

General Description

Temperature Sensor General Description

• Sensor selection guide

◆ Select type of sensor element which meets the working temperature and accuracy. Platinum PT100 RTD, thermistor and thermocouple are three basic types. Sensor element cannot be used if in its natural form. It must be built in protection tube to form a sensor assembly for use.

◆ Select style of sensor assembly and material of protection tube to the requirement for heat resistance, corrosion resistance, mechanical strength, mounting condition, etc.

◆ The sensing temperature shall fall in the working temperature range of sensor to ensure the sensing accuracy and service life.

◆ It is suggestible to select Sheath type sensor when sensing a temperature below room temperature.

◆ Select lead wire of appropriate insulating material to match special environment, such as high ambient temperature, wet, corrosive, etc.

• Temperature sensor assembly

◆ Classified by extension wire (lead wire)

Lead wire type :

One end of lead wire connected with sensor element inside protection tube, the other end is provided for external wiring.

T-head :

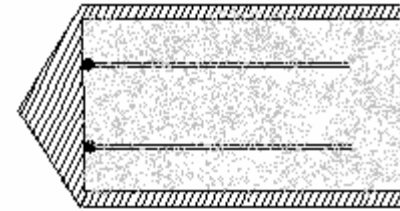
A T shape connection head made of aluminium or other material. Inner side of terminal block of the head connected with sensor element, the outside is provided for external wiring.

Common type :

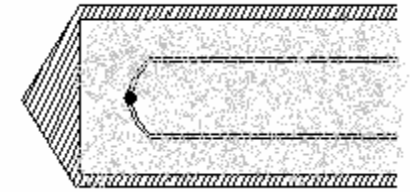
An insulation tube is inserted between sensor element and inner wall of protection tube.

Common type thermocouple sensor assembly

Earthed type



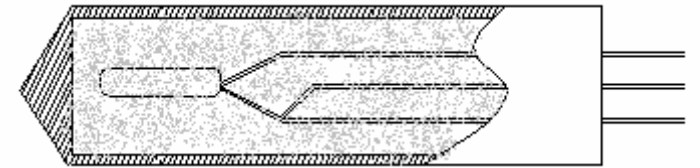
Isolated type



Earthed type: Good heat response, weak noise resistance

Isolated type : Slower heat response, good noise resistance

Common type PT-100 RTD sensor assembly



All PT-100 RTD sensors are un-earthed (isolated) type

◆ Classified by sensor element

PT100 RTD sensor :

low temperature range type : sensing -200°C to +100°C

medium temperature range type : sensing 0°C to + 300°C

high temperature range type : sensing 0°C to + 500°C

Round-head :

An enclosed round shape connection head made of aluminium or other material. Terminal block locates inside the head. Inner side of terminal block connected with sensor element, the outside is provided for external wiring.

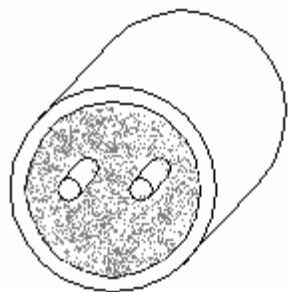
◆ Classified by construction inside protection tube

Sheath type :

MgO powder is filled inside protection tube to insulate sensor element. Sheath sensor has excellent characteristics of heat transfer, air tight and mechanical strength. The tube is flexible and available for free bending with a curvature of 3-4 times of the diameter of the protection tube.

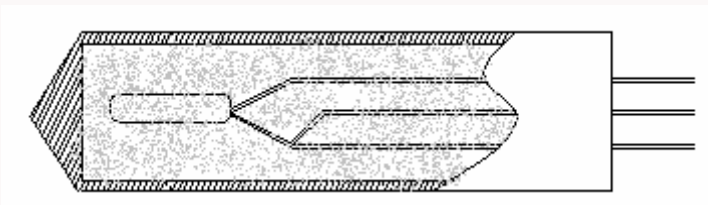
	JIS code		Sensing range	Remarks
	Current	Previous		
	B		200°C ~ 1700°C	uncommon
	S	PR10%	0°C~1600°C	uncommon
	R	PR13%	0°C~1600°C	
◆ Classified by construction inside protection tube	K	CA	-200°C~1200°C	
	J	IC	0°C~750°C	
	E	CRC	-200°C~800°C	uncommon
	T	CC	-200°C~350°C	uncommon
Thermistor sensor : Thermistor is not used for industrial temp. control due to its narrow range span.				
● Common protection tube material				

Sheath type thermocouple sensor assembly



Material	Working Temperature	Max. temp.	Characteristic
SUS304	850°C	1000°C	corrosion & heat resistance
SUS310S	1000°C	1100°C	corrosion resistance superior heat resistance
Ti-alloy	500°C	500°C	superior chemical stability

Sheath type PT100 RTD sensor assembly



Inconel	1100°C	1250°C	corrosion & heat resistance
Ceramic	1500°C	1550°C	corrosion resistance superior heat resistance
Working temp. : the limit that the sensor is used continuously.			
Max. temp. : the limit that the sensor sustains for short period.			
Teflon coated tube : for the purpose of enhancing chemical stability.			

Temperature sensor General description

● PT100 RTD Specification -- JIS				● Thermocouple specification -- JIS			
Standard	sensing temp.	0.2 class tolerance	0.5 class tolerance	Sensor	Sensing temp.	Class	Tolerance
100Ω at 0°C	-200°C	±0.55°C	±1.3°C	R	0 -1600°C	0.25	±1.5°C & ±0.25% of temp. sensed
	-100°C	±0.35°C	±0.8°C	S	0 -1600°C	0.25	±1.5°C & ±0.25% of temp. sensed
	0°C	±0.15°C	±0.3°C	K	0 -1200°C	0.75	±2.5°C & ±0.75% of temp. sensed
	100°C	±0.35°C	±0.8°C	J	0- 750°C	0.75	±2.5°C & ±0.75% of temp. sensed
	200°C	±0.55°C	±1.3°C				
	300°C	±0.75°C	±1.8°C				
	350°C	±0.85°C	±2.05°C				
	400°C	±0.95°C	±2.3°C				
	500°C	±1.15°C	±2.8°C				

● Compensation extension wire

To maintain accuracy of sensing , compensation extension wire should be applied to connect sensor assembly and temperature controller.

Sensor	Wire type	Current code	Previous code	Wire gauge	Wire insul.	Shield	Colour	Finishing shield	Ambient
R	common	RX-H	WPR-H	7/0.32x2	fibreglass	fibreglass	black	non	0 -150°C
		RX-H	WPR-H	4/0.65x2	fibreglass	fibreglass	black	non	
		RX-H	WPR-H	7/0.65x2	fibreglass	fibreglass	black	non	
K	element	TC-K-H(SOS)	TC-CA-H(SOS)	4/0.32x2	fibreglass	non	blue	SUS304 overbraid	0 -150°C
		TC-K-H(OS)	TC-CA-H(OS)	0.65x2	fibreglass	non	blue	Cu overbraid(nickel)	
		TC-K-H(SOS)	TC-CA-H(SOS)	0.65x2	fibreglass	non	blue	SUS304 overbraid	
	common	KX-H	WCA-H	4/0.32x2	fibreglass	fibreglass	blue	non	0 -150°C
		KX-H(SOS)	WCA-H(OS)	4/0.32x2	fibreglass	fibreglass	blue	Cu overbraid(nickel)	
		KX-H	WCA-H	7/0.32x2	fibreglass	fibreglass	blue	non	
		KX-H	WCA-H	4/0.65x2	fibreglass	fibreglass	blue	non	
		KX-H	WCA-H	7/0.65x2	fibreglass	fibreglass	blue	non	
		KX-G	WCA-G	4/0.32x2	PVC	PVC	blue	non	-20 to 70°C
		KX-G	WCA-G	7/0.32x2	PVC	PVC	blue	non	
		KX-G	WCA-G	4/0.65x2	PVC	PVC	blue	non	
KX-G	WCA-G	7/0.65x2	PVC	PVC	blue	non			
	KX-G(SOS)	WCA-G(SOS)	7/0.65x2	PVC	PVC	blue	SUS304 overbraid		

J	element	TC-J-H(SOS)	TC-IC-H(SOS)	0.65x2	fibreglass	non	yellow	SUS304 overbraid	0 -150°C
	common	JX-H	WIC-H	4/0.65x2	fibreglass	fibreglass	yellow	non	0 -150°C
		JX-H(SOS)	WIC-H(SOS)	4/0.65x2	fibreglass	fibreglass	yellow	SUS304 overbraid	
		JX-H	WIC-H	7/0.65x2	fibreglass	fibreglass	yellow	non	
		JX-G	WIC-G	7/0.32x2	PVC	PVC	yellow	non	-20 to 70°C
JX-G	WIC-G	7/0.65x2	PVC	PVC	yellow	non			

element type : The material of element type compensation wire is identical to that of the same sensor type.

Compensation wire colour code :

1. positive(+) polarity : **red**

2. negative(-) polarity : **white or black for R; blue for K; yellow for J**

Temperature sensor General description

● Installation and application

◆ Install temperature sensor assembly at the most appropriate location in load machine in accordance with requirement of system control. Normally, the location where temperature keeps stable is chosen to plant sensor assembly.

● Factors causing temperature error

◆ Combined error

In practical application, overall tolerance of a temperature system contains tolerances of sensor element, lead wire and controller.

Thus the overall tolerance may become larger.

For example :

◆ Ideal depth of inserting sensor in the device to be sensed

Sensor of metal protection tube : > 15 times of tube diameter

Sensor of non-metal tube : >10 times of tube diameter

PT100 RTD tube assembly : >20times of tube diameter

Sensing Temp. (assumption)	0.75 class thermocouple (JIS Tolerance)	±3°C class Compensation Lead Wire (JIS Tolerance)	±1.5°CClass 0 -400°C Temp. controller	Combined Error
200°C	±2.5°C	±3°C	±6°C	±11.5°C

	400°C	±3°C	±3°C	±6°C	±12.0°C
◆ When sensing flowing fluid, sensor tube shall be installed opposing to the direction of fluid flow. The tube must be strong enough to resist bending force and vibration caused by fluid flow.	◆ Natural aging of sensor element.				
	◆ Deterioration due to operating beyond sensor's working temp range.				
◆ If sensor tube is mounted horizontally on a vertical wall/well, it may be necessary to duly support the tube considering tube length and diameter, surrounding temperature and vibration.	◆ Accumulation of dust on surface of protection tub tube.				
	◆ Turbulence, such as opening of the door of a chamber causes a sudden change in temperature and control error accordingly.				
◆ Do not immerse sensor assembly in fluid unless sensor assembly is water proof type.	◆ When sensing temperature of air in fast flow, the temperature measured may be higher than real temperature because of effect of compression and friction.				
◆ Thermocouple sensor element has + and - polarity. The lead wire of sensor must be connected to + and - polarity of terminal block of temperature controller correctly.	◆ Although length of extension wire has minor effect on sensing accuracy of PT100 3wire RTD, error will occur if the extension wires are in difference length.				
◆ The lead wire of sensor shall not be stranded with live power wire/cable to avoid electrical interference which will cause error on control accuracy.	◆ If a sheath sensor is straightened from previous bend for re use, be aware of that the sensor element may be damaged and error may occur.				
◆ If thermocouple sensor is located in a place where electrical leakage occurs, it is necessary to use isolated (un-earthed) type sensor.	◆ Replacing sensor in a system will cause an Interchangeability error. Re-calibration can be made by Reset adjustment on temperature controller.				
◆ Compression fitting is applicable to system temperature below 600°C. Do not exert compression fitting on Teflon coated tube because the coating will be damaged.					
◆ Loose flange fitting is applicable to system temperature below 400°C.					
	Sensor	Temp. range	Interchangeability error		
			standard lead wire	special lead wire	
	PT100	-195 to +480°C	0°C---0.3°C		
	K	0 to 275°C	±2°C	±1°C	
		275 to 1260°C	- ±0.75%	±1.25%	
	J	0 to 275°C	±2°C	±1°C	
		275 to 700°C	±0.75%	±1.25%	
	* : to calculate Interchangeability error expressed in supposing K-sensor sensing 300°Cinterchangeability error = ±300°C X0.75%= ±2.25°C				