

# DID YOU KNOW?

**NO: 3**

**May 18, 2009**

## **RTD SENSORS**

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### **What Is an RTD?**

Resistance Temperature Detectors (RTDs) are temperature sensors that contain a resistor that changes resistance value as its temperature changes. The higher the temperature, the higher the resistance. These devices require an electrical current to produce a voltage drop across the sensor that can then be measured by a calibrated read-out device.

RTDs have been used for many years in laboratories and industry and have an excellent reputation for accuracy, repeatability, and stability.

**It is important to remember that RTDs are susceptible to shock and excessive vibration and must be treated with care!**

### **Why Use an RTD Instead of a Thermocouple or Thermistor?**

RTDs offer several advantages:

- A wide temperature range (-200 to 850 C)
- Better accuracy than thermocouples
- Good interchangeability
- Long-term stability
- Easy to recalibrate
- Moderately priced

The most popular RTD type is Platinum. Platinum RTDs are linear over a wide range of temperatures and generally have relatively rapid response times. An RTD will also provide accurate readings over narrow temperature spans (very useful in steam sterilization testing and validation). Typically, they are provided encapsulated in probes with an external indicator or controller.

**Please note that Primus uses only Class “A” Platinum RTDs.**

### **Recent Questions and Issues from the Field**

#### **Can I do a qualitative check of the RTD with an ohmmeter?**

Yes, you can. To do this, disconnect the RTD from the control board. Twist the two similar colored wires together and check the resistance from that pair to the third wire. Compare the resulting resistance to a European curve resistance temperature table (see attached table). Primus uses 100 ohm European curve RTDs. This means the RTD will read 100 ohms at 0 degrees C.

#### **My temperatures and pressures seem to be unstable. Do I have a bad control board?**

Not necessarily. You can have one faulty RTD that can affect the pressure transducer and the other RTD(s). For example, a damaged load probe, jacket RTD, or chamber RTD can affect the other RTDs and/or the pressure transducer through the control board circuitry. Testing the RTDs with an ohmmeter is a good and simple way to evaluate the RTDs to see if they are the root cause problem.

#### **Can I order the various RTDs from Primus?**

Yes, Primus keeps a full stock of RTDs in Omaha, NE. When ordering, ideally have the serial number of the unit you are working on and/or have the lead length. This will ensure that you get exactly what you need.



# PRIMUS

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# RTD Temperature vs. Resistance Table

For European Curve, Alpha = .00385, ITS-90

1° Celsius Increments

°C	Ohms	Diff.	°C	Ohms	Diff.	°C	Ohms	Diff.	°C	Ohms	Diff.	°C	Ohms	Diff.	°C	Ohms	Diff.
-200	18.52		-140	43.88	0.42	-80	68.33	0.41	-20	92.16	0.39	± 0	100.00	0.39	+60	123.24	0.38
199	18.96	0.44	139	44.29	0.41	79	68.73	0.40	19	92.55	0.39	+ 1	100.39	0.39	61	123.62	0.38
198	19.39	0.43	138	44.71	0.42	78	69.13	0.40	18	92.95	0.40	2	100.78	0.39	62	124.01	0.39
197	19.82	0.43	137	45.12	0.41	77	69.53	0.40	17	93.34	0.39	3	101.17	0.39	63	124.39	0.38
196	20.25	0.43	136	45.53	0.41	76	69.93	0.40	16	93.73	0.39	4	101.56	0.39	64	124.77	0.38
195	20.68	0.43	135	45.95	0.42	75	70.33	0.40	15	94.12	0.39	5	101.95	0.39	65	125.17	0.40
194	21.11	0.43	134	46.35	0.40	74	70.73	0.40	14	94.52	0.40	6	102.34	0.39	66	125.55	0.38
193	21.54	0.43	133	46.76	0.41	73	71.13	0.40	13	94.91	0.39	7	102.73	0.39	67	125.93	0.38
192	21.97	0.43	132	47.18	0.42	72	71.53	0.40	12	95.30	0.39	8	103.12	0.39	68	126.32	0.39
191	22.40	0.43	131	47.59	0.41	71	71.93	0.40	11	95.69	0.39	9	103.51	0.39	69	126.70	0.38
190	22.83	0.43	130	48.00	0.41	70	72.33	0.40	10	96.09	0.40	10	103.90	0.39	70	127.08	0.38
189	23.26	0.43	129	48.41	0.41	69	72.73	0.40	9	96.48	0.39	11	104.29	0.39	71	127.46	0.38
188	23.69	0.43	128	48.82	0.41	68	73.13	0.40	8	96.87	0.39	12	104.68	0.39	72	127.85	0.39
187	24.12	0.43	127	49.23	0.41	67	73.53	0.40	7	97.26	0.39	13	105.07	0.39	73	128.23	0.38
186	24.55	0.43	126	49.64	0.41	66	73.93	0.40	6	97.65	0.39	14	105.46	0.39	74	128.61	0.38
185	24.97	0.42	125	50.06	0.42	65	74.33	0.40	5	98.04	0.39	15	105.85	0.39	75	128.99	0.38
184	25.39	0.42	124	50.47	0.41	64	74.73	0.40	4	98.44	0.40	16	106.24	0.39	76	129.38	0.39
183	25.82	0.43	123	50.88	0.41	63	75.13	0.40	3	98.83	0.39	17	106.63	0.39	77	129.76	0.38
182	26.25	0.43	122	51.29	0.41	62	75.53	0.40	2	99.22	0.39	18	107.02	0.39	78	130.14	0.38
181	26.67	0.42	121	51.70	0.41	61	75.93	0.40	1	99.61	0.39	19	107.40	0.38	79	130.52	0.38
180	27.10	0.43	120	52.11	0.41	60	76.33	0.40				20	107.79	0.39	80	130.90	0.38
179	27.52	0.42	119	52.52	0.41	59	76.73	0.40				21	108.18	0.39	81	131.28	0.38
178	27.95	0.43	118	52.92	0.40	58	77.13	0.40				22	108.57	0.39	82	131.67	0.39
177	28.37	0.42	117	53.33	0.41	57	77.52	0.39				23	108.96	0.39	83	132.05	0.38
176	28.80	0.43	116	53.74	0.41	56	77.92	0.40				24	109.35	0.39	84	132.43	0.38
175	29.22	0.42	115	54.15	0.41	55	78.32	0.40				25	109.73	0.38	85	132.81	0.38
174	29.65	0.43	114	54.56	0.41	54	78.72	0.40				26	110.12	0.39	86	133.19	0.38
173	30.07	0.42	113	54.97	0.41	53	79.11	0.39				27	110.51	0.39	87	133.57	0.38
172	30.49	0.42	112	55.38	0.41	52	79.51	0.40				28	110.90	0.39	88	133.95	0.38
171	30.92	0.43	111	55.78	0.40	51	79.91	0.40				29	111.28	0.38	89	134.33	0.38
170	31.34	0.42	110	56.19	0.41	50	80.31	0.40				30	111.67	0.39	90	134.71	0.38
169	31.76	0.42	109	56.60	0.41	49	80.70	0.39				31	112.06	0.39	91	135.09	0.38
168	32.18	0.42	108	57.00	0.40	48	81.10	0.40				32	112.45	0.39	92	135.47	0.38
167	32.61	0.43	107	57.41	0.41	47	81.50	0.40				33	112.83	0.38	93	135.85	0.38
166	33.03	0.42	106	57.82	0.41	46	81.89	0.39				34	113.22	0.39	94	136.23	0.38
165	33.45	0.42	105	58.22	0.40	45	82.29	0.40				35	113.61	0.39	95	136.61	0.38
164	33.86	0.41	104	58.63	0.41	44	82.69	0.40				36	113.99	0.38	96	136.99	0.38
163	34.28	0.42	103	59.04	0.41	43	83.08	0.39				37	114.38	0.39	97	137.37	0.38
162	34.70	0.42	102	59.44	0.40	42	83.48	0.40				38	114.77	0.39	98	137.75	0.38
161	35.12	0.42	101	59.85	0.41	41	83.88	0.40				39	115.15	0.38	99	138.13	0.38
160	35.54	0.42	100	60.26	0.41	40	84.27	0.39				40	115.54	0.39	100	138.51	0.38
159	35.96	0.42	99	60.67	0.41	39	84.67	0.40				41	115.93	0.39	101	138.89	0.38
158	36.38	0.42	98	61.07	0.40	38	85.06	0.39				42	116.31	0.38	102	139.27	0.38
157	36.80	0.42	97	61.48	0.41	37	85.46	0.40				43	116.70	0.39	103	139.65	0.38
156	37.22	0.42	96	61.87	0.41	36	85.85	0.39				44	117.08	0.38	104	140.03	0.38
155	37.63	0.41	95	62.29	0.42	35	86.25	0.40				45	117.47	0.39	105	140.39	0.36
154	38.05	0.42	94	62.69	0.40	34	86.64	0.39				46	117.85	0.38	106	140.77	0.38
153	38.47	0.42	93	63.10	0.41	33	87.04	0.40				47	118.24	0.39	107	141.15	0.38
152	38.89	0.42	92	63.50	0.40	32	87.43	0.39				48	118.62	0.38	108	141.53	0.38
151	39.31	0.42	91	63.91	0.41	31	87.83	0.40				49	119.01	0.39	109	141.91	0.38
150	39.72	0.41	90	64.30	0.39	30	88.22	0.39				50	119.40	0.39	110	142.29	0.38
149	40.14	0.42	89	64.70	0.40	29	88.62	0.40				51	119.78	0.38	111	142.66	0.37
148	40.56	0.42	88	65.11	0.41	28	89.01	0.39				52	120.16	0.38	112	143.04	0.38
147	40.97	0.41	87	65.51	0.40	27	89.40	0.39				53	120.55	0.39	113	143.42	0.38
146	41.39	0.42	86	65.91	0.40	26	89.80	0.40				54	120.93	0.38	114	143.80	0.38
145	41.80	0.41	85	66.31	0.40	25	90.19	0.39				55	121.32	0.39	115	144.18	0.38
144	42.22	0.42	84	66.72	0.41	24	90.59	0.40				56	121.70	0.38	116	144.56	0.38
143	42.64	0.42	83	67.12	0.40	23	90.98	0.39				57	122.09	0.39	117	144.94	0.38
142	43.05	0.41	82	67.52	0.40	22	91.37	0.39				58	122.47	0.38	118	145.32	0.38
141	43.46	0.41	81	67.92	0.40	21	91.77	0.40				59	122.86	0.39	119	145.69	0.37

Note: At 100°C, resistance is 138.50 ohms.

(DIN 43 760)



# RTD Temperature vs. Resistance Table

For European Curve, Alpha = .00385, ITS-90

1° Celsius Increments

°C	Ohms	Diff.															
+120	146.07	0.38	+180	168.48	0.37	+240	190.47	0.36	+300	212.05	0.36	+360	233.21	0.35	+420	253.96	0.34
121	146.45	0.38	181	168.85	0.37	241	190.83	0.36	301	212.40	0.35	361	233.56	0.35	421	254.30	0.34
122	146.82	0.37	182	169.22	0.37	242	191.20	0.37	302	212.76	0.36	362	233.91	0.35	422	254.65	0.35
123	147.20	0.38	183	169.59	0.37	243	191.56	0.36	303	213.12	0.36	363	234.26	0.35	423	254.99	0.34
124	147.58	0.38	184	169.96	0.37	244	191.92	0.36	304	213.47	0.35	364	234.60	0.36	424	255.33	0.34
125	147.95	0.37	185	170.33	0.37	245	192.28	0.36	305	213.83	0.36	365	234.95	0.35	425	255.67	0.34
126	148.33	0.38	186	170.69	0.36	246	192.66	0.38	306	214.19	0.36	366	235.30	0.35	426	256.01	0.34
127	148.71	0.38	187	171.06	0.37	247	193.02	0.36	307	214.55	0.36	367	235.65	0.35	427	256.35	0.34
128	149.08	0.37	188	171.43	0.37	248	193.38	0.36	308	214.90	0.35	368	236.00	0.35	428	256.70	0.35
129	149.46	0.38	189	171.80	0.37	249	193.74	0.36	309	215.26	0.36	369	236.35	0.35	429	257.04	0.34
130	149.83	0.37	190	172.17	0.37	250	194.10	0.36	310	215.61	0.35	370	236.70	0.35	430	257.38	0.34
131	150.21	0.38	191	172.54	0.37	251	194.47	0.37	311	215.97	0.36	371	237.05	0.35	431	257.72	0.34
132	150.58	0.37	192	172.91	0.37	252	194.83	0.36	312	216.32	0.35	372	237.40	0.35	432	258.06	0.34
133	150.96	0.38	193	173.27	0.36	253	195.19	0.36	313	216.68	0.36	373	237.75	0.35	433	258.40	0.34
134	151.34	0.38	194	173.64	0.37	254	195.55	0.36	314	217.03	0.35	374	238.09	0.34	434	258.74	0.34
135	151.71	0.37	195	174.01	0.37	255	195.90	0.35	315	217.39	0.36	375	238.44	0.35	435	259.08	0.34
136	152.09	0.38	196	174.39	0.38	256	196.26	0.36	316	217.73	0.34	376	238.79	0.35	436	259.42	0.34
137	152.46	0.37	197	174.75	0.36	257	196.62	0.36	317	218.08	0.35	377	239.14	0.35	437	259.76	0.34
138	152.84	0.38	198	175.12	0.37	258	196.98	0.36	318	218.44	0.36	378	239.48	0.34	438	260.10	0.34
139	153.21	0.37	199	175.49	0.37	259	197.35	0.37	319	218.79	0.35	379	239.83	0.35	439	260.44	0.34
140	153.58	0.37	200	175.86	0.37	260	197.71	0.36	320	219.15	0.36	380	240.18	0.35	440	260.78	0.34
141	153.95	0.37	201	176.23	0.37	261	198.07	0.36	321	219.50	0.35	381	240.52	0.34	441	261.12	0.34
142	154.32	0.37	202	176.59	0.36	262	198.43	0.36	322	219.85	0.35	382	240.87	0.35	442	261.46	0.34
143	154.71	0.39	203	176.96	0.37	263	198.79	0.36	323	220.21	0.36	383	241.22	0.35	443	261.80	0.34
144	155.08	0.37	204	177.33	0.37	264	199.15	0.36	324	220.56	0.35	384	241.56	0.34	444	262.14	0.34
145	155.46	0.38	205	177.70	0.37	265	199.51	0.36	325	220.91	0.35	385	241.91	0.35	445	262.48	0.34
146	155.83	0.37	206	178.06	0.36	266	199.87	0.36	326	221.27	0.36	386	242.25	0.34	446	262.83	0.35
147	156.21	0.38	207	178.43	0.37	267	200.23	0.36	327	221.62	0.35	387	242.60	0.35	447	263.17	0.34
148	156.58	0.37	208	178.80	0.37	268	200.59	0.36	328	221.97	0.35	388	242.95	0.35	448	263.50	0.33
149	156.96	0.38	209	179.16	0.36	269	200.95	0.36	329	222.32	0.35	389	243.29	0.34	449	263.84	0.34
150	157.33	0.37	210	179.53	0.37	270	201.31	0.36	330	222.68	0.36	390	243.64	0.35	450	264.18	0.34
151	157.71	0.38	211	179.90	0.37	271	201.67	0.36	331	223.03	0.35	391	243.98	0.34	451	264.52	0.34
152	158.08	0.37	212	180.26	0.36	272	202.03	0.36	332	223.38	0.35	392	244.33	0.35	452	264.86	0.34
153	158.45	0.37	213	180.63	0.37	273	202.38	0.35	333	223.73	0.35	393	244.67	0.34	453	265.20	0.34
154	158.83	0.38	214	180.99	0.36	274	202.74	0.36	334	224.09	0.36	394	245.02	0.35	454	265.54	0.34
155	159.20	0.37	215	181.36	0.37	275	203.10	0.36	335	224.45	0.36	395	245.36	0.34	455	265.87	0.33
156	159.56	0.36	216	181.73	0.37	276	203.46	0.36	336	224.80	0.35	396	245.71	0.35	456	266.21	0.34
157	159.94	0.38	217	182.09	0.36	277	203.82	0.36	337	225.15	0.35	397	246.05	0.34	457	266.55	0.34
158	160.31	0.37	218	182.46	0.37	278	204.18	0.36	338	225.50	0.35	398	246.40	0.35	458	266.89	0.34
159	160.68	0.37	219	182.82	0.36	279	204.54	0.36	339	225.85	0.35	399	246.74	0.34	459	267.22	0.33
160	161.05	0.37	220	183.19	0.37	280	204.90	0.36	340	226.21	0.36	400	247.09	0.35	460	267.56	0.34
161	161.43	0.38	221	183.55	0.36	281	205.25	0.35	341	226.56	0.35	401	247.43	0.34	461	267.90	0.34
162	161.80	0.37	222	183.92	0.37	282	205.61	0.36	342	226.91	0.35	402	247.78	0.35	462	268.24	0.34
163	162.17	0.37	223	184.28	0.36	283	205.97	0.36	343	227.26	0.35	403	248.12	0.34	463	268.57	0.33
164	162.54	0.37	224	184.65	0.37	284	206.33	0.36	344	227.61	0.35	404	248.46	0.34	464	268.91	0.34
165	162.91	0.37	225	185.01	0.36	285	206.70	0.37	345	227.96	0.35	405	248.81	0.35	465	269.25	0.34
166	163.28	0.37	226	185.38	0.37	286	207.05	0.35	346	228.31	0.35	406	249.15	0.34	466	269.58	0.33
167	163.66	0.38	227	185.74	0.36	287	207.41	0.36	347	228.66	0.35	407	249.50	0.35	467	269.92	0.34
168	164.03	0.37	228	186.11	0.37	288	207.77	0.36	348	229.01	0.35	408	249.84	0.34	468	270.26	0.34
169	164.40	0.37	229	186.47	0.36	289	208.13	0.36	349	229.36	0.35	409	250.18	0.34	469	270.59	0.33
170	164.77	0.37	230	186.84	0.37	290	208.48	0.35	350	229.72	0.34	410	250.53	0.35	470	270.93	0.34
171	165.14	0.37	231	187.20	0.36	291	208.84	0.36	351	230.07	0.35	411	250.89	0.34	471	271.27	0.34
172	165.51	0.37	232	187.56	0.36	292	209.20	0.36	352	230.42	0.35	412	251.21	0.34	472	271.60	0.33
173	165.88	0.37	233	187.93	0.37	293	209.55	0.35	353	230.77	0.35	413	251.55	0.34	473	271.94	0.34
174	166.25	0.37	234	188.29	0.36	294	209.91	0.36	354	231.12	0.35	414	251.90	0.35	474	272.27	0.33
175	166.62	0.37	235	188.65	0.36	295	210.27	0.36	355	231.47	0.35	415	252.24	0.34	475	272.61	0.34
176	167.00	0.38	236	189.02	0.37	296	210.62	0.35	356	231.81	0.36	416	252.59	0.35	476	272.95	0.34
177	167.37	0.37	237	189.38	0.36	297	210.98	0.36	357	232.16	0.35	417	252.94	0.35	477	273.28	0.33
178	167.74	0.37	238	189.74	0.36	298	211.34	0.36	358	232.51	0.35	418	253.28	0.34	478	273.62	0.34
179	168.11	0.37	239	190.11	0.37	299	211.69	0.35	359	232.86	0.35	419	253.62	0.34	479	273.95	0.33

Note: At 100°C, resistance is 138.50 ohms.

(DIN 43 760)