



Designation: E 1751 – 00

# Standard Guide for Temperature Electromotive Force (emf) Tables for Non- Letter Designated Thermocouple Combinations<sup>1</sup>

This standard is issued under the fixed designation E 1751; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This guide consists of reference tables that give temperature-electromotive force (emf) relationships for special purpose, limited use, thermocouple combinations that do not have a letter designation.

1.2 Extension wire or compensating extension wires are not covered by this guide. ASTM MNL 12<sup>2</sup> or thermocouple alloy suppliers should be consulted.

## 2. Terminology

### 2.1 Definitions:

2.1.1 For definitions of terms used in this guide see Terminology E 344.

### 2.2 Definitions of Terms Specific to This Standard:

2.2.1 *matched pairs, n*—a set of positive and negative thermoelements chosen so that a thermocouple fabricated from these thermoelements will match a specified temperature-electromotive force relationship to within a specified tolerance, at the time of first use.

## 3. Source of Data

3.1 The data in these tables are based on the SI Volt and the International Temperature Scale of 1990.

3.2 All temperature–electromotive force data in Tables 1-18 have been developed from NIST, NRC, and wire manufacturers' data.

3.3 Tables 1-14 give emf values in millivolts to three decimal places (1  $\mu\text{V}$ ) at 1 °C or 1 °F intervals. Tables 15-18 give emf values in microvolts to one decimal place (0.1  $\mu\text{V}$ ) at 1 °C or 1 °F intervals. If greater precision is required, refer to the equation and coefficients listed for each thermocouple alloy.

## 4. Significance and Use

4.1 These thermocouple combinations have been developed for specific applications by the wire manufacturer(s). If addi-

tional information is required, consult ASTM MNL 12 or one of the following thermocouple manufacturers: Carpenter Technology, Engelhard Corp. Specialty Metals Div., Hoskins Mfg. Co., Johnson Matthey, Sigmund Cohn Corp.

## 5. Thermocouple Types

5.1 Letter symbols have not been assigned. Identification is made by alloy composition with the thermoelectrically positive material listed first.

5.1.1 Tungsten versus tungsten–26 % rhenium.

5.1.2 Platinel II.<sup>3</sup>

5.1.3 KP versus gold–0.07 % iron.<sup>4</sup>

5.1.4 Platinum–5 % molybdenum versus platinum–0.1 % molybdenum.

5.1.5 Platinum–40 % rhodium versus platinum–20 % rhodium.

5.1.6 Nickel–18 % molybdenum versus nickel–0.8 % cobalt.<sup>5</sup>

5.1.7 Iridium–40 % rhodium versus iridium.

5.1.8 Gold versus platinum.

5.1.9 Platinum versus palladium.

## 6. Tolerances on Initial Values of emf versus Temperature

6.1 Tolerances on initial values of emf versus temperature have not been established for the thermocouples in this guide. When required, tolerances on initial values of emf versus temperature should be established by agreement between the consumer and the producer. These thermocouple combinations are supplied typically as matched pairs.

## 7. Table Information

7.1 The following is a list of emf versus temperature tables included in this guide.

Table Number	Thermocouple Type	Temperature Range
Table 1	Tungsten versus Tungsten–26 % Rhenium	0 °C to 2315 °C
Table 2	Tungsten versus Tungsten–26 % Rhenium	32 °F to 4200 °F

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee E20 on Temperature Measurement and is the direct responsibility of Subcommittee E20.04 on Thermocouples.

Current edition approved May 10, 2000. Published August 2000. Originally published as E 1751-95. Last previous edition E 1751-95<sup>1</sup>.

<sup>2</sup> *Manual on the Use of Thermocouples in Temperature Measurement*, ASTM Manual 12, ASTM, 1993.

<sup>3</sup> Trademark of Engelhard Corp., Specialty Metals Division.

<sup>4</sup> Alloy compositions are expressed in percentages by mass, except for the gold–0.07 % iron alloy, which is given in atomic percent.

<sup>5</sup> Nickel–18 % molybdenum versus nickel 0.8 % cobalt is supplied by Carpenter Technology as 20 alloy and 19 alloy.

Table 3	Platinel II	0 °C to 1395 °C
Table 4	Platinel II	32 °F to 2543 °F
Table 5	KP versus Gold–0.07 % Iron	–273 °C to 7 °C
Table 6	KP versus Gold–0.07 % Iron	–459 °F to 44 °F
Table 7	Platinum–5 % Molybdenum versus Platinum–0.1 % Molybdenum	0 °C to 1600 °C
Table 8	Platinum–5 % Molybdenum versus Platinum–0.1 % Molybdenum	32 °F to 2912 °F
Table 9	Platinum–40 % Rhodium versus Platinum–20 % Rhodium	0 °C to 1888 °C
Table 10	Platinum–40 % Rhodium versus Platinum–20 % Rhodium	32 °F to 3430 °F
Table 11	Nickel–18 % Molybdenum versus Nickel–0.8 % Cobalt	–50 °C to 1410 °C
Table 12	Nickel–18 % Molybdenum versus Nickel–0.8 % Cobalt	–58 °F to 2570 °F
Table 13	Iridium 40 % Rhodium versus Iridium	0 °C to 2110 °C
Table 14	Iridium 40 % Rhodium versus Iridium	32 °F to 3830 °F
Table 15	Gold versus Platinum	0 °C to 1000 °C
Table 16	Gold versus Platinum	32 °F to 1832 °F
Table 17	Platinum versus Palladium	0 °C to 1500 °C
Table 18	Platinum versus Palladium	32 °F to 2732 °F
Table 19	Polynomial Coefficients for the Computation of Temperatures in °C or °F as a Function of Thermocouple emf	

7.2 Tables 1-18 were derived from equations of the form:

$$E = c_0 + c_1 T + c_2 T^2 + \dots c_n T^n \quad (1)$$

where:

$E$  = the emf in millivolts (except for Tables 15-18 where  $E$  is in microvolts), and

$T$  = the temperature in °C or °F. The coefficients used to calculate each table are given at the end of the table.

7.3 Table 19 gives coefficients of inverse equations that may be used to compute approximate values of temperature ( $T$ ) in either °C or °F for each thermocouple combination. The inverse equations are of the form:

$$T = b_0 + b_1 E + b_2 E^2 + \dots b_n E^n \quad (2)$$

except for the gold versus platinum thermocouple in the ranges 209 °C to 1000 °C (408.2 °F to 1832 °F), where the inverse equation is of the form:

$$T = b_0 + \sum_{i=1}^{11} b_i \left( \frac{E - 9645}{7620} \right)^i \quad (3)$$

For these equations, the thermocouple emf ( $E$ ) is in units of millivolts, except for gold versus platinum and platinum versus palladium thermocouples, for which the emf is in units of microvolts.

7.3.1 Table 19 also gives the temperature range, emf range, and error range of each inverse equation.

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**TABLE 1 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0°C**

°C	0	1	2	3	4	5	6	7	8	9	10	°C
Thermoelectric Voltage in Millivolts												
0	0.000	0.001	0.003	0.004	0.005	0.007	0.008	0.010	0.012	0.013	0.015	0
10	0.015	0.017	0.018	0.020	0.022	0.024	0.026	0.028	0.030	0.032	0.034	10
20	0.034	0.036	0.038	0.041	0.043	0.045	0.048	0.050	0.053	0.055	0.058	20
30	0.058	0.060	0.063	0.065	0.068	0.071	0.074	0.076	0.079	0.082	0.085	30
40	0.085	0.088	0.091	0.094	0.097	0.100	0.104	0.107	0.110	0.113	0.117	40
50	0.117	0.120	0.123	0.127	0.130	0.134	0.138	0.141	0.145	0.148	0.152	50
60	0.152	0.156	0.160	0.164	0.168	0.172	0.175	0.179	0.184	0.188	0.192	60
70	0.192	0.196	0.200	0.204	0.209	0.213	0.217	0.222	0.226	0.231	0.235	70
80	0.235	0.240	0.244	0.249	0.254	0.258	0.263	0.268	0.273	0.277	0.282	80
90	0.282	0.287	0.292	0.297	0.302	0.307	0.312	0.318	0.323	0.328	0.333	90
100	0.333	0.339	0.344	0.349	0.355	0.360	0.366	0.371	0.377	0.382	0.388	100
110	0.388	0.394	0.399	0.405	0.411	0.417	0.422	0.428	0.434	0.440	0.446	110
120	0.446	0.452	0.458	0.464	0.471	0.477	0.483	0.489	0.495	0.502	0.508	120
130	0.508	0.514	0.521	0.527	0.534	0.540	0.547	0.553	0.560	0.567	0.573	130
140	0.573	0.580	0.587	0.594	0.601	0.607	0.614	0.621	0.628	0.635	0.642	140
150	0.642	0.649	0.656	0.664	0.671	0.678	0.685	0.693	0.700	0.707	0.715	150
160	0.715	0.722	0.729	0.737	0.744	0.752	0.760	0.767	0.775	0.782	0.790	160
170	0.790	0.798	0.806	0.813	0.821	0.829	0.837	0.845	0.853	0.861	0.869	170
180	0.869	0.877	0.885	0.893	0.902	0.910	0.918	0.926	0.935	0.943	0.951	180
190	0.951	0.960	0.968	0.976	0.985	0.993	1.002	1.011	1.019	1.028	1.037	190
200	1.037	1.045	1.054	1.063	1.072	1.080	1.089	1.098	1.107	1.116	1.125	200
210	1.125	1.134	1.143	1.152	1.161	1.170	1.180	1.189	1.198	1.207	1.217	210
220	1.217	1.226	1.235	1.245	1.254	1.264	1.273	1.283	1.292	1.302	1.311	220
230	1.311	1.321	1.331	1.340	1.350	1.360	1.369	1.379	1.389	1.399	1.409	230
240	1.409	1.419	1.429	1.439	1.449	1.459	1.469	1.479	1.489	1.499	1.509	240
250	1.509	1.520	1.530	1.540	1.550	1.561	1.571	1.582	1.592	1.602	1.613	250
260	1.613	1.623	1.634	1.644	1.655	1.666	1.676	1.687	1.698	1.708	1.719	260
270	1.719	1.730	1.741	1.752	1.762	1.773	1.784	1.795	1.806	1.817	1.828	270
280	1.828	1.839	1.850	1.862	1.873	1.884	1.895	1.906	1.918	1.929	1.940	280
290	1.940	1.951	1.963	1.974	1.986	1.997	2.009	2.020	2.032	2.043	2.055	290
300	2.055	2.066	2.078	2.090	2.101	2.113	2.125	2.136	2.148	2.160	2.172	300
310	2.172	2.184	2.196	2.208	2.219	2.231	2.243	2.255	2.267	2.280	2.292	310
320	2.292	2.304	2.316	2.328	2.340	2.353	2.365	2.377	2.389	2.402	2.414	320
330	2.414	2.426	2.439	2.451	2.464	2.476	2.489	2.501	2.514	2.526	2.539	330
340	2.539	2.552	2.564	2.577	2.590	2.602	2.615	2.628	2.641	2.653	2.666	340
350	2.666	2.679	2.692	2.705	2.718	2.731	2.744	2.757	2.770	2.783	2.796	350
360	2.796	2.809	2.822	2.836	2.849	2.862	2.875	2.888	2.902	2.915	2.928	360
370	2.928	2.942	2.955	2.968	2.982	2.995	3.009	3.022	3.036	3.049	3.063	370
380	3.063	3.076	3.090	3.104	3.117	3.131	3.145	3.158	3.172	3.186	3.200	380
390	3.200	3.214	3.227	3.241	3.255	3.269	3.283	3.297	3.311	3.325	3.339	390
400	3.339	3.353	3.367	3.381	3.395	3.409	3.423	3.438	3.452	3.466	3.480	400
410	3.480	3.494	3.509	3.523	3.537	3.552	3.566	3.580	3.595	3.609	3.624	410
420	3.624	3.638	3.653	3.667	3.682	3.696	3.711	3.725	3.740	3.755	3.769	420
430	3.769	3.784	3.799	3.813	3.828	3.843	3.858	3.872	3.887	3.902	3.917	430
440	3.917	3.932	3.947	3.962	3.977	3.992	4.007	4.022	4.037	4.052	4.067	440
450	4.067	4.082	4.097	4.112	4.127	4.142	4.158	4.173	4.188	4.203	4.219	450
460	4.219	4.234	4.249	4.264	4.280	4.295	4.311	4.326	4.341	4.357	4.372	460
470	4.372	4.388	4.403	4.419	4.434	4.450	4.465	4.481	4.497	4.512	4.528	470
480	4.528	4.544	4.559	4.575	4.591	4.606	4.622	4.638	4.654	4.670	4.685	480
490	4.685	4.701	4.717	4.733	4.749	4.765	4.781	4.797	4.813	4.829	4.845	490
500	4.845	4.861	4.877	4.893	4.909	4.925	4.941	4.957	4.974	4.990	5.006	500
°C	0	1	2	3	4	5	6	7	8	9	10	°C

**TABLE 1 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0°C** *Continued*

°C	0	1	2	3	4	5	6	7	8	9	10	°C
Thermoelectric Voltage in Millivolts												
<b>500</b>	4.845	4.861	4.877	4.893	4.909	4.925	4.941	4.957	4.974	4.990	5.006	<b>500</b>
<b>510</b>	5.006	5.022	5.038	5.055	5.071	5.087	5.104	5.120	5.136	5.153	5.169	<b>510</b>
<b>520</b>	5.169	5.185	5.202	5.218	5.235	5.251	5.267	5.284	5.300	5.317	5.334	<b>520</b>
<b>530</b>	5.334	5.350	5.367	5.383	5.400	5.416	5.433	5.450	5.466	5.483	5.500	<b>530</b>
<b>540</b>	5.500	5.517	5.533	5.550	5.567	5.584	5.600	5.617	5.634	5.651	5.668	<b>540</b>
<b>550</b>	5.668	5.685	5.702	5.718	5.735	5.752	5.769	5.786	5.803	5.820	5.837	<b>550</b>
<b>560</b>	5.837	5.854	5.871	5.888	5.906	5.923	5.940	5.957	5.974	5.991	6.008	<b>560</b>
<b>570</b>	6.008	6.026	6.043	6.060	6.077	6.095	6.112	6.129	6.146	6.164	6.181	<b>570</b>
<b>580</b>	6.181	6.198	6.216	6.233	6.250	6.268	6.285	6.303	6.320	6.338	6.355	<b>580</b>
<b>590</b>	6.355	6.373	6.390	6.408	6.425	6.443	6.460	6.478	6.495	6.513	6.531	<b>590</b>
<b>600</b>	6.531	6.548	6.566	6.583	6.601	6.619	6.636	6.654	6.672	6.690	6.707	<b>600</b>
<b>610</b>	6.707	6.725	6.743	6.761	6.778	6.796	6.814	6.832	6.850	6.868	6.886	<b>610</b>
<b>620</b>	6.886	6.903	6.921	6.939	6.957	6.975	6.993	7.011	7.029	7.047	7.065	<b>620</b>
<b>630</b>	7.065	7.083	7.101	7.119	7.137	7.155	7.173	7.191	7.210	7.228	7.246	<b>630</b>
<b>640</b>	7.246	7.264	7.282	7.300	7.319	7.337	7.355	7.373	7.391	7.410	7.428	<b>640</b>
<b>650</b>	7.428	7.446	7.465	7.483	7.501	7.519	7.538	7.556	7.575	7.593	7.611	<b>650</b>
<b>660</b>	7.611	7.630	7.648	7.667	7.685	7.703	7.722	7.740	7.759	7.777	7.796	<b>660</b>
<b>670</b>	7.796	7.814	7.833	7.852	7.870	7.889	7.907	7.926	7.944	7.963	7.982	<b>670</b>
<b>680</b>	7.982	8.000	8.019	8.038	8.056	8.075	8.094	8.113	8.131	8.150	8.169	<b>680</b>
<b>690</b>	8.169	8.187	8.206	8.225	8.244	8.263	8.281	8.300	8.319	8.338	8.357	<b>690</b>
<b>700</b>	8.357	8.376	8.395	8.414	8.432	8.451	8.470	8.489	8.508	8.527	8.546	<b>700</b>
<b>710</b>	8.546	8.565	8.584	8.603	8.622	8.641	8.660	8.679	8.698	8.717	8.737	<b>710</b>
<b>720</b>	8.737	8.756	8.775	8.794	8.813	8.832	8.851	8.870	8.890	8.909	8.928	<b>720</b>
<b>730</b>	8.928	8.947	8.966	8.986	9.005	9.024	9.043	9.063	9.082	9.101	9.120	<b>730</b>
<b>740</b>	9.120	9.140	9.159	9.178	9.198	9.217	9.236	9.256	9.275	9.295	9.314	<b>740</b>
<b>750</b>	9.314	9.333	9.353	9.372	9.392	9.411	9.430	9.450	9.469	9.489	9.508	<b>750</b>
<b>760</b>	9.508	9.528	9.547	9.567	9.586	9.606	9.625	9.645	9.665	9.684	9.704	<b>760</b>
<b>770</b>	9.704	9.723	9.743	9.763	9.782	9.802	9.821	9.841	9.861	9.880	9.900	<b>770</b>
<b>780</b>	9.900	9.920	9.939	9.959	9.979	9.998	10.018	10.038	10.058	10.077	10.097	<b>780</b>
<b>790</b>	10.097	10.117	10.137	10.156	10.176	10.196	10.216	10.236	10.256	10.275	10.295	<b>790</b>
<b>800</b>	10.295	10.315	10.335	10.355	10.375	10.395	10.414	10.434	10.454	10.474	10.494	<b>800</b>
<b>810</b>	10.494	10.514	10.534	10.554	10.574	10.594	10.614	10.634	10.654	10.674	10.694	<b>810</b>
<b>820</b>	10.694	10.714	10.734	10.754	10.774	10.794	10.814	10.834	10.854	10.874	10.894	<b>820</b>
<b>830</b>	10.894	10.914	10.934	10.954	10.974	10.995	11.015	11.035	11.055	11.075	11.095	<b>830</b>
<b>840</b>	11.095	11.115	11.136	11.156	11.176	11.196	11.216	11.236	11.257	11.277	11.297	<b>840</b>
<b>850</b>	11.297	11.317	11.338	11.358	11.378	11.398	11.419	11.439	11.459	11.479	11.500	<b>850</b>
<b>860</b>	11.500	11.520	11.540	11.561	11.581	11.601	11.622	11.642	11.662	11.683	11.703	<b>860</b>
<b>870</b>	11.703	11.723	11.744	11.764	11.784	11.805	11.825	11.845	11.866	11.886	11.907	<b>870</b>
<b>880</b>	11.907	11.927	11.948	11.968	11.988	12.009	12.029	12.050	12.070	12.091	12.111	<b>880</b>
<b>890</b>	12.111	12.132	12.152	12.173	12.193	12.214	12.234	12.255	12.275	12.296	12.316	<b>890</b>
<b>900</b>	12.316	12.337	12.357	12.378	12.398	12.419	12.439	12.460	12.481	12.501	12.522	<b>900</b>
<b>910</b>	12.522	12.542	12.563	12.583	12.604	12.625	12.645	12.666	12.686	12.707	12.728	<b>910</b>
<b>920</b>	12.728	12.748	12.769	12.790	12.810	12.831	12.852	12.872	12.893	12.914	12.934	<b>920</b>
<b>930</b>	12.934	12.955	12.976	12.996	13.017	13.038	13.058	13.079	13.100	13.121	13.141	<b>930</b>
<b>940</b>	13.141	13.162	13.183	13.204	13.224	13.245	13.266	13.287	13.307	13.328	13.349	<b>940</b>
<b>950</b>	13.349	13.370	13.390	13.411	13.432	13.453	13.474	13.494	13.515	13.536	13.557	<b>950</b>
<b>960</b>	13.557	13.578	13.598	13.619	13.640	13.661	13.682	13.702	13.723	13.744	13.765	<b>960</b>
<b>970</b>	13.765	13.786	13.807	13.828	13.848	13.869	13.890	13.911	13.932	13.953	13.974	<b>970</b>
<b>980</b>	13.974	13.995	14.015	14.036	14.057	14.078	14.099	14.120	14.141	14.162	14.183	<b>980</b>
<b>990</b>	14.183	14.204	14.225	14.245	14.266	14.287	14.308	14.329	14.350	14.371	14.392	<b>990</b>
<b>1000</b>	14.392	14.413	14.434	14.455	14.476	14.497	14.518	14.539	14.560	14.581	14.602	<b>1000</b>
°C	0	1	2	3	4	5	6	7	8	9	10	°C

**TABLE 1 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0°C** *Continued*

°C	0	1	2	3	4	5	6	7	8	9	10	°C
Thermoelectric Voltage in Millivolts												
<b>1000</b>	14.392	14.413	14.434	14.455	<b>14.476</b>	14.497	14.518	14.539	14.560	14.581	14.602	<b>1000</b>
<b>1010</b>	14.602	14.623	14.644	14.665	<b>14.686</b>	14.707	14.728	14.749	14.770	14.791	14.812	<b>1010</b>
<b>1020</b>	14.812	14.833	14.854	14.875	<b>14.896</b>	14.917	14.938	14.959	14.980	15.001	15.022	<b>1020</b>
<b>1030</b>	15.022	15.043	15.064	15.085	15.106	15.127	15.148	15.169	15.190	15.211	15.232	<b>1030</b>
<b>1040</b>	15.232	15.253	15.274	15.295	<b>15.316</b>	15.337	15.359	15.380	15.401	15.422	15.443	<b>1040</b>
<b>1050</b>	15.443	15.464	15.485	15.506	<b>15.527</b>	15.548	15.569	15.590	15.611	15.633	15.654	<b>1050</b>
<b>1060</b>	15.654	15.675	15.696	15.717	<b>15.738</b>	15.759	15.780	15.801	15.822	15.844	15.865	<b>1060</b>
<b>1070</b>	15.865	15.886	15.907	15.928	<b>15.949</b>	15.970	15.991	16.012	16.034	16.055	16.076	<b>1070</b>
<b>1080</b>	16.076	16.097	16.118	16.139	<b>16.160</b>	16.181	16.202	16.224	16.245	16.266	16.287	<b>1080</b>
<b>1090</b>	16.287	16.308	16.329	16.350	<b>16.372</b>	16.393	16.414	16.435	16.456	16.477	16.498	<b>1090</b>
<b>1100</b>	16.498	16.520	16.541	16.562	<b>16.583</b>	16.604	16.625	16.646	16.668	16.689	16.710	<b>1100</b>
<b>1110</b>	16.710	16.731	16.752	16.773	<b>16.794</b>	16.816	16.837	16.858	16.879	16.900	16.921	<b>1110</b>
<b>1120</b>	16.921	16.943	16.964	16.985	17.006	17.027	17.048	17.069	17.091	17.112	17.133	<b>1120</b>
<b>1130</b>	17.133	17.154	17.175	17.196	<b>17.218</b>	17.239	17.260	17.281	17.302	17.323	17.345	<b>1130</b>
<b>1140</b>	17.345	17.366	17.387	17.408	<b>17.429</b>	17.450	17.471	17.493	17.514	17.535	17.556	<b>1140</b>
<b>1150</b>	17.556	17.577	17.598	17.620	<b>17.641</b>	17.662	17.683	17.704	17.725	17.747	17.768	<b>1150</b>
<b>1160</b>	17.768	17.789	17.810	17.831	<b>17.852</b>	17.874	17.895	17.916	17.937	17.958	17.979	<b>1160</b>
<b>1170</b>	17.979	18.000	18.022	18.043	<b>18.064</b>	18.085	18.106	18.127	18.149	18.170	18.191	<b>1170</b>
<b>1180</b>	18.191	18.212	18.233	18.254	<b>18.275</b>	18.297	18.318	18.339	18.360	18.381	18.402	<b>1180</b>
<b>1190</b>	18.402	18.423	18.445	18.466	<b>18.487</b>	18.508	18.529	18.550	18.571	18.593	18.614	<b>1190</b>
<b>1200</b>	18.614	18.635	18.656	18.677	<b>18.698</b>	18.719	18.741	18.762	18.783	18.804	18.825	<b>1200</b>
<b>1210</b>	18.825	18.846	18.867	18.888	<b>18.910</b>	18.931	18.952	18.973	18.994	19.015	19.036	<b>1210</b>
<b>1220</b>	19.036	19.057	19.078	19.100	19.121	19.142	19.163	19.184	19.205	19.226	19.247	<b>1220</b>
<b>1230</b>	19.247	19.268	19.289	19.311	<b>19.332</b>	19.353	19.374	19.395	19.416	19.437	19.458	<b>1230</b>
<b>1240</b>	19.458	19.479	19.500	19.521	<b>19.543</b>	19.564	19.585	19.606	19.627	19.648	19.669	<b>1240</b>
<b>1250</b>	19.669	19.690	19.711	19.732	<b>19.753</b>	19.774	19.795	19.816	19.837	19.858	19.880	<b>1250</b>
<b>1260</b>	19.880	19.901	19.922	19.943	<b>19.964</b>	19.985	20.006	20.027	20.048	20.069	20.090	<b>1260</b>
<b>1270</b>	20.090	20.111	20.132	20.153	<b>20.174</b>	20.195	20.216	20.237	20.258	20.279	20.300	<b>1270</b>
<b>1280</b>	20.300	20.321	20.342	20.363	<b>20.384</b>	20.405	20.426	20.447	20.468	20.489	20.510	<b>1280</b>
<b>1290</b>	20.510	20.531	20.552	20.573	<b>20.594</b>	20.615	20.636	20.657	20.678	20.699	20.720	<b>1290</b>
<b>1300</b>	20.720	20.741	20.762	20.783	<b>20.804</b>	20.824	20.845	20.866	20.887	20.908	20.929	<b>1300</b>
<b>1310</b>	20.929	20.950	20.971	20.992	21.013	21.034	21.055	21.076	21.097	21.117	21.138	<b>1310</b>
<b>1320</b>	21.138	21.159	21.180	21.201	21.222	21.243	21.264	21.285	21.305	21.326	21.347	<b>1320</b>
<b>1330</b>	21.347	21.368	21.389	21.410	21.431	21.452	21.472	21.493	21.514	21.535	21.556	<b>1330</b>
<b>1340</b>	21.556	21.577	21.597	21.618	21.639	21.660	21.681	21.702	21.722	21.743	21.764	<b>1340</b>
<b>1350</b>	21.764	21.785	21.806	21.826	21.847	21.868	21.889	21.910	21.930	21.951	21.972	<b>1350</b>
<b>1360</b>	21.972	21.993	22.014	22.034	22.055	22.076	22.097	22.117	22.138	22.159	22.180	<b>1360</b>
<b>1370</b>	22.180	22.200	22.221	22.242	22.263	22.283	22.304	22.325	22.345	22.366	22.387	<b>1370</b>
<b>1380</b>	22.387	22.408	22.428	22.449	22.470	22.490	22.511	22.532	22.552	22.573	22.594	<b>1380</b>
<b>1390</b>	22.594	22.614	22.635	22.656	22.676	22.697	22.718	22.738	22.759	22.780	22.800	<b>1390</b>
<b>1400</b>	22.800	22.821	22.841	22.862	22.883	22.903	22.924	22.945	22.965	22.986	23.006	<b>1400</b>
<b>1410</b>	23.006	23.027	23.047	23.068	23.089	23.109	23.130	23.150	23.171	23.191	23.212	<b>1410</b>
<b>1420</b>	23.212	23.233	23.253	23.274	23.294	23.315	23.335	23.356	23.376	23.397	23.417	<b>1420</b>
<b>1430</b>	23.417	23.438	23.458	23.479	23.499	23.520	23.540	23.561	23.581	23.602	23.622	<b>1430</b>
<b>1440</b>	23.622	23.643	23.663	23.683	23.704	23.724	23.745	23.765	23.786	23.806	23.826	<b>1440</b>
<b>1450</b>	23.826	23.847	23.867	23.888	23.908	23.928	23.949	23.969	23.990	24.010	24.030	<b>1450</b>
<b>1460</b>	24.030	24.051	24.071	24.091	24.112	24.132	24.152	24.173	24.193	24.213	24.234	<b>1460</b>
<b>1470</b>	24.234	24.254	24.274	24.295	24.315	24.335	24.356	24.376	24.396	24.416	24.437	<b>1470</b>
<b>1480</b>	24.437	24.457	24.477	24.498	24.518	24.538	24.558	24.578	24.599	24.619	24.639	<b>1480</b>
<b>1490</b>	24.639	24.659	24.680	24.700	24.720	24.740	24.760	24.781	24.801	24.821	24.841	<b>1490</b>
<b>1500</b>	24.841	24.861	24.881	24.902	24.922	24.942	24.962	24.982	25.002	25.022	25.042	<b>1500</b>
°C	0	1	2	3	4	5	6	7	8	9	10	°C



**TABLE 1 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0°C** *Continued*

°C	0	1	2	3	4	5	6	7	8	9	10	°C
Thermoelectric Voltage in Millivolts												
<b>1500</b>	24.841	24.861	24.881	24.902	24.922	24.942	24.962	24.982	25.002	25.022	25.042	<b>1500</b>
<b>1510</b>	25.042	25.063	25.083	25.103	25.123	25.143	25.163	25.183	25.203	25.223	25.243	<b>1510</b>
<b>1520</b>	25.243	25.263	25.283	25.303	25.324	25.344	25.364	25.384	25.404	25.424	25.444	<b>1520</b>
<b>1530</b>	25.444	25.464	25.484	25.504	25.524	25.544	25.564	25.584	25.603	25.623	25.643	<b>1530</b>
<b>1540</b>	25.643	25.663	25.683	25.703	25.723	25.743	25.763	25.783	25.803	25.823	25.843	<b>1540</b>
<b>1550</b>	25.843	25.862	25.882	25.902	25.922	25.942	25.962	25.982	26.001	26.021	26.041	<b>1550</b>
<b>1560</b>	26.041	26.061	26.081	26.101	26.120	26.140	26.160	26.180	26.200	26.219	26.239	<b>1560</b>
<b>1570</b>	26.239	26.259	26.279	26.298	26.318	26.338	26.358	26.377	26.397	26.417	26.437	<b>1570</b>
<b>1580</b>	26.437	26.456	26.476	26.496	26.515	26.535	26.555	26.574	26.594	26.614	26.633	<b>1580</b>
<b>1590</b>	26.633	26.653	26.673	26.692	26.712	26.731	26.751	26.771	26.790	26.810	26.829	<b>1590</b>
<b>1600</b>	26.829	26.849	26.869	26.888	26.908	26.927	26.947	26.966	26.986	27.005	27.025	<b>1600</b>
<b>1610</b>	27.025	27.044	27.064	27.083	27.103	27.122	27.142	27.161	27.181	27.200	27.220	<b>1610</b>
<b>1620</b>	27.220	27.239	27.259	27.278	27.297	27.317	27.336	27.356	27.375	27.394	27.414	<b>1620</b>
<b>1630</b>	27.414	27.433	27.453	27.472	27.491	27.511	27.530	27.549	27.569	27.588	27.607	<b>1630</b>
<b>1640</b>	27.607	27.627	27.646	27.665	27.685	27.704	27.723	27.742	27.762	27.781	27.800	<b>1640</b>
<b>1650</b>	27.800	27.819	27.839	27.858	27.877	27.896	27.915	27.935	27.954	27.973	27.992	<b>1650</b>
<b>1660</b>	27.992	28.011	28.031	28.050	28.069	28.088	28.107	28.126	28.145	28.164	28.184	<b>1660</b>
<b>1670</b>	28.184	28.203	28.222	28.241	28.260	28.279	28.298	28.317	28.336	28.355	28.374	<b>1670</b>
<b>1680</b>	28.374	28.393	28.412	28.431	28.450	28.469	28.488	28.507	28.526	28.545	28.564	<b>1680</b>
<b>1690</b>	28.564	28.583	28.602	28.621	28.640	28.659	28.678	28.697	28.716	28.734	28.753	<b>1690</b>
<b>1700</b>	28.753	28.772	28.791	28.810	28.829	28.848	28.866	28.885	28.904	28.923	28.942	<b>1700</b>
<b>1710</b>	28.942	28.961	28.979	28.998	29.017	29.036	29.054	29.073	29.092	29.111	29.129	<b>1710</b>
<b>1720</b>	29.129	29.148	29.167	29.186	29.204	29.223	29.242	29.260	29.279	29.298	29.316	<b>1720</b>
<b>1730</b>	29.316	29.335	29.354	29.372	29.391	29.409	29.428	29.447	29.465	29.484	29.502	<b>1730</b>
<b>1740</b>	29.502	29.521	29.539	29.558	29.577	29.595	29.614	29.632	29.651	29.669	29.688	<b>1740</b>
<b>1750</b>	29.688	29.706	29.725	29.743	29.762	29.780	29.798	29.817	29.835	29.854	29.872	<b>1750</b>
<b>1760</b>	29.872	29.891	29.909	29.927	29.946	29.964	29.982	30.001	30.019	30.038	30.056	<b>1760</b>
<b>1770</b>	30.056	30.074	30.092	30.111	30.129	30.147	30.166	30.184	30.202	30.220	30.239	<b>1770</b>
<b>1780</b>	30.239	30.257	30.275	30.293	30.312	30.330	30.348	30.366	30.384	30.403	30.421	<b>1780</b>
<b>1790</b>	30.421	30.439	30.457	30.475	30.493	30.511	30.530	30.548	30.566	30.584	30.602	<b>1790</b>
<b>1800</b>	30.602	30.620	30.638	30.656	30.674	30.692	30.710	30.728	30.746	30.764	30.782	<b>1800</b>
<b>1810</b>	30.782	30.800	30.818	30.836	30.854	30.872	30.890	30.908	30.926	30.944	30.962	<b>1810</b>
<b>1820</b>	30.962	30.980	30.997	31.015	31.033	31.051	31.069	31.087	31.105	31.122	31.140	<b>1820</b>
<b>1830</b>	31.140	31.158	31.176	31.194	31.211	31.229	31.247	31.265	31.282	31.300	31.318	<b>1830</b>
<b>1840</b>	31.318	31.336	31.353	31.371	31.389	31.406	31.424	31.442	31.459	31.477	31.495	<b>1840</b>
<b>1850</b>	31.495	31.512	31.530	31.548	31.565	31.583	31.600	31.618	31.636	31.653	31.671	<b>1850</b>
<b>1860</b>	31.671	31.688	31.706	31.723	31.741	31.758	31.776	31.793	31.811	31.828	31.846	<b>1860</b>
<b>1870</b>	31.846	31.863	31.881	31.898	31.915	31.933	31.950	31.968	31.985	32.002	32.020	<b>1870</b>
<b>1880</b>	32.020	32.037	32.054	32.072	32.089	32.106	32.124	32.141	32.158	32.176	32.193	<b>1880</b>
<b>1890</b>	32.193	32.210	32.227	32.245	32.262	32.279	32.296	32.313	32.331	32.348	32.365	<b>1890</b>
<b>1900</b>	32.365	32.382	32.399	32.417	32.434	32.451	32.468	32.485	32.502	32.519	32.536	<b>1900</b>
<b>1910</b>	32.536	32.553	32.570	32.587	32.605	32.622	32.639	32.656	32.673	32.690	32.707	<b>1910</b>
<b>1920</b>	32.707	32.724	32.741	32.758	32.774	32.791	32.808	32.825	32.842	32.859	32.876	<b>1920</b>
<b>1930</b>	32.876	32.893	32.910	32.927	32.943	32.960	32.977	32.994	33.011	33.027	33.044	<b>1930</b>
<b>1940</b>	33.044	33.061	33.078	33.095	33.111	33.128	33.145	33.162	33.178	33.195	33.212	<b>1940</b>
<b>1950</b>	33.212	33.228	33.245	33.262	33.278	33.295	33.312	33.328	33.345	33.361	33.378	<b>1950</b>
<b>1960</b>	33.378	33.395	33.411	33.428	33.444	33.461	33.477	33.494	33.510	33.527	33.543	<b>1960</b>
<b>1970</b>	33.543	33.560	33.576	33.593	33.609	33.626	33.642	33.659	33.675	33.691	33.708	<b>1970</b>
<b>1980</b>	33.708	33.724	33.741	33.757	33.773	33.790	33.806	33.822	33.839	33.855	33.871	<b>1980</b>
<b>1990</b>	33.871	33.887	33.904	33.920	33.936	33.952	33.969	33.985	34.001	34.017	34.033	<b>1990</b>
<b>2000</b>	34.033	34.050	34.066	34.082	34.098	34.114	34.130	34.146	34.163	34.179	34.195	<b>2000</b>
°C	0	1	2	3	4	5	6	7	8	9	10	°C

**TABLE 1 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°C), reference junctions at 0°C** *Continued*

°C	0	1	2	3	4	5	6	7	8	9	10	°C
Thermoelectric Voltage in Millivolts												
<b>2000</b>	34.033	34.050	34.066	34.082	34.098	34.114	34.130	34.146	34.163	34.179	34.195	<b>2000</b>
<b>2010</b>	34.195	34.211	34.227	34.243	34.259	34.275	34.291	34.307	34.323	34.339	34.355	<b>2010</b>
<b>2020</b>	34.355	34.371	34.387	34.403	34.419	34.435	34.451	34.467	34.482	34.498	34.514	<b>2020</b>
<b>2030</b>	34.514	34.530	34.546	34.562	34.578	34.593	34.609	34.625	34.641	34.657	34.672	<b>2030</b>
<b>2040</b>	34.672	34.688	34.704	34.720	34.735	34.751	34.767	34.782	34.798	34.814	34.829	<b>2040</b>
<b>2050</b>	34.829	34.845	34.861	34.876	34.892	34.908	34.923	34.939	34.954	34.970	34.985	<b>2050</b>
<b>2060</b>	34.985	35.001	35.016	35.032	35.047	35.063	35.078	35.094	35.109	35.125	35.140	<b>2060</b>
<b>2070</b>	35.140	35.156	35.171	35.187	35.202	35.217	35.233	35.248	35.263	35.279	35.294	<b>2070</b>
<b>2080</b>	35.294	35.309	35.325	35.340	35.355	35.371	35.386	35.401	35.416	35.432	35.447	<b>2080</b>
<b>2090</b>	35.447	35.462	35.477	35.492	35.508	35.523	35.538	35.553	35.568	35.583	35.598	<b>2090</b>
<b>2100</b>	35.598	35.613	35.629	35.644	35.659	35.674	35.689	35.704	35.719	35.734	35.749	<b>2100</b>
<b>2110</b>	35.749	35.764	35.779	35.794	35.809	35.824	35.839	35.853	35.868	35.883	35.898	<b>2110</b>
<b>2120</b>	35.898	35.913	35.928	35.943	35.958	35.972	35.987	36.002	36.017	36.032	36.046	<b>2120</b>
<b>2130</b>	36.046	36.061	36.076	36.091	36.105	36.120	36.135	36.149	36.164	36.179	36.193	<b>2130</b>
<b>2140</b>	36.193	36.208	36.223	36.237	36.252	36.266	36.281	36.296	36.310	36.325	36.339	<b>2140</b>
<b>2150</b>	36.339	36.354	36.368	36.383	36.397	36.412	36.426	36.441	36.455	36.469	36.484	<b>2150</b>
<b>2160</b>	36.484	36.498	36.513	36.527	36.541	36.556	36.570	36.584	36.599	36.613	36.627	<b>2160</b>
<b>2170</b>	36.627	36.642	36.656	36.670	36.684	36.699	36.713	36.727	36.741	36.756	36.770	<b>2170</b>
<b>2180</b>	36.770	36.784	36.798	36.812	36.826	36.840	36.855	36.869	36.883	36.897	36.911	<b>2180</b>
<b>2190</b>	36.911	36.925	36.939	36.953	36.967	36.981	36.995	37.009	37.023	37.037	37.051	<b>2190</b>
<b>2200</b>	37.051	37.065	37.079	37.092	37.106	37.120	37.134	37.148	37.162	37.176	37.189	<b>2200</b>
<b>2210</b>	37.189	37.203	37.217	37.231	37.245	37.258	37.272	37.286	37.299	37.313	37.327	<b>2210</b>
<b>2220</b>	37.327	37.341	37.354	37.368	37.381	37.395	37.409	37.422	37.436	37.449	37.463	<b>2220</b>
<b>2230</b>	37.463	37.477	37.490	37.504	37.517	37.531	37.544	37.558	37.571	37.585	37.598	<b>2230</b>
<b>2240</b>	37.598	37.611	37.625	37.638	37.652	37.665	37.678	37.692	37.705	37.718	37.732	<b>2240</b>
<b>2250</b>	37.732	37.745	37.758	37.771	37.785	37.798	37.811	37.824	37.838	37.851	37.864	<b>2250</b>
<b>2260</b>	37.864	37.877	37.890	37.903	37.917	37.930	37.943	37.956	37.969	37.982	37.995	<b>2260</b>
<b>2270</b>	37.995	38.008	38.021	38.034	38.047	38.060	38.073	38.086	38.099	38.112	38.125	<b>2270</b>
<b>2280</b>	38.125	38.138	38.151	38.163	38.176	38.189	38.202	38.215	38.228	38.240	38.253	<b>2280</b>
<b>2290</b>	38.253	38.266	38.279	38.291	38.304	38.317	38.329	38.342	38.355	38.367	38.380	<b>2290</b>
<b>2300</b>	38.380	38.393	38.405	38.418	38.431	38.443	38.456	38.468	38.481	38.493	38.506	<b>2300</b>
<b>2310</b>	38.506	38.518	38.531	38.543	38.556	38.568						<b>2310</b>
°C	0	1	2	3	4	5	6	7	8	9	10	°C

Coefficients and temperature ranges of equations used to compute the above ITS-90 based table for Tungsten versus Tungsten - 26% Rhenium thermocouples.

0 °C to 630.615 °C		630.615 °C to 2315 °C	
$c_0$	= 0.000 000 0	$c_0$	= -1.106 441 2
$c_1$	= 1.279 220 1 X 10 <sup>-03</sup>	$c_1$	= 9.496 245 5 X 10 <sup>-03</sup>
$c_2$	= 2.163 475 4 X 10 <sup>-05</sup>	$c_2$	= -3.646 751 6 X 10 <sup>-06</sup>
$c_3$	= -1.139 323 4 X 10 <sup>-08</sup>	$c_3$	= 3.114 133 0 X 10 <sup>-08</sup>
$c_4$	= 4.385 002 2 X 10 <sup>-12</sup>	$c_4$	= -3.861 522 2 X 10 <sup>-11</sup>
$c_5$	= -1.708 920 2 X 10 <sup>-15</sup>	$c_5$	= 2.445 501 2 X 10 <sup>-14</sup>
		$c_6$	= -8.988 805 3 X 10 <sup>-18</sup>
		$c_7$	= 1.812 023 7 X 10 <sup>-21</sup>
		$c_8$	= -1.553 459 1 X 10 <sup>-25</sup>

**TABLE 2 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32°F**

°F	0	1	2	3	4	5	6	7	8	9	10	°F
Thermoelectric Voltage in Millivolts												
<b>30</b>			0.000	0.001	0.001	0.002	0.003	0.004	0.005	0.005	0.006	<b>30</b>
<b>40</b>	0.006	0.007	0.008	0.009	0.009	0.010	0.011	0.012	0.013	0.014	0.015	<b>40</b>
<b>50</b>	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	<b>50</b>
<b>60</b>	0.025	0.026	0.027	0.028	0.030	0.031	0.032	0.033	0.034	0.035	0.037	<b>60</b>
<b>70</b>	0.037	0.038	0.039	0.040	0.041	0.043	0.044	0.045	0.047	0.048	0.049	<b>70</b>
<b>80</b>	0.049	0.051	0.052	0.053	0.055	0.056	0.058	0.059	0.060	0.062	0.063	<b>80</b>
<b>90</b>	0.063	0.065	0.066	0.068	0.069	0.071	0.072	0.074	0.075	0.077	0.079	<b>90</b>
<b>100</b>	0.079	0.080	0.082	0.083	0.085	0.087	0.088	0.090	0.092	0.093	0.095	<b>100</b>
<b>110</b>	0.095	0.097	0.099	0.100	0.102	0.104	0.106	0.107	0.109	0.111	0.113	<b>110</b>
<b>120</b>	0.113	0.115	0.117	0.119	0.120	0.122	0.124	0.126	0.128	0.130	0.132	<b>120</b>
<b>130</b>	0.132	0.134	0.136	0.138	0.140	0.142	0.144	0.146	0.148	0.150	0.152	<b>130</b>
<b>140</b>	0.152	0.154	0.156	0.159	0.161	0.163	0.165	0.167	0.169	0.172	0.174	<b>140</b>
<b>150</b>	0.174	0.176	0.178	0.180	0.183	0.185	0.187	0.189	0.192	0.194	0.196	<b>150</b>
<b>160</b>	0.196	0.199	0.201	0.203	0.206	0.208	0.211	0.213	0.215	0.218	0.220	<b>160</b>
<b>170</b>	0.220	0.223	0.225	0.228	0.230	0.233	0.235	0.238	0.240	0.243	0.245	<b>170</b>
<b>180</b>	0.245	0.248	0.250	0.253	0.256	0.258	0.261	0.264	0.266	0.269	0.272	<b>180</b>
<b>190</b>	0.272	0.274	0.277	0.280	0.282	0.285	0.288	0.291	0.293	0.296	0.299	<b>190</b>
<b>200</b>	0.299	0.302	0.305	0.307	0.310	0.313	0.316	0.319	0.322	0.325	0.327	<b>200</b>
<b>210</b>	0.327	0.330	0.333	0.336	0.339	0.342	0.345	0.348	0.351	0.354	0.357	<b>210</b>
<b>220</b>	0.357	0.360	0.363	0.366	0.369	0.372	0.375	0.379	0.382	0.385	0.388	<b>220</b>
<b>230</b>	0.388	0.391	0.394	0.397	0.401	0.404	0.407	0.410	0.413	0.417	0.420	<b>230</b>
<b>240</b>	0.420	0.423	0.426	0.430	0.433	0.436	0.440	0.443	0.446	0.450	0.453	<b>240</b>
<b>250</b>	0.453	0.456	0.460	0.463	0.466	0.470	0.473	0.477	0.480	0.484	0.487	<b>250</b>
<b>260</b>	0.487	0.491	0.494	0.498	0.501	0.505	0.508	0.512	0.515	0.519	0.522	<b>260</b>
<b>270</b>	0.522	0.526	0.529	0.533	0.537	0.540	0.544	0.548	0.551	0.555	0.559	<b>270</b>
<b>280</b>	0.559	0.562	0.566	0.570	0.573	0.577	0.581	0.585	0.588	0.592	0.596	<b>280</b>
<b>290</b>	0.596	0.600	0.604	0.607	0.611	0.615	0.619	0.623	0.627	0.631	0.634	<b>290</b>
<b>300</b>	0.634	0.638	0.642	0.646	0.650	0.654	0.658	0.662	0.666	0.670	0.674	<b>300</b>
<b>310</b>	0.674	0.678	0.682	0.686	0.690	0.694	0.698	0.702	0.706	0.710	0.715	<b>310</b>
<b>320</b>	0.715	0.719	0.723	0.727	0.731	0.735	0.739	0.744	0.748	0.752	0.756	<b>320</b>
<b>330</b>	0.756	0.760	0.765	0.769	0.773	0.777	0.782	0.786	0.790	0.794	0.799	<b>330</b>
<b>340</b>	0.799	0.803	0.807	0.812	0.816	0.820	0.825	0.829	0.834	0.838	0.842	<b>340</b>
<b>350</b>	0.842	0.847	0.851	0.856	0.860	0.865	0.869	0.874	0.878	0.883	0.887	<b>350</b>
<b>360</b>	0.887	0.892	0.896	0.901	0.905	0.910	0.914	0.919	0.923	0.928	0.933	<b>360</b>
<b>370</b>	0.933	0.937	0.942	0.947	0.951	0.956	0.961	0.965	0.970	0.975	0.979	<b>370</b>
<b>380</b>	0.979	0.984	0.989	0.993	0.998	1.003	1.008	1.013	1.017	1.022	1.027	<b>380</b>
<b>390</b>	1.027	1.032	1.037	1.041	1.046	1.051	1.056	1.061	1.066	1.071	1.076	<b>390</b>
<b>400</b>	1.076	1.080	1.085	1.090	1.095	1.100	1.105	1.110	1.115	1.120	1.125	<b>400</b>
<b>410</b>	1.125	1.130	1.135	1.140	1.145	1.150	1.155	1.160	1.165	1.170	1.176	<b>410</b>
<b>420</b>	1.176	1.181	1.186	1.191	1.196	1.201	1.206	1.211	1.217	1.222	1.227	<b>420</b>
<b>430</b>	1.227	1.232	1.237	1.243	1.248	1.253	1.258	1.264	1.269	1.274	1.279	<b>430</b>
<b>440</b>	1.279	1.285	1.290	1.295	1.301	1.306	1.311	1.317	1.322	1.327	1.333	<b>440</b>
<b>450</b>	1.333	1.338	1.343	1.349	1.354	1.360	1.365	1.371	1.376	1.381	1.387	<b>450</b>
<b>460</b>	1.387	1.392	1.398	1.403	1.409	1.414	1.420	1.425	1.431	1.437	1.442	<b>460</b>
<b>470</b>	1.442	1.448	1.453	1.459	1.464	1.470	1.476	1.481	1.487	1.492	1.498	<b>470</b>
<b>480</b>	1.498	1.504	1.509	1.515	1.521	1.526	1.532	1.538	1.544	1.549	1.555	<b>480</b>
<b>490</b>	1.555	1.561	1.567	1.572	1.578	1.584	1.590	1.595	1.601	1.607	1.613	<b>490</b>
<b>500</b>	1.613	1.619	1.625	1.630	1.636	1.642	1.648	1.654	1.660	1.666	1.672	<b>500</b>
°F	0	1	2	3	4	5	6	7	8	9	10	°F



**TABLE 2 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32°F** *Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
Thermoelectric Voltage in Millivolts												
<b>500</b>	1.613	1.619	1.625	1.630	1.636	1.642	1.648	1.654	1.660	1.666	1.672	<b>500</b>
<b>510</b>	1.672	1.677	1.683	1.689	1.695	1.701	1.707	1.713	1.719	1.725	1.731	<b>510</b>
<b>520</b>	1.731	1.737	1.743	1.749	1.755	1.761	1.767	1.773	1.779	1.785	1.792	<b>520</b>
<b>530</b>	1.792	1.798	1.804	1.810	1.816	1.822	1.828	1.834	1.841	1.847	1.853	<b>530</b>
<b>540</b>	1.853	1.859	1.865	1.871	1.878	1.884	1.890	1.896	1.903	1.909	1.915	<b>540</b>
<b>550</b>	1.915	1.921	1.928	1.934	1.940	1.946	1.953	1.959	1.965	1.972	1.978	<b>550</b>
<b>560</b>	1.978	1.984	1.991	1.997	2.003	2.010	2.016	2.023	2.029	2.035	2.042	<b>560</b>
<b>570</b>	2.042	2.048	2.055	2.061	2.068	2.074	2.080	2.087	2.093	2.100	2.106	<b>570</b>
<b>580</b>	2.106	2.113	2.119	2.126	2.132	2.139	2.146	2.152	2.159	2.165	2.172	<b>580</b>
<b>590</b>	2.172	2.178	2.185	2.192	2.198	2.205	2.211	2.218	2.225	2.231	2.238	<b>590</b>
<b>600</b>	2.238	2.245	2.251	2.258	2.265	2.272	2.278	2.285	2.292	2.298	2.305	<b>600</b>
<b>610</b>	2.305	2.312	2.319	2.325	2.332	2.339	2.346	2.353	2.359	2.366	2.373	<b>610</b>
<b>620</b>	2.373	2.380	2.387	2.393	2.400	2.407	2.414	2.421	2.428	2.435	2.442	<b>620</b>
<b>630</b>	2.442	2.448	2.455	2.462	2.469	2.476	2.483	2.490	2.497	2.504	2.511	<b>630</b>
<b>640</b>	2.511	2.518	2.525	2.532	2.539	2.546	2.553	2.560	2.567	2.574	2.581	<b>640</b>
<b>650</b>	2.581	2.588	2.595	2.602	2.609	2.616	2.624	2.631	2.638	2.645	2.652	<b>650</b>
<b>660</b>	2.652	2.659	2.666	2.673	2.681	2.688	2.695	2.702	2.709	2.717	2.724	<b>660</b>
<b>670</b>	2.724	2.731	2.738	2.745	2.753	2.760	2.767	2.774	2.782	2.789	2.796	<b>670</b>
<b>680</b>	2.796	2.803	2.811	2.818	2.825	2.833	2.840	2.847	2.855	2.862	2.869	<b>680</b>
<b>690</b>	2.869	2.877	2.884	2.891	2.899	2.906	2.914	2.921	2.928	2.936	2.943	<b>690</b>
<b>700</b>	2.943	2.951	2.958	2.965	2.973	2.980	2.988	2.995	3.003	3.010	3.018	<b>700</b>
<b>710</b>	3.018	3.025	3.033	3.040	3.048	3.055	3.063	3.070	3.078	3.086	3.093	<b>710</b>
<b>720</b>	3.093	3.101	3.108	3.116	3.123	3.131	3.139	3.146	3.154	3.161	3.169	<b>720</b>
<b>730</b>	3.169	3.177	3.184	3.192	3.200	3.207	3.215	3.223	3.230	3.238	3.246	<b>730</b>
<b>740</b>	3.246	3.254	3.261	3.269	3.277	3.284	3.292	3.300	3.308	3.315	3.323	<b>740</b>
<b>750</b>	3.323	3.331	3.339	3.347	3.354	3.362	3.370	3.378	3.386	3.394	3.401	<b>750</b>
<b>760</b>	3.401	3.409	3.417	3.425	3.433	3.441	3.449	3.456	3.464	3.472	3.480	<b>760</b>
<b>770</b>	3.480	3.488	3.496	3.504	3.512	3.520	3.528	3.536	3.544	3.552	3.560	<b>770</b>
<b>780</b>	3.560	3.568	3.576	3.584	3.592	3.600	3.608	3.616	3.624	3.632	3.640	<b>780</b>
<b>790</b>	3.640	3.648	3.656	3.664	3.672	3.680	3.688	3.696	3.704	3.712	3.721	<b>790</b>
<b>800</b>	3.721	3.729	3.737	3.745	3.753	3.761	3.769	3.777	3.786	3.794	3.802	<b>800</b>
<b>810</b>	3.802	3.810	3.818	3.826	3.835	3.843	3.851	3.859	3.868	3.876	3.884	<b>810</b>
<b>820</b>	3.884	3.892	3.900	3.909	3.917	3.925	3.934	3.942	3.950	3.958	3.967	<b>820</b>
<b>830</b>	3.967	3.975	3.983	3.992	4.000	4.008	4.017	4.025	4.033	4.042	4.050	<b>830</b>
<b>840</b>	4.050	4.058	4.067	4.075	4.084	4.092	4.100	4.109	4.117	4.126	4.134	<b>840</b>
<b>850</b>	4.134	4.142	4.151	4.159	4.168	4.176	4.185	4.193	4.202	4.210	4.219	<b>850</b>
<b>860</b>	4.219	4.227	4.236	4.244	4.253	4.261	4.270	4.278	4.287	4.295	4.304	<b>860</b>
<b>870</b>	4.304	4.312	4.321	4.329	4.338	4.346	4.355	4.364	4.372	4.381	4.389	<b>870</b>
<b>880</b>	4.389	4.398	4.407	4.415	4.424	4.433	4.441	4.450	4.458	4.467	4.476	<b>880</b>
<b>890</b>	4.476	4.484	4.493	4.502	4.511	4.519	4.528	4.537	4.545	4.554	4.563	<b>890</b>
<b>900</b>	4.563	4.571	4.580	4.589	4.598	4.606	4.615	4.624	4.633	4.641	4.650	<b>900</b>
<b>910</b>	4.650	4.659	4.668	4.677	4.685	4.694	4.703	4.712	4.721	4.730	4.738	<b>910</b>
<b>920</b>	4.738	4.747	4.756	4.765	4.774	4.783	4.791	4.800	4.809	4.818	4.827	<b>920</b>
<b>930</b>	4.827	4.836	4.845	4.854	4.863	4.872	4.880	4.889	4.898	4.907	4.916	<b>930</b>
<b>940</b>	4.916	4.925	4.934	4.943	4.952	4.961	4.970	4.979	4.988	4.997	5.006	<b>940</b>
<b>950</b>	5.006	5.015	5.024	5.033	5.042	5.051	5.060	5.069	5.078	5.087	5.096	<b>950</b>
<b>960</b>	5.096	5.105	5.114	5.123	5.133	5.142	5.151	5.160	5.169	5.178	5.187	<b>960</b>
<b>970</b>	5.187	5.196	5.205	5.214	5.224	5.233	5.242	5.251	5.260	5.269	5.278	<b>970</b>
<b>980</b>	5.278	5.288	5.297	5.306	5.315	5.324	5.334	5.343	5.352	5.361	5.370	<b>980</b>
<b>990</b>	5.370	5.380	5.389	5.398	5.407	5.416	5.426	5.435	5.444	5.453	5.463	<b>990</b>
<b>1000</b>	5.463	5.472	5.481	5.491	5.500	5.509	5.518	5.528	5.537	5.546	5.556	<b>1000</b>
°F	0	1	2	3	4	5	6	7	8	9	10	°F

**TABLE 2 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32°F** *Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
Thermoelectric Voltage in Millivolts												
<b>1000</b>	5.463	5.472	5.481	5.491	5.500	5.509	5.518	5.528	5.537	5.546	5.556	<b>1000</b>
<b>1010</b>	5.556	5.565	5.574	5.584	5.593	5.602	5.612	5.621	5.630	5.640	5.649	<b>1010</b>
<b>1020</b>	5.649	5.658	5.668	5.677	5.687	5.696	5.705	5.715	5.724	5.734	5.743	<b>1020</b>
<b>1030</b>	5.743	5.752	5.762	5.771	5.781	5.790	5.800	5.809	5.818	5.828	5.837	<b>1030</b>
<b>1040</b>	5.837	5.847	5.856	5.866	5.875	5.885	5.894	5.904	5.913	5.923	5.932	<b>1040</b>
<b>1050</b>	5.932	5.942	5.951	5.961	5.970	5.980	5.989	5.999	6.008	6.018	6.027	<b>1050</b>
<b>1060</b>	6.027	6.037	6.047	6.056	6.066	6.075	6.085	6.095	6.104	6.114	6.123	<b>1060</b>
<b>1070</b>	6.123	6.133	6.143	6.152	6.162	6.171	6.181	6.191	6.200	6.210	6.220	<b>1070</b>
<b>1080</b>	6.220	6.229	6.239	6.249	6.258	6.268	6.278	6.287	6.297	6.307	6.316	<b>1080</b>
<b>1090</b>	6.316	6.326	6.336	6.345	6.355	6.365	6.374	6.384	6.394	6.404	6.413	<b>1090</b>
<b>1100</b>	6.413	6.423	6.433	6.443	6.452	6.462	6.472	6.482	6.491	6.501	6.511	<b>1100</b>
<b>1110</b>	6.511	6.521	6.531	6.540	6.550	6.560	6.570	6.580	6.589	6.599	6.609	<b>1110</b>
<b>1120</b>	6.609	6.619	6.629	6.638	6.648	6.658	6.668	6.678	6.688	6.698	6.707	<b>1120</b>
<b>1130</b>	6.707	6.717	6.727	6.737	6.747	6.757	6.767	6.777	6.786	6.796	6.806	<b>1130</b>
<b>1140</b>	6.806	6.816	6.826	6.836	6.846	6.856	6.866	6.876	6.886	6.896	6.905	<b>1140</b>
<b>1150</b>	6.905	6.915	6.925	6.935	6.945	6.955	6.965	6.975	6.985	6.995	7.005	<b>1150</b>
<b>1160</b>	7.005	7.015	7.025	7.035	7.045	7.055	7.065	7.075	7.085	7.095	7.105	<b>1160</b>
<b>1170</b>	7.105	7.115	7.125	7.135	7.145	7.155	7.165	7.175	7.185	7.196	7.206	<b>1170</b>
<b>1180</b>	7.206	7.216	7.226	7.236	7.246	7.256	7.266	7.276	7.286	7.296	7.306	<b>1180</b>
<b>1190</b>	7.306	7.317	7.327	7.337	7.347	7.357	7.367	7.377	7.387	7.398	7.408	<b>1190</b>
<b>1200</b>	7.408	7.418	7.428	7.438	7.448	7.458	7.469	7.479	7.489	7.499	7.509	<b>1200</b>
<b>1210</b>	7.509	7.519	7.530	7.540	7.550	7.560	7.570	7.581	7.591	7.601	7.611	<b>1210</b>
<b>1220</b>	7.611	7.622	7.632	7.642	7.652	7.662	7.673	7.683	7.693	7.703	7.714	<b>1220</b>
<b>1230</b>	7.714	7.724	7.734	7.745	7.755	7.765	7.775	7.786	7.796	7.806	7.816	<b>1230</b>
<b>1240</b>	7.816	7.827	7.837	7.847	7.858	7.868	7.878	7.889	7.899	7.909	7.920	<b>1240</b>
<b>1250</b>	7.920	7.930	7.940	7.951	7.961	7.971	7.982	7.992	8.002	8.013	8.023	<b>1250</b>
<b>1260</b>	8.023	8.034	8.044	8.054	8.065	8.075	8.085	8.096	8.106	8.117	8.127	<b>1260</b>
<b>1270</b>	8.127	8.137	8.148	8.158	8.169	8.179	8.190	8.200	8.210	8.221	8.231	<b>1270</b>
<b>1280</b>	8.231	8.242	8.252	8.263	8.273	8.284	8.294	8.305	8.315	8.325	8.336	<b>1280</b>
<b>1290</b>	8.336	8.346	8.357	8.367	8.378	8.388	8.399	8.409	8.420	8.430	8.441	<b>1290</b>
<b>1300</b>	8.441	8.451	8.462	8.472	8.483	8.493	8.504	8.515	8.525	8.536	8.546	<b>1300</b>
<b>1310</b>	8.546	8.557	8.567	8.578	8.588	8.599	8.610	8.620	8.631	8.641	8.652	<b>1310</b>
<b>1320</b>	8.652	8.662	8.673	8.684	8.694	8.705	8.715	8.726	8.737	8.747	8.758	<b>1320</b>
<b>1330</b>	8.758	8.768	8.779	8.790	8.800	8.811	8.821	8.832	8.843	8.853	8.864	<b>1330</b>
<b>1340</b>	8.864	8.875	8.885	8.896	8.907	8.917	8.928	8.939	8.949	8.960	8.971	<b>1340</b>
<b>1350</b>	8.971	8.981	8.992	9.003	9.013	9.024	9.035	9.045	9.056	9.067	9.078	<b>1350</b>
<b>1360</b>	9.078	9.088	9.099	9.110	9.120	9.131	9.142	9.153	9.163	9.174	9.185	<b>1360</b>
<b>1370</b>	9.185	9.196	9.206	9.217	9.228	9.239	9.249	9.260	9.271	9.282	9.292	<b>1370</b>
<b>1380</b>	9.292	9.303	9.314	9.325	9.335	9.346	9.357	9.368	9.379	9.389	9.400	<b>1380</b>
<b>1390</b>	9.400	9.411	9.422	9.433	9.443	9.454	9.465	9.476	9.487	9.498	9.508	<b>1390</b>
<b>1400</b>	9.508	9.519	9.530	9.541	9.552	9.563	9.573	9.584	9.595	9.606	9.617	<b>1400</b>
<b>1410</b>	9.617	9.628	9.638	9.649	9.660	9.671	9.682	9.693	9.704	9.715	9.725	<b>1410</b>
<b>1420</b>	9.725	9.736	9.747	9.758	9.769	9.780	9.791	9.802	9.813	9.824	9.834	<b>1420</b>
<b>1430</b>	9.834	9.845	9.856	9.867	9.878	9.889	9.900	9.911	9.922	9.933	9.944	<b>1430</b>
<b>1440</b>	9.944	9.955	9.966	9.977	9.988	9.998	10.009	10.020	10.031	10.042	10.053	<b>1440</b>
<b>1450</b>	10.053	10.064	10.075	10.086	10.097	10.108	10.119	10.130	10.141	10.152	10.163	<b>1450</b>
<b>1460</b>	10.163	10.174	10.185	10.196	10.207	10.218	10.229	10.240	10.251	10.262	10.273	<b>1460</b>
<b>1470</b>	10.273	10.284	10.295	10.306	10.317	10.328	10.339	10.350	10.361	10.372	10.383	<b>1470</b>
<b>1480</b>	10.383	10.395	10.406	10.417	10.428	10.439	10.450	10.461	10.472	10.483	10.494	<b>1480</b>
<b>1490</b>	10.494	10.505	10.516	10.527	10.538	10.549	10.561	10.572	10.583	10.594	10.605	<b>1490</b>
<b>1500</b>	10.605	10.616	10.627	10.638	10.649	10.660	10.671	10.683	10.694	10.705	10.716	<b>1500</b>
°F	0	1	2	3	4	5	6	7	8	9	10	°F

**TABLE 2 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32°F** *Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
Thermoelectric Voltage in Millivolts												
<b>1500</b>	10.605	10.616	10.627	10.638	10.649	10.660	10.671	10.683	10.694	10.705	10.716	<b>1500</b>
<b>1510</b>	10.716	10.727	10.738	10.749	10.760	10.772	10.783	10.794	10.805	10.816	10.827	<b>1510</b>
<b>1520</b>	10.827	10.838	10.850	10.861	10.872	10.883	10.894	10.905	10.916	10.928	10.939	<b>1520</b>
<b>1530</b>	10.939	10.950	10.961	10.972	10.983	10.995	11.006	11.017	11.028	11.039	11.051	<b>1530</b>
<b>1540</b>	11.051	11.062	11.073	11.084	11.095	11.106	11.118	11.129	11.140	11.151	11.162	<b>1540</b>
<b>1550</b>	11.162	11.174	11.185	11.196	11.207	11.219	11.230	11.241	11.252	11.263	11.275	<b>1550</b>
<b>1560</b>	11.275	11.286	11.297	11.308	11.320	11.331	11.342	11.353	11.365	11.376	11.387	<b>1560</b>
<b>1570</b>	11.387	11.398	11.410	11.421	11.432	11.443	11.455	11.466	11.477	11.488	11.500	<b>1570</b>
<b>1580</b>	11.500	11.511	11.522	11.533	11.545	11.556	11.567	11.579	11.590	11.601	11.612	<b>1580</b>
<b>1590</b>	11.612	11.624	11.635	11.646	11.658	11.669	11.680	11.692	11.703	11.714	11.725	<b>1590</b>
<b>1600</b>	11.725	11.737	11.748	11.759	11.771	11.782	11.793	11.805	11.816	11.827	11.839	<b>1600</b>
<b>1610</b>	11.839	11.850	11.861	11.873	11.884	11.895	11.907	11.918	11.929	11.941	11.952	<b>1610</b>
<b>1620</b>	11.952	11.963	11.975	11.986	11.997	12.009	12.020	12.032	12.043	12.054	12.066	<b>1620</b>
<b>1630</b>	12.066	12.077	12.088	12.100	12.111	12.123	12.134	12.145	12.157	12.168	12.179	<b>1630</b>
<b>1640</b>	12.179	12.191	12.202	12.214	12.225	12.236	12.248	12.259	12.271	12.282	12.293	<b>1640</b>
<b>1650</b>	12.293	12.305	12.316	12.328	12.339	12.350	12.362	12.373	12.385	12.396	12.407	<b>1650</b>
<b>1660</b>	12.407	12.419	12.430	12.442	12.453	12.465	12.476	12.487	12.499	12.510	12.522	<b>1660</b>
<b>1670</b>	12.522	12.533	12.545	12.556	12.567	12.579	12.590	12.602	12.613	12.625	12.636	<b>1670</b>
<b>1680</b>	12.636	12.648	12.659	12.670	12.682	12.693	12.705	12.716	12.728	12.739	12.751	<b>1680</b>
<b>1690</b>	12.751	12.762	12.774	12.785	12.797	12.808	12.819	12.831	12.842	12.854	12.865	<b>1690</b>
<b>1700</b>	12.865	12.877	12.888	12.900	12.911	12.923	12.934	12.946	12.957	12.969	12.980	<b>1700</b>
<b>1710</b>	12.980	12.992	13.003	13.015	13.026	13.038	13.049	13.061	13.072	13.084	13.095	<b>1710</b>
<b>1720</b>	13.095	13.107	13.118	13.130	13.141	13.153	13.164	13.176	13.187	13.199	13.210	<b>1720</b>
<b>1730</b>	13.210	13.222	13.234	13.245	13.257	13.268	13.280	13.291	13.303	13.314	13.326	<b>1730</b>
<b>1740</b>	13.326	13.337	13.349	13.360	13.372	13.383	13.395	13.407	13.418	13.430	13.441	<b>1740</b>
<b>1750</b>	13.441	13.453	13.464	13.476	13.487	13.499	13.510	13.522	13.534	13.545	13.557	<b>1750</b>
<b>1760</b>	13.557	13.568	13.580	13.591	13.603	13.615	13.626	13.638	13.649	13.661	13.672	<b>1760</b>
<b>1770</b>	13.672	13.684	13.696	13.707	13.719	13.730	13.742	13.753	13.765	13.777	13.788	<b>1770</b>
<b>1780</b>	13.788	13.800	13.811	13.823	13.835	13.846	13.858	13.869	13.881	13.892	13.904	<b>1780</b>
<b>1790</b>	13.904	13.916	13.927	13.939	13.950	13.962	13.974	13.985	13.997	14.009	14.020	<b>1790</b>
<b>1800</b>	14.020	14.032	14.043	14.055	14.067	14.078	14.090	14.101	14.113	14.125	14.136	<b>1800</b>
<b>1810</b>	14.136	14.148	14.159	14.171	14.183	14.194	14.206	14.218	14.229	14.241	14.252	<b>1810</b>
<b>1820</b>	14.252	14.264	14.276	14.287	14.299	14.311	14.322	14.334	14.345	14.357	14.369	<b>1820</b>
<b>1830</b>	14.369	14.380	14.392	14.404	14.415	14.427	14.439	14.450	14.462	14.474	14.485	<b>1830</b>
<b>1840</b>	14.485	14.497	14.508	14.520	14.532	14.543	14.555	14.567	14.578	14.590	14.602	<b>1840</b>
<b>1850</b>	14.602	14.613	14.625	14.637	14.648	14.660	14.672	14.683	14.695	14.707	14.718	<b>1850</b>
<b>1860</b>	14.718	14.730	14.742	14.753	14.765	14.777	14.788	14.800	14.812	14.823	14.835	<b>1860</b>
<b>1870</b>	14.835	14.847	14.858	14.870	14.882	14.893	14.905	14.917	14.928	14.940	14.952	<b>1870</b>
<b>1880</b>	14.952	14.963	14.975	14.987	14.998	15.010	15.022	15.033	15.045	15.057	15.069	<b>1880</b>
<b>1890</b>	15.069	15.080	15.092	15.104	15.115	15.127	15.139	15.150	15.162	15.174	15.185	<b>1890</b>
<b>1900</b>	15.185	15.197	15.209	15.220	15.232	15.244	15.256	15.267	15.279	15.291	15.302	<b>1900</b>
<b>1910</b>	15.302	15.314	15.326	15.337	15.349	15.361	15.373	15.384	15.396	15.408	15.419	<b>1910</b>
<b>1920</b>	15.419	15.431	15.443	15.455	15.466	15.478	15.490	15.501	15.513	15.525	15.536	<b>1920</b>
<b>1930</b>	15.536	15.548	15.560	15.572	15.583	15.595	15.607	15.618	15.630	15.642	15.654	<b>1930</b>
<b>1940</b>	15.654	15.665	15.677	15.689	15.701	15.712	15.724	15.736	15.747	15.759	15.771	<b>1940</b>
<b>1950</b>	15.771	15.783	15.794	15.806	15.818	15.829	15.841	15.853	15.865	15.876	15.888	<b>1950</b>
<b>1960</b>	15.888	15.900	15.912	15.923	15.935	15.947	15.958	15.970	15.982	15.994	16.005	<b>1960</b>
<b>1970</b>	16.005	16.017	16.029	16.041	16.052	16.064	16.076	16.087	16.099	16.111	16.123	<b>1970</b>
<b>1980</b>	16.123	16.134	16.146	16.158	16.170	16.181	16.193	16.205	16.217	16.228	16.240	<b>1980</b>
<b>1990</b>	16.240	16.252	16.264	16.275	16.287	16.299	16.310	16.322	16.334	16.346	16.357	<b>1990</b>
<b>2000</b>	16.357	16.369	16.381	16.393	16.404	16.416	16.428	16.440	16.451	16.463	16.475	<b>2000</b>
°F	0	1	2	3	4	5	6	7	8	9	10	°F

**TABLE 2 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32°F** *Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
Thermoelectric Voltage in Millivolts												
<b>2000</b>	16.357	16.369	16.381	16.393	16.404	16.416	16.428	16.440	16.451	16.463	16.475	<b>2000</b>
<b>2010</b>	16.475	16.487	16.498	16.510	16.522	16.534	16.545	16.557	16.569	16.581	16.592	<b>2010</b>
<b>2020</b>	16.592	16.604	16.616	16.628	16.639	16.651	16.663	16.675	16.686	16.698	16.710	<b>2020</b>
<b>2030</b>	16.710	16.722	16.733	16.745	16.757	16.769	16.780	16.792	16.804	16.816	16.827	<b>2030</b>
<b>2040</b>	16.827	16.839	16.851	16.863	16.874	16.886	16.898	16.910	16.921	16.933	16.945	<b>2040</b>
<b>2050</b>	16.945	16.957	16.968	16.980	16.992	17.004	17.015	17.027	17.039	17.051	17.062	<b>2050</b>
<b>2060</b>	17.062	17.074	17.086	17.098	17.109	17.121	17.133	17.145	17.156	17.168	17.180	<b>2060</b>
<b>2070</b>	17.180	17.192	17.203	17.215	17.227	17.239	17.250	17.262	17.274	17.286	17.298	<b>2070</b>
<b>2080</b>	17.298	17.309	17.321	17.333	17.345	17.356	17.368	17.380	17.392	17.403	17.415	<b>2080</b>
<b>2090</b>	17.415	17.427	17.439	17.450	17.462	17.474	17.486	17.497	17.509	17.521	17.533	<b>2090</b>
<b>2100</b>	17.533	17.544	17.556	17.568	17.580	17.591	17.603	17.615	17.627	17.638	17.650	<b>2100</b>
<b>2110</b>	17.650	17.662	17.674	17.685	17.697	17.709	17.721	17.732	17.744	17.756	17.768	<b>2110</b>
<b>2120</b>	17.768	17.780	17.791	17.803	17.815	17.827	17.838	17.850	17.862	17.874	17.885	<b>2120</b>
<b>2130</b>	17.885	17.897	17.909	17.921	17.932	17.944	17.956	17.968	17.979	17.991	18.003	<b>2130</b>
<b>2140</b>	18.003	18.015	18.026	18.038	18.050	18.062	18.073	18.085	18.097	18.109	18.120	<b>2140</b>
<b>2150</b>	18.120	18.132	18.144	18.156	18.167	18.179	18.191	18.203	18.214	18.226	18.238	<b>2150</b>
<b>2160</b>	18.238	18.250	18.261	18.273	18.285	18.297	18.308	18.320	18.332	18.344	18.355	<b>2160</b>
<b>2170</b>	18.355	18.367	18.379	18.391	18.402	18.414	18.426	18.438	18.449	18.461	18.473	<b>2170</b>
<b>2180</b>	18.473	18.485	18.496	18.508	18.520	18.532	18.543	18.555	18.567	18.579	18.590	<b>2180</b>
<b>2190</b>	18.590	18.602	18.614	18.625	18.637	18.649	18.661	18.672	18.684	18.696	18.708	<b>2190</b>
<b>2200</b>	18.708	18.719	18.731	18.743	18.755	18.766	18.778	18.790	18.802	18.813	18.825	<b>2200</b>
<b>2210</b>	18.825	18.837	18.849	18.860	18.872	18.884	18.895	18.907	18.919	18.931	18.942	<b>2210</b>
<b>2220</b>	18.942	18.954	18.966	18.978	18.989	19.001	19.013	19.025	19.036	19.048	19.060	<b>2220</b>
<b>2230</b>	19.060	19.071	19.083	19.095	19.107	19.118	19.130	19.142	19.154	19.165	19.177	<b>2230</b>
<b>2240</b>	19.177	19.189	19.200	19.212	19.224	19.236	19.247	19.259	19.271	19.282	19.294	<b>2240</b>
<b>2250</b>	19.294	19.306	19.318	19.329	19.341	19.353	19.364	19.376	19.388	19.400	19.411	<b>2250</b>
<b>2260</b>	19.411	19.423	19.435	19.446	19.458	19.470	19.482	19.493	19.505	19.517	19.528	<b>2260</b>
<b>2270</b>	19.528	19.540	19.552	19.564	19.575	19.587	19.599	19.610	19.622	19.634	19.646	<b>2270</b>
<b>2280</b>	19.646	19.657	19.669	19.681	19.692	19.704	19.716	19.727	19.739	19.751	19.763	<b>2280</b>
<b>2290</b>	19.763	19.774	19.786	19.798	19.809	19.821	19.833	19.844	19.856	19.868	19.880	<b>2290</b>
<b>2300</b>	19.880	19.891	19.903	19.915	19.926	19.938	19.950	19.961	19.973	19.985	19.996	<b>2300</b>
<b>2310</b>	19.996	20.008	20.020	20.031	20.043	20.055	20.067	20.078	20.090	20.102	20.113	<b>2310</b>
<b>2320</b>	20.113	20.125	20.137	20.148	20.160	20.172	20.183	20.195	20.207	20.218	20.230	<b>2320</b>
<b>2330</b>	20.230	20.242	20.253	20.265	20.277	20.288	20.300	20.312	20.323	20.335	20.347	<b>2330</b>
<b>2340</b>	20.347	20.358	20.370	20.382	20.393	20.405	20.417	20.428	20.440	20.452	20.463	<b>2340</b>
<b>2350</b>	20.463	20.475	20.487	20.498	20.510	20.522	20.533	20.545	20.557	20.568	20.580	<b>2350</b>
<b>2360</b>	20.580	20.592	20.603	20.615	20.627	20.638	20.650	20.661	20.673	20.685	20.696	<b>2360</b>
<b>2370</b>	20.696	20.708	20.720	20.731	20.743	20.755	20.766	20.778	20.790	20.801	20.813	<b>2370</b>
<b>2380</b>	20.813	20.824	20.836	20.848	20.859	20.871	20.883	20.894	20.906	20.918	20.929	<b>2380</b>
<b>2390</b>	20.929	20.941	20.952	20.964	20.976	20.987	20.999	21.011	21.022	21.034	21.045	<b>2390</b>
<b>2400</b>	21.045	21.057	21.069	21.080	21.092	21.103	21.115	21.127	21.138	21.150	21.162	<b>2400</b>
<b>2410</b>	21.162	21.173	21.185	21.196	21.208	21.220	21.231	21.243	21.254	21.266	21.278	<b>2410</b>
<b>2420</b>	21.278	21.289	21.301	21.312	21.324	21.336	21.347	21.359	21.370	21.382	21.394	<b>2420</b>
<b>2430</b>	21.394	21.405	21.417	21.428	21.440	21.452	21.463	21.475	21.486	21.498	21.509	<b>2430</b>
<b>2440</b>	21.509	21.521	21.533	21.544	21.556	21.567	21.579	21.591	21.602	21.614	21.625	<b>2440</b>
<b>2450</b>	21.625	21.637	21.648	21.660	21.672	21.683	21.695	21.706	21.718	21.729	21.741	<b>2450</b>
<b>2460</b>	21.741	21.753	21.764	21.776	21.787	21.799	21.810	21.822	21.833	21.845	21.857	<b>2460</b>
<b>2470</b>	21.857	21.868	21.880	21.891	21.903	21.914	21.926	21.937	21.949	21.960	21.972	<b>2470</b>
<b>2480</b>	21.972	21.984	21.995	22.007	22.018	22.030	22.041	22.053	22.064	22.076	22.087	<b>2480</b>
<b>2490</b>	22.087	22.099	22.110	22.122	22.134	22.145	22.157	22.168	22.180	22.191	22.203	<b>2490</b>
<b>2500</b>	22.203	22.214	22.226	22.237	22.249	22.260	22.272	22.283	22.295	22.306	22.318	<b>2500</b>
°F	0	1	2	3	4	5	6	7	8	9	10	°F

**TABLE 2 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32°F** *Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
Thermoelectric Voltage in Millivolts												
<b>2500</b>	22.203	22.214	22.226	22.237	22.249	22.260	22.272	22.283	22.295	22.306	22.318	<b>2500</b>
<b>2510</b>	22.318	22.329	22.341	22.352	22.364	22.375	22.387	22.398	22.410	22.421	22.433	<b>2510</b>
<b>2520</b>	22.433	22.444	22.456	22.467	22.479	22.490	22.502	22.513	22.525	22.536	22.548	<b>2520</b>
<b>2530</b>	22.548	22.559	22.571	22.582	22.594	22.605	22.617	22.628	22.640	22.651	22.663	<b>2530</b>
<b>2540</b>	22.663	22.674	22.686	22.697	22.709	22.720	22.731	22.743	22.754	22.766	22.777	<b>2540</b>
<b>2550</b>	22.777	22.789	22.800	22.812	22.823	22.835	22.846	22.858	22.869	22.880	22.892	<b>2550</b>
<b>2560</b>	22.892	22.903	22.915	22.926	22.938	22.949	22.961	22.972	22.983	22.995	23.006	<b>2560</b>
<b>2570</b>	23.006	23.018	23.029	23.041	23.052	23.064	23.075	23.086	23.098	23.109	23.121	<b>2570</b>
<b>2580</b>	23.121	23.132	23.143	23.155	23.166	23.178	23.189	23.201	23.212	23.223	23.235	<b>2580</b>
<b>2590</b>	23.235	23.246	23.258	23.269	23.280	23.292	23.303	23.315	23.326	23.337	23.349	<b>2590</b>
<b>2600</b>	23.349	23.360	23.372	23.383	23.394	23.406	23.417	23.429	23.440	23.451	23.463	<b>2600</b>
<b>2610</b>	23.463	23.474	23.486	23.497	23.508	23.520	23.531	23.542	23.554	23.565	23.577	<b>2610</b>
<b>2620</b>	23.577	23.588	23.599	23.611	23.622	23.633	23.645	23.656	23.668	23.679	23.690	<b>2620</b>
<b>2630</b>	23.690	23.702	23.713	23.724	23.736	23.747	23.758	23.770	23.781	23.792	23.804	<b>2630</b>
<b>2640</b>	23.804	23.815	23.826	23.838	23.849	23.860	23.872	23.883	23.894	23.906	23.917	<b>2640</b>
<b>2650</b>	23.917	23.928	23.940	23.951	23.962	23.974	23.985	23.996	24.008	24.019	24.030	<b>2650</b>
<b>2660</b>	24.030	24.042	24.053	24.064	24.076	24.087	24.098	24.110	24.121	24.132	24.143	<b>2660</b>
<b>2670</b>	24.143	24.155	24.166	24.177	24.189	24.200	24.211	24.222	24.234	24.245	24.256	<b>2670</b>
<b>2680</b>	24.256	24.268	24.279	24.290	24.301	24.313	24.324	24.335	24.347	24.358	24.369	<b>2680</b>
<b>2690</b>	24.369	24.380	24.392	24.403	24.414	24.425	24.437	24.448	24.459	24.470	24.482	<b>2690</b>
<b>2700</b>	24.482	24.493	24.504	24.516	24.527	24.538	24.549	24.560	24.572	24.583	24.594	<b>2700</b>
<b>2710</b>	24.594	24.605	24.617	24.628	24.639	24.650	24.662	24.673	24.684	24.695	24.707	<b>2710</b>
<b>2720</b>	24.707	24.718	24.729	24.740	24.751	24.763	24.774	24.785	24.796	24.807	24.819	<b>2720</b>
<b>2730</b>	24.819	24.830	24.841	24.852	24.863	24.875	24.886	24.897	24.908	24.919	24.931	<b>2730</b>
<b>2740</b>	24.931	24.942	24.953	24.964	24.975	24.987	24.998	25.009	25.020	25.031	25.042	<b>2740</b>
<b>2750</b>	25.042	25.054	25.065	25.076	25.087	25.098	25.109	25.121	25.132	25.143	25.154	<b>2750</b>
<b>2760</b>	25.154	25.165	25.176	25.188	25.199	25.210	25.221	25.232	25.243	25.254	25.266	<b>2760</b>
<b>2770</b>	25.266	25.277	25.288	25.299	25.310	25.321	25.332	25.344	25.355	25.366	25.377	<b>2770</b>
<b>2780</b>	25.377	25.388	25.399	25.410	25.421	25.433	25.444	25.455	25.466	25.477	25.488	<b>2780</b>
<b>2790</b>	25.488	25.499	25.510	25.521	25.532	25.544	25.555	25.566	25.577	25.588	25.599	<b>2790</b>
<b>2800</b>	25.599	25.610	25.621	25.632	25.643	25.654	25.666	25.677	25.688	25.699	25.710	<b>2800</b>
<b>2810</b>	25.710	25.721	25.732	25.743	25.754	25.765	25.776	25.787	25.798	25.809	25.820	<b>2810</b>
<b>2820</b>	25.820	25.832	25.843	25.854	25.865	25.876	25.887	25.898	25.909	25.920	25.931	<b>2820</b>
<b>2830</b>	25.931	25.942	25.953	25.964	25.975	25.986	25.997	26.008	26.019	26.030	26.041	<b>2830</b>
<b>2840</b>	26.041	26.052	26.063	26.074	26.085	26.096	26.107	26.118	26.129	26.140	26.151	<b>2840</b>
<b>2850</b>	26.151	26.162	26.173	26.184	26.195	26.206	26.217	26.228	26.239	26.250	26.261	<b>2850</b>
<b>2860</b>	26.261	26.272	26.283	26.294	26.305	26.316	26.327	26.338	26.349	26.360	26.371	<b>2860</b>
<b>2870</b>	26.371	26.382	26.393	26.404	26.415	26.426	26.437	26.447	26.458	26.469	26.480	<b>2870</b>
<b>2880</b>	26.480	26.491	26.502	26.513	26.524	26.535	26.546	26.557	26.568	26.579	26.590	<b>2880</b>
<b>2890</b>	26.590	26.601	26.611	26.622	26.633	26.644	26.655	26.666	26.677	26.688	26.699	<b>2890</b>
<b>2900</b>	26.699	26.710	26.721	26.731	26.742	26.753	26.764	26.775	26.786	26.797	26.808	<b>2900</b>
<b>2910</b>	26.808	26.819	26.829	26.840	26.851	26.862	26.873	26.884	26.895	26.905	26.916	<b>2910</b>
<b>2920</b>	26.916	26.927	26.938	26.949	26.960	26.971	26.981	26.992	27.003	27.014	27.025	<b>2920</b>
<b>2930</b>	27.025	27.036	27.047	27.057	27.068	27.079	27.090	27.101	27.112	27.122	27.133	<b>2930</b>
<b>2940</b>	27.133	27.144	27.155	27.166	27.176	27.187	27.198	27.209	27.220	27.230	27.241	<b>2940</b>
<b>2950</b>	27.241	27.252	27.263	27.274	27.284	27.295	27.306	27.317	27.328	27.338	27.349	<b>2950</b>
<b>2960</b>	27.349	27.360	27.371	27.382	27.392	27.403	27.414	27.425	27.435	27.446	27.457	<b>2960</b>
<b>2970</b>	27.457	27.468	27.478	27.489	27.500	27.511	27.521	27.532	27.543	27.554	27.564	<b>2970</b>
<b>2980</b>	27.564	27.575	27.586	27.597	27.607	27.618	27.629	27.639	27.650	27.661	27.672	<b>2980</b>
<b>2990</b>	27.672	27.682	27.693	27.704	27.714	27.725	27.736	27.747	27.757	27.768	27.779	<b>2990</b>
<b>3000</b>	27.779	27.789	27.800	27.811	27.821	27.832	27.843	27.854	27.864	27.875	27.886	<b>3000</b>
°F	0	1	2	3	4	5	6	7	8	9	10	°F



**TABLE 2 Tungsten versus Tungsten-26 % Rhenium thermocouples—thermoelectric voltage as a function of temperature (°F), reference junctions at 32°F** *Continued*

°F	0	1	2	3	4	5	6	7	8	9	10	°F
Thermoelectric Voltage in Millivolts												
<b>3000</b>	27.779	27.789	27.800	27.811	27.821	27.832	27.843	27.854	27.864	27.875	27.886	<b>3000</b>
<b>3010</b>	27.886	27.896	27.907	27.918	27.928	27.939	27.950	27.960	27.971	27.982	27.992	<b>3010</b>
<b>3020</b>	27.992	28.003	28.013	28.024	28.035	28.045	28.056	28.067	28.077	28.088	28.099	<b>3020</b>
<b>3030</b>	28.099	28.109	28.120	28.130	28.141	28.152	28.162	28.173	28.184	28.194	28.205	<b>3030</b>
<b>3040</b>	28.205	28.215	28.226	28.237	28.247	28.258	28.268	28.279	28.290	28.300	28.311	<b>3040</b>
<b>3050</b>	28.311	28.321	28.332	28.342	28.353	28.364	28.374	28.385	28.395	28.406	28.416	<b>3050</b>
<b>3060</b>	28.416	28.427	28.438	28.448	28.459	28.469	28.480	28.490	28.501	28.511	28.522	<b>3060</b>
<b>3070</b>	28.522	28.533	28.543	28.554	28.564	28.575	28.585	28.596	28.606	28.617	28.627	<b>3070</b>
<b>3080</b>	28.627	28.638	28.648	28.659	28.669	28.680	28.690	28.701	28.711	28.722	28.732	<b>3080</b>
<b>3090</b>	28.732	28.743	28.753	28.764	28.774	28.785	28.795	28.806	28.816	28.827	28.837	<b>3090</b>
<b>3100</b>	28.837	28.848	28.858	28.869	28.879	28.889	28.900	28.910	28.921	28.931	28.942	<b>3100</b>
<b>3110</b>	28.942	28.952	28.963	28.973	28.983	28.994	29.004	29.015	29.025	29.036	29.046	<b>3110</b>
<b>3120</b>	29.046	29.056	29.067	29.077	29.088	29.098	29.109	29.119	29.129	29.140	29.150	<b>3120</b>
<b>3130</b>	29.150	29.161	29.171	29.181	29.192	29.202	29.213	29.223	29.233	29.244	29.254	<b>3130</b>
<b>3140</b>	29.254	29.264	29.275	29.285	29.296	29.306	29.316	29.327	29.337	29.347	29.358	<b>3140</b>
<b>3150</b>	29.358	29.368	29.378	29.389	29.399	29.409	29.420	29.430	29.440	29.451	29.461	<b>3150</b>
<b>3160</b>	29.461	29.471	29.482	29.492	29.502	29.513	29.523	29.533	29.544	29.554	29.564	<b>3160</b>
<b>3170</b>	29.564	29.575	29.585	29.595	29.605	29.616	29.626	29.636	29.647	29.657	29.667	<b>3170</b>
<b>3180</b>	29.667	29.677	29.688	29.698	29.708	29.718	29.729	29.739	29.749	29.760	29.770	<b>3180</b>
<b>3190</b>	29.770	29.780	29.790	29.801	29.811	29.821	29.831	29.841	29.852	29.862	29.872	<b>3190</b>
<b>3200</b>	29.872	29.882	29.893	29.903	29.913	29.923	29.933	29.944	29.954	29.964	29.974	<b>3200</b>
<b>3210</b>	29.974	29.985	29.995	30.005	30.015	30.025	30.035	30.046	30.056	30.066	30.076	<b>3210</b>
<b>3220</b>	30.076	30.086	30.097	30.107	30.117	30.127	30.137	30.147	30.158	30.168	30.178	<b>3220</b>
<b>3230</b>	30.178	30.188	30.198	30.208	30.218	30.229	30.239	30.249	30.259	30.269	30.279	<b>3230</b>
<b>3240</b>	30.279	30.289	30.299	30.310	30.320	30.330	30.340	30.350	30.360	30.370	30.380	<b>3240</b>
<b>3250</b>	30.380	30.390	30.401	30.411	30.421	30.431	30.441	30.451	30.461	30.471	30.481	<b>3250</b>
<b>3260</b>	30.481	30.491	30.501	30.511	30.521	30.532	30.542	30.552	30.562	30.572	30.582	<b>3260</b>
<b>3270</b>	30.582	30.592	30.602	30.612	30.622	30.632	30.642	30.652	30.662	30.672	30.682	<b>3270</b>
<b>3280</b>	30.682	30.692	30.702	30.712	30.722	30.732	30.742	30.752	30.762	30.772	30.782	<b>3280</b>
<b>3290</b>	30.782	30.792	30.802	30.812	30.822	30.832	30.842	30.852	30.862	30.872	30.882	<b>3290</b>
<b>3300</b>	30.882	30.892	30.902	30.912	30.922	30.932	30.942	30.952	30.962	30.972	30.982	<b>3300</b>
<b>3310</b>	30.982	30.991	31.001	31.011	31.021	31.031	31.041	31.051	31.061	31.071	31.081	<b>3310</b>
<b>3320</b>	31.081	31.091	31.101	31.111	31.120	31.130	31.140	31.150	31.160	31.170	31.180	<b>3320</b>
<b>3330</b>	31.180	31.190	31.200	31.209	31.219	31.229	31.239	31.249	31.259	31.269	31.279	<b>3330</b>
<b>3340</b>	31.279	31.288	31.298	31.308	31.318	31.328	31.338	31.347	31.357	31.367	31.377	<b>3340</b>
<b>3350</b>	31.377	31.387	31.397	31.406	31.416	31.426	31.436	31.446	31.456	31.465	31.475	<b>3350</b>
<b>3360</b>	31.475	31.485	31.495	31.505	31.514	31.524	31.534	31.544	31.553	31.563	31.573	<b>3360</b>
<b>3370</b>	31.573	31.583	31.593	31.602	31.612	31.622	31.632	31.641	31.651	31.661	31.671	<b>3370</b>
<b>3380</b>	31.671	31.680	31.690	31.700	31.710	31.719	31.729	31.739	31.749	31.758	31.768	<b>3380</b>
<b>3390</b>	31.768	31.778	31.787	31.797	31.807	31.817	31.826	31.836	31.846	31.855	31.865	<b>3390</b>
<b>3400</b>	31.865	31.875	31.884	31.894	31.904	31.913	31.923	31.933	31.942	31.952	31.962	<b>3400</b>
<b>3410</b>	31.962	31.971	31.981	31.991	32.000	32.010	32.020	32.029	32.039	32.049	32.058	<b>3410</b>
<b>3420</b>	32.058	32.068	32.078	32.087	32.097	32.106	32.116	32.126	32.135	32.145	32.154	<b>3420</b>
<b>3430</b>	32.154	32.164	32.174	32.183	32.193	32.202	32.212	32.222	32.231	32.241	32.250	<b>3430</b>
<b>3440</b>	32.250	32.260	32.270	32.279	32.289	32.298	32.308	32.317	32.327	32.336	32.346	<b>3440</b>
<b>3450</b>	32.346	32.356	32.365	32.375	32.384	32.394	32.403	32.413	32.422	32.432	32.441	<b>3450</b>
<b>3460</b>	32.441	32.451	32.460	32.470	32.479	32.489	32.498	32.508	32.517	32.527	32.536	<b>3460</b>
<b>3470</b>	32.536	32.546	32.555	32.565	32.574	32.584	32.593	32.603	32.612	32.622	32.631	<b>3470</b>
<b>3480</b>	32.631	32.640	32.650	32.659	32.669	32.678	32.688	32.697	32.707	32.716	32.725	<b>3480</b>
<b>3490</b>	32.725	32.735	32.744	32.754	32.763	32.773	32.782	32.791	32.801	32.810	32.820	<b>3490</b>
<b>3500</b>	32.820	32.829	32.838	32.848	32.857	32.867	32.876	32.885	32.895	32.904	32.913	<b>3500</b>
°F	0	1	2	3	4	5	6	7	8	9	10	°F