Simulating thermocouples and RTDs for calibration and testing

Thermocouples and RTDs are the most common sensors used in process temperature measurements.

Simulating a process sensor signal into a process instrument or control system input enables a technician to verify whether the device responds correctly to the temperature measured by the instrument. There are many different ways to simulate these sensors for testing purposes.

You can use a mV dc source and a mV vs temperature look up table (below on the left), for simulating thermocouples or a resistance decade box and resistance vs temperature look up table (below on the right), for simulating RTDs. This method, however, has become outdated with modern temperature calibrators that do the conversion for the user. With modern calibrators, simply select the sensor type to simulate, input the temperature to source and connect to the devices under test.

Thermocouple Table – Temperature vs mV

°C	0	1	2	3
0	0.000	0.039	0.079	0.119
10	0.397	0.437	0.477	0.517
20	0.796	0.838	0.879	0.919
30	1.203	1.244	1.285	1.326
40	1.612	1.653	1.694	1.735
50	2.023	2.064	2.106	2.147
60	2.436	2.478	2.519	2.561
70	2.851	2.893	2.934	2.976
80	3.267	3.308	3.350	3.391
90	3.682	3.723	3.765	3.806
100	4.096	4.136	4.179	4.220

RTD Table – Temperature vs Resistance

°C	Ohm	Diff.	°C	Ohm	Diff.	°C	Ohm	Diff.
0	100.00	0.39	10	103.90	0.39	20	107.79	0.39
1	100.39	0.39	11	104.29	0.39	21	108.18	0.39
2	100.78	0.39	12	104.68	0.39	22	108.57	0.39
3	101.17	0.39	13	105.07	0.39	23	108.96	0.39
4	101.56	0.39	14	105.46	0.39	24	109.35	0.39
5	101.95	0.39	15	105.85	0.39	25	109.73	0.39
6	102.34	0.39	16	106.24	0.39	26	110.12	0.39
7	102.73	0.39	17	106.63	0.39	27	110.51	0.39
8	103.12	0.39	18	107.02	0.39	28	110.90	0.39
9	103.51	0.39	19	107.40	0.38	29	111.28	0.38

Suggested test tools

712 RTD Temperature Calibrator

See pg 17

714 Thermocouple Temperature Calibrator

See pg 17

7526A Precision Process Calibrator

See pg 5

726 Precision Multifunction Process Calibrator

See pg 6

754 Documenting Process Calibrator

See pg 5