Resistance Thermometers

Resistance thermometers are widely used in various processes within the temperature range of -200°C to +850°C. They provide more accurate readings than thermocouples, especially at low temperatures. Standard designs are suitable up to 500°C, while special types are available for applications up to 850°C upon request.

The maximum operating temperatures stated in the catalogue refer to clean air environments free from harmful gases. In environments with corrosive or aggressive gases, the service life of the resistance thermometers may be reduced depending on the severity of the exposure.

Resistance thermometers are suitable for use in machinery, tanks, pipelines, and media such as air, steam, gas, water, and oil, as well as for surface measurements in low and high-pressure processes.

VR02
Steam and Water Temperature

Vira temperature sensors are specifically designed for steam applications, delivering accurate and reliable performance even in high-pressure and high-temperature environments. Built for durability, Vira sensors ensure precise control, making them the ideal choice for steam systems requiring optimal safety and efficiency.

VR01 resistance thermometer is a straight type model without raccord, designed for precise and stable temperature measurement. A B-type connection head is used in standard production. Diameters of 9 mm and above are manufactured as inset type and include the VR05 inset element. Upon request, inset versions can also be produced in diameters below 9 mm.

VR03
Flue Gas Temperature

Vira flue gas temperature sensor is designed for accurate, real-time temperature measurement in high-temperature environments. Made from corrosion-resistant materials, it ensures long-term reliability and seamless integration with boiler control systems, helping optimize efficiency and reduce emissions.

VR02 resistance thermometer is a raccord type model designed for precise and reliable temperature measurement. It is supplied with a standard ½" raccord connection. Diameters of 9 mm and above are manufactured as inset type and include the VR05 inset element. Upon request, inset versions can also be produced in diameters below 9 mm.

Steam and Water Temperature

Type	: VR02
Element	: Pt-100, Pt-1000 (2,3,4 Wire)
Housing	: 1.4571 DIN Stainless Steel (AISI 316)
Size (D)	: This size must be selected by customer
Length (L)	: This size must be selected by customer
Connection	: ½"
Head	: Screwed, Chain and o-ring sealing water proof (IP67)

Flue Gas Temperature

Type	: VR03
Element	: Pt-100, Pt-1000 (2,3,4 Wire)
Housing	: 1.4571 DIN Stainless Steel (AISI 316)
Size (D)	: This size must be selected by customer
Length (L)	: This size must be selected by customer
Connection	: ½"
Head to Thread Length	: 120 mm
Head	: Screwed, Chain and o-ring sealing water proof (IP67)

Note: Resistance thermometers can be manufactured in special dimensions according to customer requirements.

Resistance Thermometer:

Changing the resistance value of a temperature wire obtained by resistance thermometer is a conductive sensor depending on the temperature. It is widely used in industry and laboratory applications found after thermocouple. They give more accurate values than thermocouples, especially at low temperatures and in the processes where precise measurement is desired. The value of the changing resistance changes depending on the temperature change. A varying voltage is obtained with the constant current applied on it.

There are some things to consider for resistance thermometers. The first of these is that the current applied on it causes a small temperature change. Another important element is the resistance of the wires carrying the current. In resistance thermometers, the temperature change factor is defined by "α". Resistance changes are usually formulated as follows.

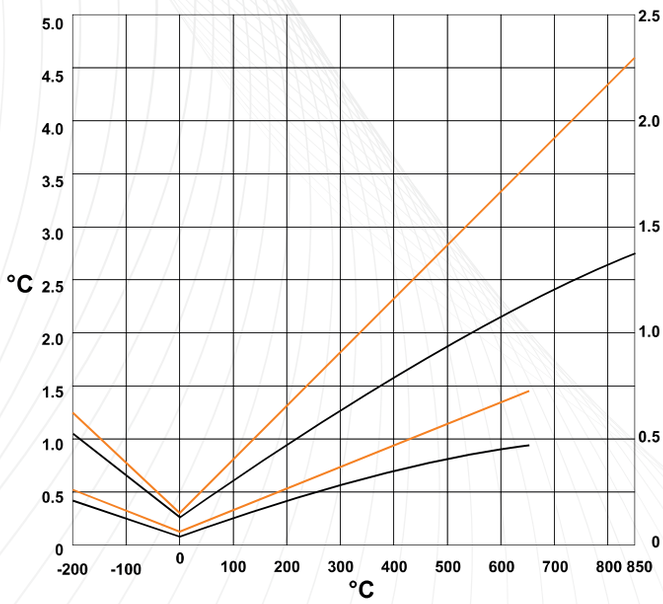
α : Resistance thermometer temperature change factor
R_0 : Resistance value at 0°C
R_{100} : Resistance value at 100°C

$$a = \frac{R100 - R0}{R_\circ * 100\ °C}$$

Resistance thermometer temperature-resistance change values comply with DIN43760 and IEC751 standards. Pt-100 and Ni-1000 resist 100 Ohms at 0°C with a tolerance of ±0.1 Ohm. Temperature-resistance change values are calculated with the following formula:

Rt = Ro (1 + At + Bt)
Rt = Resistance value at any temperature T
Ro = Resistance value at 0°C
t = Temperature
A = 0390784×10-² °C-³ (Constant)
B = 0.578408×10-⁶ °C-² (Constant)

Resistance Thermometer Resistance Graph



Resistance Thermometer Tolerance Table

TEMPERATURE °C	TOLERANCE IEC 751:1983 (BS EN 60751:1996)			
	A CLASS		B CLASS	
	±°C	±OHM	±°C	±OHM
-200	0.55	0.24	1.3	0.56
-100	0.35	0.14	0.8	0.32
0	0.15	0.06	0.3	0.12
100	0.35	0.13	0.8	0.30
200	0.55	0.20	1.3	0.48
300	0.75	0.27	1.8	0.64
400	0.95	0.33	2.3	0.79
500	1.15	0.38	2.8	0.93
600	1.35	0.43	3.3	1.06
650	1.45	0.46	3.6	1.13
700	-	-	3.8	1.17
800	-	-	4.3	1.28
850	-	-	4.6	1.34

Three important points should be taken into consideration in the use of resistance thermometers:
1- Environmental conditions
2- Maximum and minimum operating temperatures
3- Tolerance values

When looking at resistance changes related to temperature, Platinum and Nickel wire give the best performance among many alloys and metals. For this reason, resistors wrapped from these wires are used in Pt-100 and Ni-100s. It is best to use Pt-100 in this area.

a = 3,85.10-³ (1/°C) for Platinum
a = 6,17.10-³ (1/°C) for Nickel

Looking at the resistance thermometer structure, it consists of inset, outer protective sheath and other connection parts. Resistance thermometer element that measures the temperature is placed in the inset with outer protection. Metal oxide powders are filled in the sheath. A single piece of wire is used between the terminal element and the terminal and this wire is insulated with insulators.

In standard production, the inset diameters are 6mm or 8mm, the resistance thermometer element in the sheath is defined as inset with its connection terminal. Inset is mounted in outer protective sheath. With this structure, the inset resistance thermometer in the outer protective sheath can be removed more easily without removing the outer protective sheath from the process. If the resistance thermometer element in the inset is to be connected to a single device, it is produced as a single element, but if it is to be connected to a second device, then it is produced as double element.

Resistance Thermometer Element:
The resistance thermometer element consists of placing the resistance wire wrapped in Platinum or Nickel wire in Ceramic, Glass or Mica. Platinum resistance thermometer elements are used from -200 °C to +850 °C. Since the resistance thermometer elements are used from -60 °C to +150 °C. Pt-100 element is widely used because it gives constant temperature and more accurate values. They are also more readily available. For this reason, Pt-100 is preferred even in processes suitable for Ni-100 ranges.

The resistance thermometer element placed at the tip in the inset is connected to the terminal with Copper (Cu), Silver (Ag) or Nickel chrome (NiCr) wires. If Copper and Silver are chosen, these wires are ignored because their resistance is very low. Applications above 600 °C use as internal connection wire in nickel chrome wire is good. Since the resistance of nickel chrome wire is high, the resistance of this wire is measured and written into the head-terminal block.

Resistance Thermometer Inset:
The resistance thermometer element is not mounted directly on the outer protective sheath. It is placed in a smaller diameter metal sheath and identified as an inset. The inset is placed in the outer protective sheath in a separate metal sheath as the second sheath. In this way, when the resistance thermometer element is damaged, the inset can be changed easily from inside the head without stopping the process and without removing the outer sheath. In this way, if there is an outer sheath and a head available, a more economical product is obtained by only providing inset without the connection parts.

RESİSTANCE THERMOMETER TOLERANCE TABLE (PLATINUM RESISTANT) EN60751 (IEC751)

Temp. °C	Tolerance									
	Class B		Class A		1/3 DIN*		1/5 DIN*		1/10 DIN*	
	± °C	± Ohms	± °C	± Ohms	± °C	± Ohms	± °C	± Ohms	± °C	± Ohms
-200	1.30	0.56	0.55	0.24	0.44	0.19	0.26	0.11	0.13	0.06
-100	0.80	0.32	0.35	0.14	0.27	0.11	0.16	0.06	0.08	0.03
0	0.30	0.12	0.15	0.06	0.10	0.04	0.06	0.02	0.03	0.01
100	0.80	0.30	0.35	0.13	0.27	0.11	0.16	0.05	0.08	0.03
200	1.30	0.48	0.55	0.20	0.44	0.16	0.25	0.10	0.13	0.05
300	1.80	0.64	0.75	0.27	0.60	0.21	0.36	0.13	-	-
400	2.30	0.79	0.95	0.33	0.77	0.26	-	-	-	-
500	2.80	0.93	1.15	0.38	-	-	-	-	-	-
600	3.30	1.06	1.35	0.43	-	-	-	-	-	-
650	3.60	1.13	1.45	0.46	-	-	-	-	-	-
700	3.80	1.17	-	-	-	-	-	-	-	-
800	4.30	1.28	-	-	-	-	-	-	-	-
850	4.60	1.34	-	-	-	-	-	-	-	-

NOTE
Tolerance is calculated to 2 decimal places and taken as a fraction. Class Be.
* Tabulated values for close tolerance detectors are 1/2rd, 1/5th and 1/10th DIN interpolated and are for guidance only,

Protective sheath:
In resistance thermometers, the size, diameter and type of the protective sheaths are selected depending on the process conditions. Inset sheaths are selected from 304 or 316 material. Selection of outer protective sheath should be chosen from different materials for each process. For this reason, please check the "Thermocouple Protective Sheath Selection" table in the thermocouple general information section for the selection of protective sheaths.

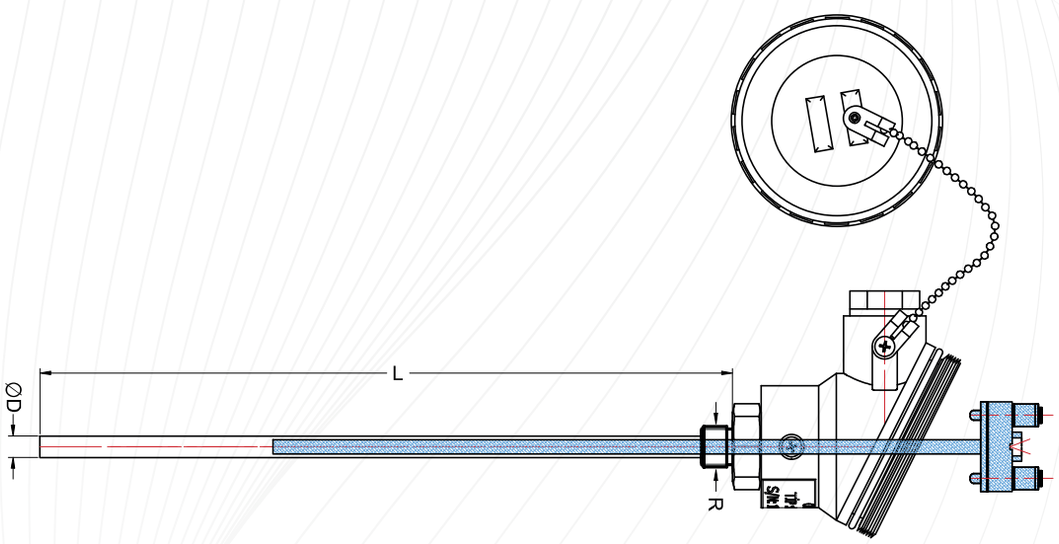
Chemical abrasions and mechanical abrasions in the process should be taken into consideration in the selection of protective sheaths. For an accurate temperature measurement in resistance thermometers, a minimum of 6 and a maximum of 15 times the outer diameters should be immersed in the process. In this way, the farthest element will enter the environment at a sufficient rate and will make the correct measurement. Resistance thermometers should be placed in the flow direction of the fluid in flowing processes.

The nominal resistanc e measurement point is determined at a distance of 8 mm from the end of the sensor body.

Feature	DIN EN 60751 (According to IEC 751) Thin Film Element Features
Temperature Range	-70 ° C to +150 ° C (Coninuous Usage) (It is possible to use it temporarily at 550 ° C.) Tolerance Class B: -70 ° C to +150 ° C Tolerance Class A: -50 ° C to +300 ° C Tolerance Class 1/3 DIN: 0 ° C to +150 ° C

Connection Cables:
Copper conductive cables are used between the device and the resistance thermometer in applications of resistance thermometers. Cables with 1.5mm2 cross-section are preferred. Cable resistance will also have an effect on the measurement value. For this reason, in standard cable connections, a 2-wire cable is used for a distance of up to 10 m, a 3-wire cable for a distance of up to 150m, and a 4-wire cable for distances of more than 150m. In addition, the resistance / current converter method is often used for long distances.

Resistance Thermometer Structure:
Resistance thermometers consist of connection head, protective sheath, inset and various connection parts. Resistance thermometer structure is given in Figure-1. Inset change is given in Figure-2.



RESİSTANCE THERMOMETER TOLERANCE TABLE						(DIN 43760 and 751 STANDARD9				
°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90
-200	18,51	-	-	-	-	-	-	-	-	-
-100	60,27	56,18	52,11	48,01	43,86	39,73	35,55	31,34	27,11	22,82
0	100,00	96,10	92,17	88,22	84,28	80,32	76,31	72,32	68,32	64,31
°C	0	10	20	30	40	50	60	70	80	90
0	100,00	103,90	107,80	111,66	115,53	119,41	123,23	127,07	130,91	134,72
100	138,52	142,30	146,08	149,82	153,57	157,32	161,06	164,78	168,48	172,17
200	175,86	179,54	183,20	186,85	190,47	194,11	197,71	201,32	204,90	208,48
300	212,04	215,61	219,16	222,69	226,22	229,72	233,23	236,71	240,19	243,65
400	247,09	250,53	253,96	257,37	260,77	264,17	267,56	270,93	274,29	277,65
500	280,98	284,30	287,62	290,92	294,21	297,48	300,75	304,02	307,25	310,50
600	313,71	316,92	320,12	323,30	326,48	329,64	332,79	335,93	339,06	342,18
700	345,28	348,38	351,46	354,53	357,59	360,64	363,67	366,70	369,71	372,71
800	375,70	378,78	381,65	384,60	387,55	390,48	-	-	-	-

Note : Resistance values of different resistance thermometer elements are obtained by multiplying the resistance values of the Pt-100 element by certain coefficients.

Sample: Pt-50 = Pt-100×1/2 equals. - Pt-500 = Pt-100×5 equals. - Pt-1000 = Pt-100×10 equals.