

# Resistance Temperature Detectors

## What is Resistance Temperature Detector (RTD)?

Generally, electrical resistance of any metallic conductor varies according to temperature changes. The sensor for measurement of temperature by utilizing this phenomenon is called “Resistance Thermometer” or “RTD” and can measure temperatures more precisely than other temperature sensors.

## Its Features

Resistance temperature detectors for industrial applications have the following features.

1. Good sensitivity.
2. Excellent stability and reproducibility.
3. High accuracy.



## Structure and Measuring Methods

### Structure:

Metal wire that changes its electric resistance to changes in temperature are utilized is called “Resistance Wire”. This resistance wire, normally of platinum, is used to manufacture a temperature sensor called “Resistance Temperature Detector(RTD)Element”. Generally speaking, RTD is composed of RTD element, lead wires, protection tube and terminals.

### Measuring Methods:

#### 2-Wires Connection: Type W

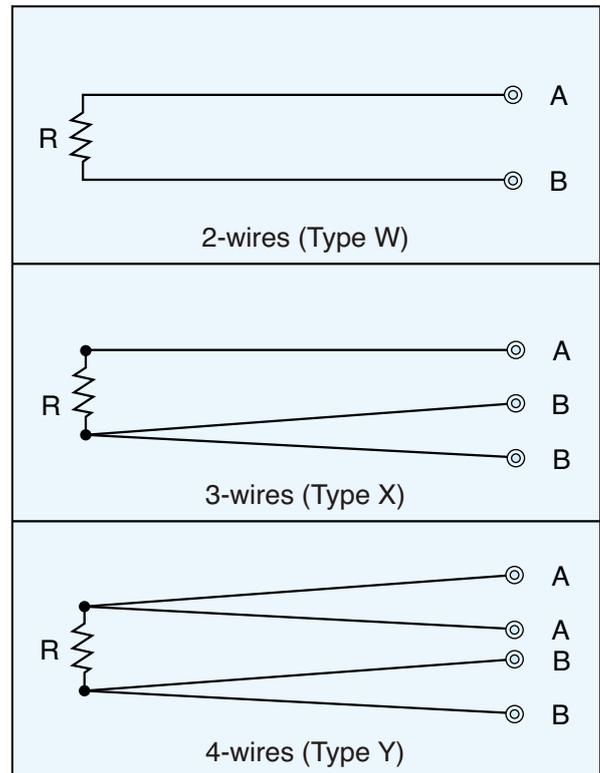
RTD element is connected to respective two wire leads. Although it is less expensive than other types, it is not recommendable for high precision measurement of temperature because it is susceptible to lead resistance and produces error.

#### 3-Wires Connection: Type X

One end of RTD element is connected to two wire leads and the other end connected to single lead to eliminate the effect from lead resistance. This type is most widely used as a reliable method in industrial applications.

#### 4-Wires Connection: Type Y

RTD element is connected to respective two wire leads to remove the effect from lead resistance. This connection cancels lead resistance effect and is especially recommendable for high precision measurement of temperature but somewhat expensive than other types.



R = RTD element. ⊙ = Terminal.  
 - = lead wire.  
 A or B = Code for terminal

## Precautions in Practical Applications

Selection of proper RTD suitable for the application is the most important factor. For precision measurement of temperature, consideration should be given to selection of RTD element, protection tube, structure and fitting (location) according to the respective resistance to heat, corrosion, mechanical shock and other environmental conditions.

## Mica Type RTD

### What is Mica Type RTD?

This is the most typical resistance temperature detector using Mica type RTD element as shown in the right picture.

### Features

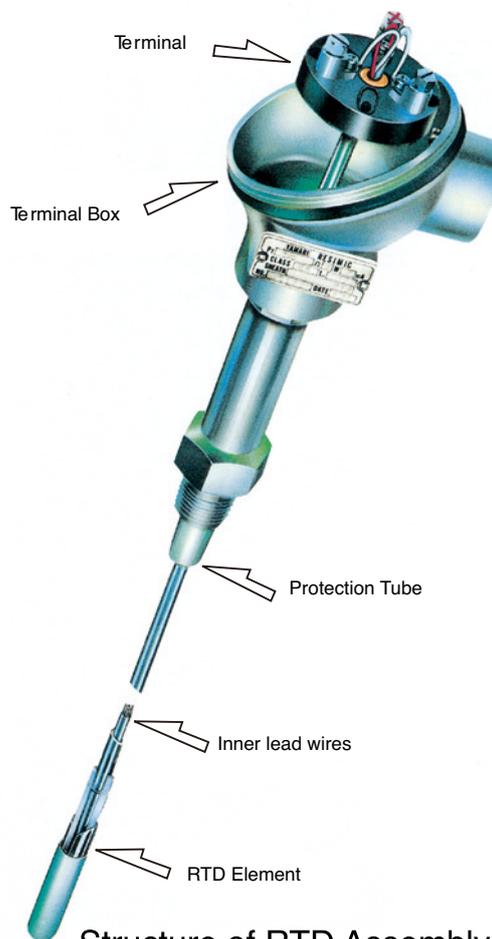
- 1) The use of high purity platinum resistance wire ensures precision measurement.
- 2) Excellent in stability and reproducibility.

### Vibration & Shock Resistance

For the use under high flow-velocity, vibration or mechanical shock, RTD element and inner lead wires are protected by shock-resistant stainless steel inner tube support.

### Low Temperature Treatment

Low temperatures often cause dew condensation in a protection tube that results in deterioration of insulation resistance. For use at sub-zero temperature, please specify "Low Temperature Treatment" that makes the sensing tip of RTD element covered with silicon or paraffin coating to protect from dewing.



Structure of RTD Assembly

### Standard Specifications

| Nominal Resistance (at 0°C) | Code |
|-----------------------------|------|
| Pt 100Ω                     | 100  |
| JPt 100Ω                    | J100 |

| No. of Element | Code |
|----------------|------|
| 1 (Single)     | S    |
| 2 (Double)     | D    |

| Lead Connection | Code |
|-----------------|------|
| 2-wires         | W    |
| 3-wires         | X    |
| 4-wires         | Y    |

| Rated Current | Code |
|---------------|------|
| 0.5 mA        | 005  |
| 1 mA          | 01   |
| 2 mA          | 02   |
| 5 mA※         | 05   |

※: 5 mA for JPt100

### Lead Wires to Applications

| Application      | Code | Operating Temperature | Inner Lead Wires |
|------------------|------|-----------------------|------------------|
| Low Temperature  | L    | -200~100°C            | Silver           |
| Mid. Temperature | M    | 0 ~250°C              | Silver           |
| High Temperature | H    | 0 ~400°C              | Nickel           |

## Properties of Insulating Tubes

| Material  | Code | Operating Temp. | Maximum Temp. | Properties  |
|-----------|------|-----------------|---------------|---|
| Ceramic 1 | PS1  | 1400°C          | 1600°C        | Highest insulation among insulation materials. Solid.               |
| Teflon    | FEP  | 180°C           | 200°C         | Excellent resistance to heat, chemicals, etc. Flexible.             |
| Polyimid  | PM   | 220°C           | —             | Characteristics similar to FEP but tougher and thin-wall thickness. |

## Properties of Metal Protection Tubes

| Material  | Code | Operating Temp.                 | Properties   |
|-----------|------|---------------------------------|--|
| Copper    | CU   | 250°C                           | Good heat conductivity and excellent corrosion-resistance.   |
| Brass     | BS   | Oxidizing 400°C Reducing 150°C  | Similar to Copper and good workability.  |
| 304S.S.   | 304  | 980°C                           | High resistance to heat and corrosion.   |
| 316S.S.   | 316  | 980°C                           | Excellent resistance to heat, acids and alkalis.   |
| 316L.S.S. | 316L | 980°C                           | Excellent resistance to grain boundary corrosion.  |
| Titanium  | TI   | Oxidizing 250°C Reducing 1000°C | Excellent resistance to corrosion at low temp. but easily oxidized and embrittled at high temperature. |
| Monel     | MN   | Oxidizing 500°C Reducing 600°C  | Excellent resistance to heat, high pressure and corrosion.   |

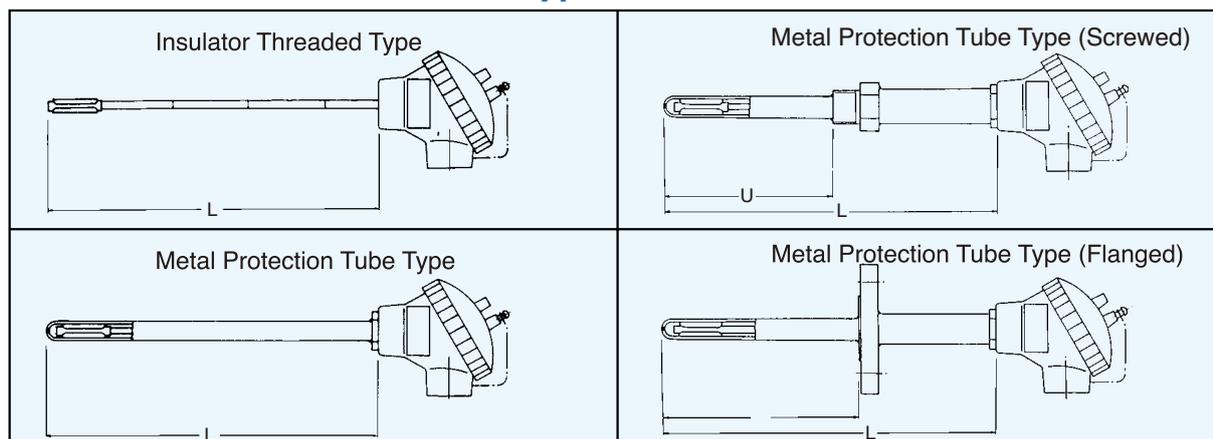
Other special tubes are also available. Operating and maximum temperatures vary depending on atmospheres.

## Standard Dimensions of Protection Tubes

(○=Available)

| material<br>Size(mm) | Regular Type single |     |      | Regular Type double |     |      | Shock Proof Type single |     |      | Shock Proof Type double |     |      | Remarks    |
|----------------------|---------------------|-----|------|---------------------|-----|------|-------------------------|-----|------|-------------------------|-----|------|------------|
|                      | 304                 | 316 | 316L | 304                 | 316 | 316L | 304                     | 316 | 316L | 304                     | 316 | 316L |            |
| 7 × 5                | ○                   |     |      |                     |     |      |                         |     |      |                         |     |      |            |
| 8 × 6                | ○                   | ○   |      |                     |     |      |                         |     |      |                         |     |      |            |
| 9 × 7                | ○                   |     |      | ○                   |     |      |                         |     |      |                         |     |      |            |
| 10 × 8               | ○                   | ○   | ○    | ○                   | ○   | ○    | ○                       | ○   | ○    |                         |     |      |            |
| 11 × 9               | ○                   |     |      | ○                   |     |      | ○                       |     |      | ○                       |     |      |            |
| 12 × 9               | ○                   | ○   | ○    | ○                   | ○   | ○    | ○                       | ○   | ○    | ○                       | ○   | ○    |            |
| 13 × 9               | ○                   |     |      | ○                   |     |      | ○                       |     |      | ○                       |     |      |            |
| 13.8 × 9.4           | ○                   | ○   | ○    | ○                   | ○   | ○    | ○                       | ○   | ○    | ○                       | ○   | ○    | 8A SCH.40  |
| 15 × 11              | ○                   | ○   | ○    | ○                   | ○   | ○    | ○                       | ○   | ○    | ○                       | ○   | ○    |            |
| 16 × 12              | ○                   |     |      | ○                   |     |      | ○                       |     |      | ○                       |     |      |            |
| 17.3 × 12.7          | ○                   | ○   | ○    | ○                   | ○   | ○    | ○                       | ○   | ○    | ○                       | ○   | ○    | 10A SCH.40 |
| 20 × 16              | ○                   |     |      | ○                   |     |      | ○                       |     |      | ○                       |     |      |            |
| 21.7 × 16.1          | ○                   | ○   | ○    | ○                   | ○   | ○    | ○                       | ○   | ○    | ○                       | ○   | ○    | 15A SCH.40 |

## Standard Assemblies of Mica Type RTD



# Sheathed Type RTD

## RESIMIC What is RESIMIC?

RESIMIC<sup>®</sup> is a registered trade name of YAMARI's metal sheathed RTD that has a monolithic structure comprising of RESICERAM<sup>®</sup> element and MI cable (MgO compacted, metal sheathed lead wires). This newly developed RTD has very quick response, longer service life and high accuracy under critical conditions.

## RESIMIC Its Features

- 1) Quick Response:  
Since RESIMIC<sup>®</sup> sensing part is filled with high purity alumina powder and protected by a metal sheath, it has much faster response than those of ordinary RTD's and can follow any slight change in temperature.
- 2) High Flexibility:  
Except for the sensing part of up to 60mm from the tip, it can be bent to the radius equal to 2 times of the sheath O.D.
- 3) High Accuracy:  
Since high purity platinum resistance wire is used, it has high accuracy falling within the class of A or B stipulated by JIS C1604-1997, or other internationally known Standards.
- 4) Wide Variety of Specifications:  
Outer diameters from 3.2mm to 8.0mm and total length up to 150 meters are available.
- 5) Wide Range of Measuring Temperatures:  
From cryogenic (−200°C) to high temperature (+500°C) can be measured although it may vary

