

Rtd Accuracy Class Table

A practical guide to rtd accuracy class table, covering the reader intent, the relationship to rtd accuracy class table, key evaluation criteria, common risks, and the information the intended project audience should confirm before taking the next step.



levelmeter.org
Main topic: Main Page
<https://www.level-meters.com/>

In the realm of industrial process control, temperature measurement is as critical as pressure or level monitoring. Resistance Temperature Detectors (RTDs) are favored for their stability, repeatability, and high accuracy. However, not all RTDs are created equal. To ensure process safety and efficiency, engineers must navigate the standardized accuracy classifications that define the permissible error margins for these sensors. This guide provides a comprehensive rtd accuracy class table, explains the underlying measurement principles, and offers practical advice for selecting the right sensor for industrial applications.

| Understanding RTD Measurement Principles

Before diving into the accuracy tables, it is essential to understand how an RTD functions. An RTD is a passive sensing element that operates on the principle that the electrical resistance of a metal increases as its temperature rises. This relationship is highly predictable and linear over a wide range.

| The Material Choice: Why Platinum?

While various metals like nickel and copper can be used, platinum is the industry standard due to its chemical inertness, wide temperature range (-200°C to +850°C), and excellent linearity. The most common RTD is the Pt100, which has a nominal resistance of 100 ohms at 0°C. Pt1000 sensors, which have 1000 ohms at 0°C, are also widely used, particularly in battery-powered or low-power applications where higher resistance reduces self-heating errors.

| The Alpha Coefficient (α)

The relationship between resistance and temperature is defined by the temperature coefficient of resistance, often referred to as the "Alpha" value. The international standard IEC 60751 specifies an Alpha of 0.003851 $\Omega/\Omega/^{\circ}\text{C}$. This means that for a Pt100 sensor, the resistance increases by approximately 0.385 ohms for every 1°C rise in temperature.

| RTD Accuracy Standards and Classifications

RTD accuracy is governed by international standards, primarily IEC 60751 (globally) and ASTM E1137 (primarily in North America). These standards categorize sensors into "classes" based on their tolerance—the maximum allowable deviation from the nominal resistance-temperature curve.

| IEC 60751 Tolerance Classes

The IEC 60751 standard was updated in 2008 to include four main tolerance classes for thin-film and wire-wound sensors: Class AA, A, B, and C. These classes specify the tolerance at a given temperature (°C) in degrees Celsius.

Class AA: The highest standard accuracy, often used in laboratory or critical pharmaceutical processes.

Class A: The standard for high-precision industrial applications.

Class B: The most common industrial grade, suitable for general-purpose monitoring.

Class C: Used in applications where broad monitoring is sufficient and cost is a primary concern.

| The RTD Accuracy Class Table

The following table outlines the tolerance formulas and the resulting temperature errors at specific points according to IEC 60751. These values apply to both Pt100 and Pt1000 sensors.

| Table 1: IEC 60751 Tolerance Formulas

Tolerance Class		Tolerance Formula (°C)		Temperature Range (Wire-Wound)	Temperature Range (Thin-Film)
Class AA	$\pm(0.1 + 0.0017t)$	t	)\$	-50°C to +250°C	0°C to +150°C
Class A	$\pm(0.15 + 0.002t)$	t	)\$	-100°C to +450°C	-30°C to +300°C
Class B	$\pm(0.30 + 0.005t)$	t	)\$	-196°C to +600°C	-50°C to +500°C
Class C	$\pm(0.60 + 0.01t)$	t	)\$	-196°C to +600°C	-50°C to +600°C

Table 2: RTD Accuracy Class Table (Error in °C at Specific Temperatures)

Temperature (°C)	Class AA (±°C)	Class A (±°C)	Class B (±°C)	Class C (±°C)
-200	N/A	N/A	1.30	2.60
-100	N/A	0.35	0.80	1.60
0	0.10	0.15	0.30	0.60
100	0.27	0.35	0.80	1.60
200	0.44	0.55	1.30	2.60
300	N/A	0.75	1.80	3.60
400	N/A	0.95	2.30	4.60
500	N/A	N/A	2.80	5.60
600	N/A	N/A	3.30	6.60

Note: "N/A" indicates that the temperature is outside the standard's defined range for that specific accuracy class.

| Factors Affecting RTD Accuracy in Practice

While the rtd accuracy class table provides a theoretical limit, real-world accuracy is influenced by several external factors. Understanding these is vital for maintaining the integrity of your measurement system.

| 1. Lead Wire Resistance

In a 2-wire RTD configuration, the resistance of the lead wires is added directly to the sensor's resistance, causing a significant positive error (offset). For example, 10 meters of standard copper wire could add 1-2 ohms, which translates to a 3-5°C error in a Pt100 sensor.

Solution: Use 3-wire or 4-wire configurations. A 3-wire setup compensates for lead resistance assuming all leads are identical, while a 4-wire setup provides the highest accuracy by completely eliminating lead wire effects.

| 2. Self-Heating

To measure resistance, a small current must be passed through the RTD. This current generates heat (I^2R). If the current is too high, the sensor will report a temperature higher than the actual process temperature.

Solution: Limit the excitation current to 1 mA or less. In level measurement applications where the RTD is integrated into a transmitter, the electronics usually manage this automatically.

| 3. Immersion Depth

If the RTD probe is not immersed deeply enough into the medium, heat may conduct along the sensor sheath to the ambient environment (stem conduction). This results in a measurement that is between the process temperature and the ambient temperature.

Solution: A general rule is to immerse the sensor to a depth at least 10 times the diameter of the protection tube.

| Integration with Level Measurement Systems

In many industrial settings, temperature measurement is not an isolated task but a critical component of accurate level measurement. For instance, when using hydrostatic level transmitters, the density of the liquid changes with temperature. To maintain high accuracy in volume or mass calculations, the system must compensate for these thermal fluctuations.

Advanced level measurement solutions, such as those found on the Main Page of industrial instrumentation providers, often feature integrated RTDs or secondary temperature inputs. Whether you are using radar level meters or ultrasonic sensors, temperature compensation ensures that the speed of signal travel or the liquid density is correctly accounted for, preventing errors in inventory management.

| Selecting the Right Accuracy Class for Your Process

Choosing the correct class from the rtd accuracy class table involves balancing cost with the requirements of the application.

Class AA/A: Essential for custody transfer, chemical reactions with narrow thermal windows, and pharmaceutical manufacturing. In these sectors, a deviation of 0.5°C can result in spoiled batches or safety risks.

Class B: The standard choice for water treatment, HVAC, and general industrial automation. It provides a reliable balance of cost and performance for most bulk storage tanks and cooling water loops.

Class C: Suitable for non-critical monitoring, such as ambient air temperature in warehouses or basic freeze protection where precise control is not required.

| Installation and Maintenance Best Practices

To ensure your RTD continues to meet the specifications in the rtd accuracy class table, follow these maintenance guidelines:

1. **Calibration:** RTDs are stable, but mechanical shock or extreme thermal cycling can cause "drift." Annual calibration against a certified reference standard is recommended for Class A and AA sensors.
2. **Insulation Resistance:** Moisture ingress into the sensor housing can create a parallel resistance path, leading to erroneously low temperature readings. Ensure all seals and cable glands are IP-rated and intact.
3. **Thermowell Selection:** Use a thermowell to protect the sensor from high pressure and corrosive media. To maintain accuracy, use a thermal transfer compound (heat sink paste) inside the thermowell to bridge the air gap between the sensor and the wall.

| Frequently Asked Questions (FAQ)

Q: Can I use a Class A RTD at 600°C?

A: According to the IEC 60751 standard, Class A accuracy for thin-film sensors is generally defined only up to 300°C. While the sensor may function at 600°C, its accuracy will likely degrade to Class B levels or worse. Always check the manufacturer's specific temperature range for the chosen class.

Q: Is a Pt1000 more accurate than a Pt100?

A: Not necessarily. Accuracy is determined by the class (A, B, etc.), not the nominal resistance. However, a Pt1000 is less sensitive to lead wire resistance errors in 2-wire setups because the lead resistance is a much smaller percentage of the total resistance.

Q: What is the difference between "1/10 DIN" and Class AA?

A: "1/10 DIN" is an older term that refers to a tolerance of 1/10th of the Class B error at 0°C ($\pm 0.03^{\circ}\text{C}$). While not an official IEC class, it is often used to describe ultra-high precision sensors that exceed Class AA requirements.

By consulting the rtd accuracy class table and adhering to proper installation standards, engineers can ensure that their temperature measurement systems provide the reliable data necessary for complex industrial automation and level control tasks. For more information on how temperature sensing integrates with industrial level technology, Review product options and application support.