TempGenius RTD Technology

What is a Platinum Element RTD?

Resistance Temperature Detectors (RTDs) are temperature sensors that contain a resistor that changes resistance value as its temperature changes. They have been used for many years to measure temperature in laboratory and industrial processes, and have developed a reputation for accuracy, repeatability, and stability. Now this state of the art technology can be utilized in Wireless Temperature Monitoring in the high precision 4 wire configuration.

Why use RTD over other technologies?

Each type of temperature sensor has a particular set of conditions for which it's best suited. RTDs offer many advantages:

- A wide temperature range (-50 to 500℃ for thin-film and -200 to 850℃ for wire-wound)
- Good accuracy (better than thermocouples)
- Good interchangeability
- 2 Year ISO 17025 Service Interval
- Stability for more than 5 years in controlled environments

With a temperature range up to 850℃, RTDs can be used in all but the highest-temperature industrial processes. When made using metals such as platinum, they are very stable and are not affected by corrosion or oxidation.

Other materials such as nickel, copper, and nickel-iron alloy have also been used for RTDs. However, these materials are not commonly used since they have lower temperature capabilities and are not as stable or repeatable as platinum. That is why TempGenius only uses platinum element RTD.

RTD types

There are two standards for platinum RTDs: the European standard (also known as the DIN or IEC standard) and the American standard.

The European standard, also known as the DIN or IEC standard, is considered the world-wide standard for platinum RTDs. This standard, DIN/IEC 60751 (or simply IEC751), requires the RTD to have an electrical resistance of 100.00 Ω at 0℃ and a temperature coefficient of resistance (TCR) of 0.00385 Ω/Ω/℃ between 0 and 100℃.

There are three resistance tolerances for Thin Film RTDs specified in IEC60751:

Class AA (Formerly 1/3B) = ±(0.1+0.0017*t)℃ or 100.00 ± 0.04Ω at 0℃

Class A = ±(0.15+0.002*t)℃ or 100.00 ± 0.06Ω at 0℃

Class B = ±(0.3+0.005*t)℃ or 100.00 ± 0.12Ω at 0℃

Also, one special class not included in DIN/IEC60751:

Class 1/10B = ±1/10 (0.3+0.005*t)℃ or 100.00 ± 0.012Ω at 0℃

The combination of resistance tolerance and temperature coefficient define the resistance vs. temperature characteristics for the RTD sensor. The larger the element tolerance, the more the sensor will deviate from a generalized curve, and the more variation there will be from sensor to sensor (interchangeability). This is important to users who need to change or replace sensors and want to minimize interchangeability errors. That represents the majority of TempGenius users that want to replace probes connected to remote wireless transmitters. Section Z contains a resistance vs. temperature curve from -200 to 850℃ with resistance values given for every degree Celsius. The following interchangeability table shows how the tolerance and temperature coefficient affect the indicated temperature of the sensor in degrees Celsius:

Element Interchangeability in ℃				
Temp ℃	**Class B**	**Class A**	**Class AA (⅓ B)**	**Class ⅒ DIN**
-196	1.28	—	—	—
-100	0.80	0.35	—	—
-50	0.55	0.25	0.18	—
-30	0.45	0.21	0.15	—
0	0.30	0.15	0.10	0.03
100	0.80	0.35	0.27	0.08
150	1.05	0.45	0.35	—
200	1.30	0.55	0.43	—
250	1.55	0.65	0.52	—
300	1.80	0.75	—	—
400	2.30	0.95	—	—
450	2.55	1.05	—	—
500	2.80	—	—	—
600	3.30	—	—	—

Our default RTD product offering is based on the European or IEC standard. TempGenius uses Class A by default.

The American standard has a resistance of 100.00 ±0.10 Ω at 0℃ and a temperature coefficient of resistance (TCR) of 0.00392 Ω/Ω/℃ nominal (between 0 and 100℃). Section Z also includes a resistance vs. temperature curve from -100 to 457℃, with resistance values given every one degree Celsius.

Tolerance Class Temperature Ranges		
Class	**Wire Wound**	**Thin Film**
AA	-50 to 250℃	0 to 150℃
A	-100 to 450℃	-30 to 300℃
B	-196 to 600℃	-50 to 500℃
1/10B	0 to 100℃	0 to 100℃

Other resistance value options
RTD elements can also be purchased with resistances of 200, 500, and 1000 Ω at 0℃. These RTDs have the same temperature coefficients as previously described, but because of their higher resistances at 0℃, they provide more resistance change per degree, allowing for greater resolution.

RTD Element Construction
Platinum RTD elements are available in two types of constructions: thin film and wire wound.

Thin Film
Thin-film RTD elements are produced by depositing a thin layer of platinum onto a substrate. A pattern is then created that provides an electrical circuit that is trimmed to provide a specific resistance. Lead wires are then attached and the element and the assembly coated to protect the platinum film and wire connections.

Thin film elements are available in the European standard (0.00385 Ω/Ω/℃), and in a special version, used primarily in the appliance industry, that has a temperature coefficient of 0.00375 Ω/Ω/℃. Thin film elements are not available in the American standard.

Wire Wound
RTD elements also come in wire-wound constructions. There are two types of wire-wound elements: those with coils of wire packaged inside a ceramic or glass tube (the most commonly used wire-wound construction), and those wound around a glass or ceramic core and covered with additional glass or ceramic material (used in more specialized applications).

Except for the 2-wire configuration, each of the above wiring arrangements allows the monitoring or control equipment to factor out the unwanted lead wire resistance and other resistances that occur in the circuit. We do not recommend 2-wire configurations with TempGenius or higher tolerance process control.

Sensors using the 3-wire construction are the most common design, found in industrial process and monitoring applications. The lead wire resistance is factored out as long as all of the lead wires have the same resistance; otherwise, errors can result.
or when tight measurement accuracy is not required. TempGenius sensors are most often specified as 4-wire configuration.

Wire Materials
When specifying the lead wire materials, care should be taken to select the right lead wires for the temperature and environment the sensor will be exposed to in service.

When selecting lead wires, temperature is by far the primary consideration, however, physical properties Such as abrasion resistance and water repelling characteristics can also be important.

Below is a table listing the capabilities of the three most popular constructions:

Lead Wire Materials			
Insulation	**Temperature Range**	**Abrasion Resistance**	**Water Submersion**
PVC	-40 to 105℃	Excellent	Good
PFA	-267 to 260℃	Good	Excellent
Fiberglass	-73 to 482℃	Poor	Poor

Configuration
Once the RTD element, wire arrangement, and wire construction are selected, the physical construction of the sensor needs to be considered. The final sensor configuration will depend upon the application.

Measuring the temperature of a liquid, a surface, or a gas stream requires different sensor configurations.