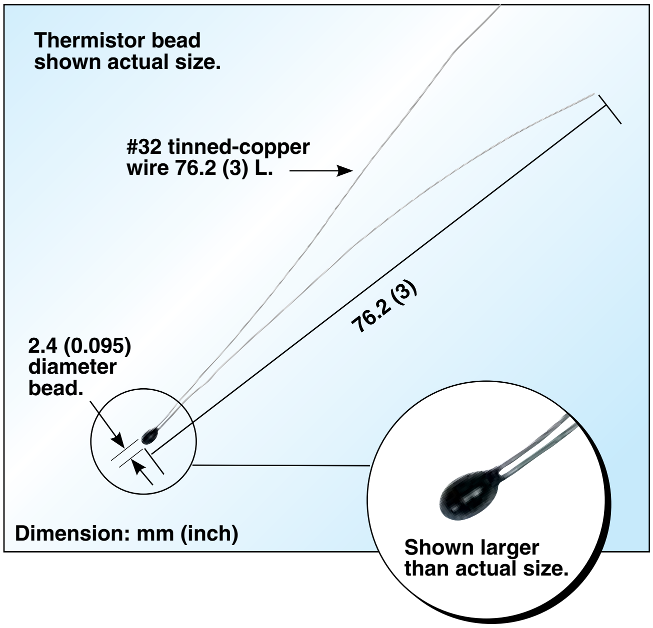
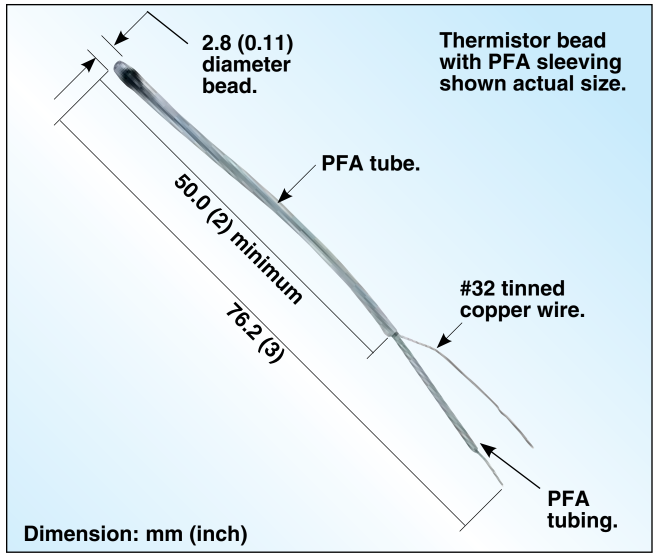
Thermistor Elements





44000 Series

RoHS

- **Epoxy Coated Thermistor Beads**
- **Precision Matched to 5 Standardized Resistance Curves**
- **Maximum Working Temperature 75°C (165°F) or 150°C (300°F) (See Table Below)**
- **Available in Interchangeabilities of ±0.1 or ±0.2°C (See Table Below)**

Resistance Vs. Temperature Characteristics

The Steinhart-Hart Equation has become the generally accepted method for specifying the resistance vs. temperature characteristics for thermistors. The Steinhart-Hart equation for temperature as a function of resistance is as follows:

$$\frac{1}{T} = A + B\,[Ln(R)] + C\,[Ln(R)]^3$$

where: A, B and C are constants derived from 3 temperature test points.
R = Thermistor's resistance in Ω
T = Temperature in degrees K

To determine the thermistor resistance at a specific temperature point, the following equation is used:

$$R = e^{(beta-(alpha/2))1/3 \,-\, ((beta+(alpha/2))1/3}$$

where:
alpha = ((A-(1/T))/C)
beta = SQRT(((B/(3C))^3)+(alpha^2/4))
T = Temperature in Kelvin (°C + 273.15)

The A, B and C constants for each of our thermistor selections can be found in Table 1. Using these constants with the above equations, you can determine the temperature of the thermistor based on its resistance, or determine a thermistor's resistance at a particular temperature.

Typical Thermometric Drift (±0.2°C Elements)

Operating Temp	10 Months	100 Months
0°C	<0.01°C	<0.01°C
25°C	<0.01°C	0.02°C
100°C	0.20°C	0.32°C
150°C	1.5°C	Not recommended

Table 1: Steinhart-Hart Constants

Model Number	Model Number	R25°C	A	B	C
44004	**44033**	**2252**	1.468×10^{-3}	2.383×10^{-4}	1.007×10^{-7}
44005	**44030**	**3000**	1.403×10^{-3}	2.373×10^{-4}	9.827×10^{-8}
44007	**44034**	**5000**	1.285×10^{-3}	2.362×10^{-4}	9.285×10^{-8}
44006	**44031**	**10000**	1.032×10^{-3}	2.387×10^{-4}	1.580×10^{-7}
44008	**44032**	**30000**	9.376×10^{-4}	2.208×10^{-4}	1.276×10^{-7}

Tolerance Curves

Accuracy tolerances for thermistor sensors are expressed as a percentage of temperature. This is also referred to as interchangeability. We list two basic accuracy/interchangeability specifications for our thermistors, ±0.10°C and ±0.20°C from 0 to 70°C (32 to 158°F).

Table 2: Interchangeability Tolerances

Temp (°C)	Model No. 44004 ±0.20°C		Model No. 44033 ±0.10°C	
	±°C	±Ω	±°C	±Ω
-80	1.00	142,000	1.00	142,000
-40	0.40	2018	0.20	1009
0	0.20	75	0.10	38
40	0.20	10	0.10	4.9
70	0.20	2.7	0.10	1.4
100	0.30	1.3	0.15	0.7
150	1.00	0.9	1.00	0.9

Note: *Temperature values (°C) are the same for each tolerance group (±0.10 or ±0.20), resistance tolerances will change based on resistance at 25°C (77°F).*

Temperature vs. resistance tables for our thermistor products can be found on pages Z-236 and Z-237. The accuracy specification of ±0.1% or 0.2% means that each thermistor's resistance will fall within these limits between 0 and 70°C (32 and 158°F).
Table 2 illustrates the interchangeability values for the model numbers 44004 (±0.2°C) and 44033 (±0.1°C) at a number of temperatures.

Stability and Drift

While thermistors are generally very accurate and stable devices, conditions such as over-temperature exposure, humidity, mechanical damage or corrosion can cause uncontrolled changes in the resistance vs. temperature characteristics of the device. Once this characteristic has been altered, it cannot be re-established. This is one reason why most thermistors with a ±0.1°C interchangeability specifcation are rated for use at temperatures somewhat lower than those with an interchangeability of ±0.2°C.

Operating Current

The suggested operating current for bead-style thermistors is approximately 10 to 15 µA. Thermistors can experience self-heating effects if their operating currents are high enough to create more heat than can be dissipated from the thermistor under operating conditions. If higher operating currents are used, it is suggested that a self heating test be performed to insure the accuracy of the measurement.

Dissipation Constant

The dissipation constant is the power in milliwatts that will raise the resistance of a thermistor by 1°C (1.8°F) over its surrounding temperature. Typical values include 8 mW/°C in a stirred oil bath, or 1 mW/°C in still air.

Time Constant

The time constant is the time required for a thermistor to react to a step change in temperature. For example, if exposed to a change from 0 to 100°C (32 to 212°F), the 63% time constant would be the time required for the thermistor to indicate a resistance at 63°C (145°F). Typically, bare thermistors suspended by their leads in a well stirred oil bath will have a 63% response time of 1 second maximum. PFA encased thermistors exposed to changes in air temperature will typically have a 63% response time of 2.5 seconds maximum.

Discount Schedule	
1 to 9	Net
10 to 24	10%
25 to 49	20%
50 to 99	30%
100 and over	40%

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Model Number	Resistance @ 25°C (Ω)	Maximum Working Temp	Interchangeability @ 0 to 70°C	Storage and Working Temp for Best Stability
44004	2252	150°C (300°F)	±0.2°C	-80 to 120°C (-110 to 250°F)
44005	3000	150°C (300°F)	±0.2°C	-80 to 120°C (-110 to 250°F)
44007	5000	150°C (300°F)	±0.2°C	-80 to 120°C (-110 to 250°F)
44006	10,000	150°C (300°F)	±0.2°C	-80 to 120°C (-110 to 250°F)
44008	30,000	150°C (300°F)	±0.2°C	-80 to 120°C (-110 to 250°F)
44033	2252	75°C (165°F)	±0.1°C	-80 to 75°C (-110 to 165°F)
44030	3000	75°C (165°F)	±0.1°C	-80 to 75°C (-110 to 165°F)
44034	5000	75°C (165°F)	±0.1°C	-80 to 75°C (-110 to 165°F)
44031	10,000	75°C (165°F)	±0.1°C	-80 to 75°C (-110 to 165°F)
44032	30,000	75°C (165°F)	±0.1°C	-80 to 75°C (-110 to 165°F)

Note: *Thermistor elements are available with PFA sleeving over 1 lead wire and PFA overall, change middle digit model number to* ***"1"*** *for an additional cost to the base price for the ±0.2°C thermistors and add additional cost to the price of the ± 0.1°C thermistors.*

Ordering Examples: 44004, *2252 Ω thermistor bead at 25°C, ±0.2°C interchangeability.*

44033, *2252 Ω thermistor bead at 25°C, ±0.1°C interchangeability.*

44104, *2252 Ω thermistor bead at 25°C, ±0.2°C interchangeability with PFA insulated lead wire and over-jacket.*

44033, *2252 Ω thermistor bead at 25°C, ±0.1°C interchangeability with PFA insulated lead wire and over-jacket.*