60751, 60751 (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**



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