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PLATINEL THERMOCOUPLE WIRE

Type P: Platinel thermocouple wire

Introduction

Platinel thermocouple wire is a proprietary precious metal combination developed to closely approximate the type K calibration curve. It demonstrates superior corrosion resistance, stability, and is usable to 1300°C. Platinel is the only high output thermocouple combination capable of serving at this temperature in an oxidizing environment.

One of the most popular and common applications for Platinel is use as a direct substitute for K type materials. Platinel has demonstrated superior life and stability at process temperatures in excess of 950°C.

Annealing

To develop the full emf of Platinel and to realize the stability benefits, the conductors must be fully annealed. Bare wire can be annealed electrically in air at 1200°C for 15 minutes. Mineral oxide compacted insulated-metal sheath assemblies should be annealed at no lower than 1050°C for 10 minutes.

Compensating Lead Wire

The use of type K wire as an extension wire for Platinel is strongly discouraged. There is sufficient difference between the two calibrations to cause reading errors of more than 20°C to develop under certain conditions.

A compensating lead wire is available that matches Platinel to within 150 micro-volts up to 175°C. This material is available in 20 gage solid and stranded conductors with Teflon and Fiberglass insulation.

Part No. P2X-20-TEF: Teflon Jacket over Teflon on conductors.

Part No. P2X-20X-GG: Impregnated glass jacket over glass on conductors.

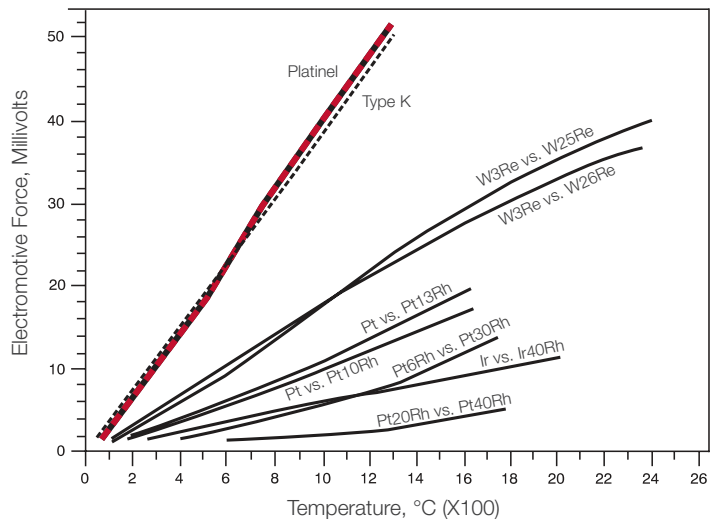
Compensating lead wire color code

Positive conductor – yellow
Negative conductor – red
Jacket – black

Compensating lead wire resistivity (room temperature)

Positive conductor 415 ohm (cir-mil) ft
Negative conductor 30 ohm (cir-mil) ft

Comparative emf vs. temperature relationship of common thermocouple materials



Type P

Stability Data

A number of tests have been conducted on the emf stability of Platinel. As in all thermocouple applications, the environment, duty cycle, handling, temperature, etc. have a strong influence. Because each application is unique, the following data is provided only as a guide for consideration.

Steady State Drift

Furnace test, change in calibration (°C) after indicated number of hours soaking at the indicated temperature.

Calibration Temp. °C	2658 hr. Soak at 1200°C	1008 hr. Soak at 1300°C
400	-1.8	+2.0
600	-0.3	+2.0
800	-0.3	+3.0
1000	-0.3	+3.0
1200	+1.8	+1.0

Cycling Drift

Change in calibration after 20,500 cycles between 100°C and 1250°C over a three month period.

Calibration Temp. °C	Calibration Shift °C
600	2.0
800	2.0
1000	3.0
1200	3.0

Calibration Comparison

The following tabulation provides a cursory view of the emf output of Platinel and Type K thermocouples. As can be seen there is sufficiently close matching between these materials to permit direct substitution in most industrial application's. All modern equipment manufactures produce process control instruments calibrated for Platinel.

Platinel VS. Type K Thermocouple Wire

Temp. °C	Platinel (m V)	Type (m V)
200	7.113	8.133
400	15.665	16.396
600	24.658	24.902
800	33.414	33.277
1000	41.521	41.269
1200	48.877	48.828

Tolerance

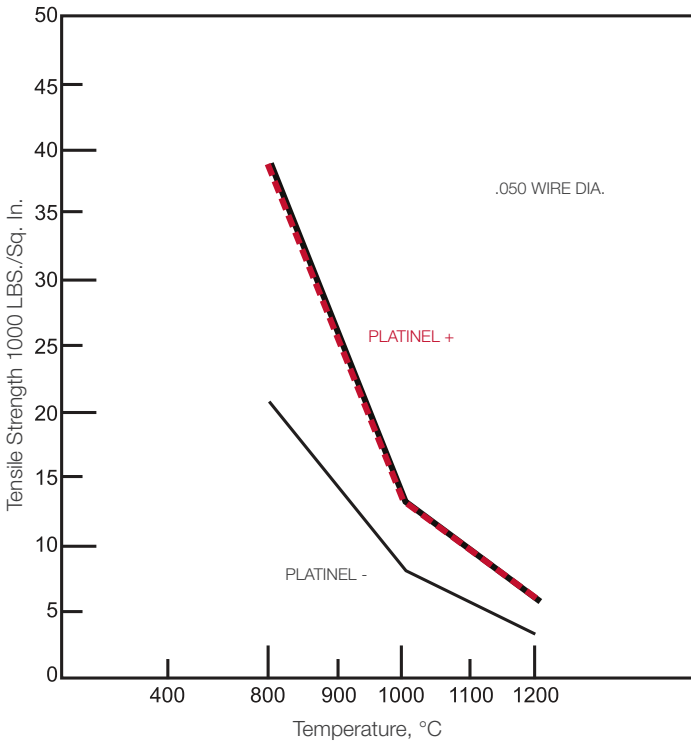
Platinel thermocouple wire is supplied as a calibrated matched pair. Individual elements should not be intermixed without consultation with the factory and the establishment of the necessary specifications. Detailed lot calibration charts at 10°C and 1°C intervals are available on special order.

Temp. °C	Standard Grade	Premium Grade
200	±.150 mV	±.100mV
400	±.150	±.100
600	±.202	±.101
800	±.252	±.126
1000	±.292	±.146
1200	±.315	±.158

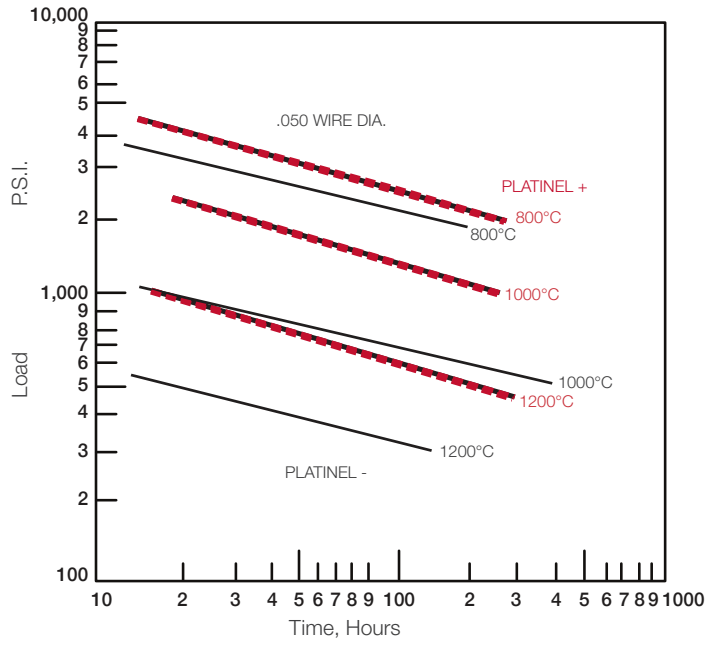
Weight for Select Wire Diameters (troy oz/ft)

Diameter (Inch)	Platinel +	Platinel -	Melting Range	Liquidus	Solidus
0.005	0.00183	0.00197	Platinel +	1608°C	1570°C
0.007	0.00359	0.00387	Platinel -	1447°C	1426°C
0.008	0.0047	0.00505			
0.009	0.00594	0.00639	Density	gm/cm	
0.010	0.00734	0.0079	Platinel +	14.93	
0.012	0.01057	0.01137	Platinel -	15.91	
0.015	0.01652	0.01777			
0.018	0.02379	0.02559	Composition		
0.020	0.02938	0.03159	Platinel +	55 Pd 31 Pt 14 Au	
0.022	0.03555	0.03823	Platinel -	65 Au 35 Pd	
0.025	0.04591	0.04937			
0.028	0.05759	0.06193			
0.030	0.06611	0.07109			
0.032	0.07521	0.08088			
0.034	0.08494	0.09134			
0.036	0.09522	0.1024			
0.038	0.10605	0.11405			
0.040	0.11751	0.12636			
0.042	0.12958	0.13935			
0.045	0.14876	0.15998			
0.048	0.16926	0.18201			
0.050	0.18361	0.19745			

Tensile Strength Data at Elevated Temperatures for Platinel



Stress to Rupture Curves for Platinel



Modulus of Elasticity (psi x 10⁶)

Temp. °C	Platinel +	Platinel -
0	20.9	19.2
100	20.9	19.2
200	20.6	18.8
300	19.8	18.1
400	19.5	17.6
500	19.1	17.0
600	18.6	16.4

Electrical Resistivity For Platinel Thermocouple Wire Ohm (cir-mil) ft

Temp. °C	Platinel +	Platinel -
0	184	144
200	216	156
400	247	164
600	273	172
800	297	184
1000	321	199
1200	342	215

Thermal Conductivity Watts/cm °C

Temp. °C	Platinel +	Platinel -
20	9.332	0.281
100	0.390	0.317
200	0.463	0.369
300	0.529	0.420
400	0.590	0.470
500	0.644	0.518
600	0.691	0.564
700	0.733	0.610
800	0.768	0.655
900	0.797	0.697

Coefficients of Linear Thermal Expansion (unit/unit/°C) from 20°C

Temp. °C	Platinel +	Platinel -
200	5.89×10^{-6}	7.92×10^{-6}
400	8.80×10^{-6}	1.10×10^{-5}
600	1.03×10^{-5}	1.05×10^{-5}
800	1.12×10^{-5}	1.21×10^{-5}
1000	1.19×10^{-5}	1.29×10^{-5}

Reference Table – Platinel Thermocouple

Temperature °C ITS 90, EMF in Millivolts, Ref. Junction 0°C

°C	0	1	2	3	4	5	6	7	8	9
0	0.000	0.030	0.060	0.090	0.120	0.150	0.180	0.210	0.241	0.271
10	0.302	0.332	0.363	0.394	0.424	0.455	0.486	0.517	0.548	0.579
20	0.610	0.641	0.673	0.704	0.735	0.767	0.798	0.830	0.862	0.894
30	0.925	0.957	0.989	1.021	1.053	1.085	1.117	1.150	1.182	1.214
40	1.247	1.279	1.312	1.345	1.377	1.410	1.443	1.476	1.509	1.542
50	1.575	1.608	1.641	1.674	1.707	1.741	1.774	1.808	1.841	1.875
60	1.908	1.942	1.976	2.010	2.044	2.078	2.112	2.146	2.180	2.214
70	2.248	2.282	2.317	2.351	2.386	2.420	2.455	2.489	2.524	2.559
80	2.593	2.628	2.663	2.698	2.733	2.768	2.803	2.838	2.874	2.909
90	2.994	2.980	3.015	3.050	3.086	3.122	3.157	3.193	3.229	3.264
100	3.300	3.336	3.372	3.408	3.444	3.480	3.516	3.553	3.589	3.625
110	3.661	3.698	3.734	3.771	3.807	3.844	3.881	3.917	3.954	3.991
120	4.028	4.064	4.101	4.138	4.175	4.212	4.250	4.287	4.324	4.361
130	4.399	4.436	4.473	4.511	4.548	4.586	4.623	4.661	4.699	4.736
140	4.774	4.812	4.850	4.888	4.925	4.963	5.001	5.039	5.078	5.116
150	5.154	5.192	5.230	5.269	5.307	5.346	5.384	5.422	5.461	5.500
160	5.538	5.577	5.615	5.654	5.693	5.732	5.771	5.810	5.848	5.887
170	5.926	5.965	6.005	6.044	6.083	6.122	6.161	6.201	6.240	6.279
180	6.319	6.358	6.398	6.437	6.477	6.516	6.556	6.596	6.635	6.675
190	6.715	6.755	6.794	6.834	6.874	6.914	6.954	6.994	7.034	7.074
200	7.115	7.156	7.195	7.235	7.275	7.316	7.356	7.396	7.437	7.477
210	7.518	7.558	7.599	7.639	7.680	7.721	7.761	7.802	7.843	7.884
220	7.924	7.965	8.006	8.047	8.088	8.129	8.170	8.211	8.252	8.293
230	8.334	8.375	8.416	8.458	8.499	8.540	8.582	8.623	8.664	8.706
240	8.747	8.788	8.830	8.871	8.913	8.955	8.996	9.038	9.079	9.121
250	9.163	9.205	9.246	9.288	9.330	9.372	9.414	9.456	9.498	9.540
260	9.581	9.623	9.666	9.708	9.750	9.792	9.834	9.876	9.918	9.961
270	10.003	10.045	10.087	10.130	10.172	10.214	10.257	10.299	10.342	10.384
280	10.427	10.469	10.512	10.554	10.597	10.639	10.682	10.725	10.767	10.810
290	10.853	10.896	10.938	10.981	11.024	11.067	11.110	11.153	11.196	11.238
300	11.281	11.324	11.367	11.410	11.453	11.497	11.540	11.583	11.626	11.669
310	11.712	11.755	11.799	11.842	11.885	11.928	11.972	12.015	12.058	12.102
320	12.145	12.188	12.232	12.275	12.319	12.362	12.405	12.449	12.492	12.536
330	12.580	12.623	12.667	12.710	12.754	12.798	12.841	12.885	12.929	12.972
340	13.016	13.060	13.104	13.147	13.191	13.235	13.279	13.323	13.366	13.410
350	13.454	13.498	13.542	13.586	13.630	13.674	13.718	13.762	13.806	13.850
360	13.894	13.938	13.982	14.026	14.070	14.114	14.159	14.203	14.247	14.291
370	14.335	14.379	14.424	14.468	14.512	14.556	14.601	14.645	14.689	14.733
380	14.778	14.822	14.866	14.911	14.955	15.000	15.044	15.088	15.133	15.177
390	15.222	15.266	15.311	15.355	15.400	15.444	15.489	15.533	15.578	15.622
400	15.667	15.711	15.756	15.800	15.845	15.890	15.934	15.979	16.023	16.068
410	16.113	16.157	16.202	16.247	16.291	16.336	16.381	16.425	16.470	16.515
420	16.560	16.604	16.649	16.694	16.739	16.784	16.828	16.873	16.918	16.963
430	17.008	17.052	17.097	17.142	17.187	17.232	17.277	17.321	17.366	17.411
440	17.456	17.501	17.546	17.591	17.636	17.681	17.726	17.771	17.816	17.860
450	17.905	17.950	17.995	18.040	18.085	18.130	18.175	18.220	18.265	18.310
460	18.355	18.400	18.445	18.490	18.535	18.580	18.625	18.670	18.715	18.760
470	18.806	18.851	18.896	18.941	18.986	19.031	19.076	19.121	19.166	19.211
480	19.256	19.301	19.346	19.391	19.437	19.482	19.527	19.572	19.617	19.662
490	19.707	19.752	19.797	19.843	19.888	19.933	19.978	20.023	20.068	20.113
500	20.158	20.204	20.249	20.294	20.339	20.384	20.429	20.474	20.519	20.565
510	20.610	20.655	20.700	20.745	20.790	20.835	20.880	20.926	20.971	21.016
520	21.061	21.106	21.151	21.196	21.242	21.287	21.332	21.377	21.422	21.467
530	21.512	21.557	21.603	21.648	21.693	21.738	21.783	21.828	21.873	21.918
540	21.963	22.009	22.054	22.099	22.144	22.189	22.234	22.279	22.324	22.369
550	22.414	22.459	22.504	22.550	22.595	22.640	22.685	22.730	22.775	22.820
560	22.865	22.910	22.955	23.000	23.045	23.090	23.135	23.180	23.225	23.270
570	23.315	23.360	23.405	23.450	23.495	23.540	23.585	23.630	23.675	23.720
580	23.765	23.810	23.855	23.900	23.945	23.990	24.035	24.080	24.125	24.169
590	24.214	24.259	24.304	24.349	24.394	24.439	24.484	24.528	24.573	24.618
600	24.663	24.708	24.753	24.797	24.842	24.887	24.932	24.977	25.021	25.066
610	25.111	25.156	25.201	25.245	25.290	25.335	25.379	25.424	25.469	25.514
620	25.558	25.603	25.648	25.692	25.737	25.782	25.826	25.871	25.915	25.960
630	26.005	26.049	26.094	26.138	26.183	26.228	26.272	26.317	26.361	26.406
640	26.450	26.495	26.539	26.584	26.628	26.673	26.717	26.762	26.806	26.850

Reference Table – Platinel Thermocouple

Temperature °C ITS 90, EMF in Millivolts, Ref. Junction 0°C

°C	0	1	2	3	4	5	6	7	8	9
650	26.895	26.939	26.984	27.028	27.072	27.117	27.161	27.205	27.250	27.294
660	27.338	27.383	27.427	27.471	27.515	27.560	27.604	27.648	27.692	27.737
670	27.781	27.825	27.869	27.913	27.957	28.002	28.046	28.090	28.134	28.178
680	28.222	28.266	28.310	28.354	28.398	28.442	28.486	28.530	28.574	28.618
690	28.662	28.706	28.750	28.794	28.838	28.882	28.925	28.969	29.013	29.057
700	29.101	29.145	29.188	29.232	29.276	29.320	29.363	29.407	29.451	29.494
710	29.538	29.582	29.625	29.669	29.713	29.756	29.800	29.843	29.887	29.930
720	29.974	30.017	30.061	30.104	30.148	30.191	30.235	30.278	30.322	30.365
730	30.408	30.452	30.495	30.538	30.582	30.625	30.668	30.711	30.755	30.798
740	30.841	30.884	30.928	30.971	31.014	31.057	31.100	31.143	31.186	31.229
750	31.272	31.315	31.358	31.401	31.444	31.487	31.530	31.573	31.616	31.659
760	31.702	31.745	31.788	31.831	31.874	31.916	31.959	32.002	32.045	32.088
770	32.130	32.173	32.216	32.259	32.301	32.344	32.387	32.429	32.472	32.514
780	32.557	32.600	32.642	32.685	32.727	32.770	32.812	32.855	32.897	32.940
790	32.982	32.025	33.067	33.110	33.152	33.195	33.237	33.279	33.322	33.364
800	33.406	33.449	33.491	33.533	33.575	33.618	33.660	33.702	33.744	33.786
810	33.828	33.871	33.913	33.955	33.997	34.039	34.081	34.123	34.165	34.207
820	34.249	34.291	34.333	34.375	34.417	34.459	34.501	34.543	34.585	34.626
830	34.668	34.710	34.752	34.794	34.836	34.877	34.919	34.961	35.002	35.044
840	35.086	35.127	35.169	35.211	35.252	35.294	35.336	35.377	35.419	35.460
850	35.502	35.543	35.585	35.626	35.668	35.709	35.750	35.792	35.833	35.875
860	35.916	35.957	35.999	36.040	36.081	36.122	36.164	36.205	36.246	36.287
870	36.328	36.370	36.411	36.452	36.493	36.534	36.575	36.616	36.657	36.698
880	36.739	36.780	36.821	36.862	36.903	36.944	36.985	37.026	37.067	37.108
890	37.148	37.189	37.230	37.271	37.312	37.352	37.393	37.434	37.474	37.515
900	37.556	37.596	37.637	37.678	37.718	37.759	37.799	37.840	37.880	37.921
910	37.961	38.002	38.042	38.083	38.123	38.163	38.204	38.244	38.284	38.325
920	38.365	38.405	38.446	38.486	38.526	38.566	38.606	38.647	38.687	38.727
930	38.767	38.807	38.847	38.887	38.927	38.967	39.007	39.047	39.087	39.127
940	39.167	39.207	39.247	39.287	39.327	39.367	39.406	39.446	39.486	39.526
950	39.565	39.605	39.645	39.685	39.724	39.764	39.804	39.843	39.883	39.922
960	39.962	40.001	40.041	40.080	40.120	40.159	40.199	40.238	40.278	40.317
970	40.356	40.396	40.435	40.474	40.514	40.553	40.592	40.631	40.671	40.710
980	40.749	40.788	40.827	40.866	40.906	40.945	40.984	41.023	41.062	41.101
990	41.140	41.179	41.218	41.257	41.295	41.334	41.373	41.412	41.451	41.490
1000	41.529	41.567	41.606	41.645	41.684	41.722	41.761	41.800	41.838	41.877
1010	41.915	41.954	41.993	42.031	42.070	42.108	42.147	42.185	42.223	42.262
1020	42.300	42.339	42.377	42.415	42.454	42.492	42.530	42.569	42.607	42.645
1030	42.683	42.721	42.760	42.798	42.836	42.874	42.912	42.950	42.988	43.026
1040	43.064	43.102	43.140	43.178	43.216	43.254	43.292	43.330	43.368	43.405
1050	43.443	43.481	43.519	43.557	43.594	43.632	43.670	43.707	43.745	43.783
1060	43.820	43.858	43.895	43.933	43.971	44.008	44.046	44.083	44.120	44.158
1070	44.195	44.233	44.270	44.307	44.345	44.382	44.419	44.457	44.494	44.531
1080	44.568	44.605	44.643	44.680	44.717	44.754	44.791	44.828	44.865	44.902
1090	44.939	44.976	45.013	45.050	45.087	45.124	45.161	45.198	45.235	45.272
1100	45.308	45.345	45.382	45.419	45.455	45.492	45.529	45.565	45.602	45.639
1110	45.675	45.712	45.748	45.785	45.822	45.858	45.895	45.931	45.967	46.004
1120	46.040	46.077	46.113	46.149	46.186	46.222	46.258	46.295	46.331	46.367
1130	46.403	46.439	46.476	46.512	46.548	46.584	46.620	46.656	46.692	46.728
1140	46.764	46.800	46.836	46.872	46.908	46.944	46.980	47.016	47.051	47.087
1150	47.123	47.159	47.195	47.230	47.266	47.302	47.337	47.373	47.409	47.444
1160	47.480	47.515	47.551	47.586	47.622	47.657	47.693	47.728	47.764	47.799
1170	47.835	47.870	47.905	47.941	47.976	48.011	48.046	48.082	48.117	48.152
1180	48.187	48.223	48.258	48.293	48.328	48.363	48.398	48.433	48.468	48.503
1190	48.538	48.573	48.608	48.643	48.678	48.713	48.748	48.782	48.817	48.852
1200	48.887	48.921	48.956	48.991	49.026	49.060	49.095	49.129	49.164	49.199
1210	49.233	49.268	49.302	49.337	49.371	49.406	49.440	49.475	49.509	49.543
1220	49.578	49.612	49.646	49.681	49.715	49.749	49.783	49.818	49.852	49.886
1230	49.920	49.954	49.988	50.023	50.057	50.091	50.125	50.159	50.193	50.227
1240	50.261	50.294	50.328	50.362	50.396	50.430	50.464	50.498	50.531	50.565
1250	50.599	50.632	50.666	50.700	50.734	50.767	50.801	50.834	50.868	50.901
1260	50.935	50.968	51.002	51.035	51.069	51.102	51.136	51.169	51.202	51.236
1270	51.269	51.302	51.336	51.369	51.402	51.435	51.468	51.502	51.535	51.568
1280	51.601	51.634	51.667	51.700	51.733	51.766	51.799	51.832	51.865	51.898
1290	51.931	51.963	51.996	52.029	52.062	52.095	52.127	52.160	52.193	52.226

Reference Table – Platinel Thermocouple

Temperature °C ITS 90, EMF in Millivolts, Ref. Junction 0°C

°C	0	1	2	3	4	5	6	7	8	9
1300	52.258	52.291	52.323	52.356	52.389	52.421	52.454	52.486	52.519	52.551
1310	52.584	52.616	52.648	52.681	52.713	52.745	52.778	52.810	52.842	52.875
1320	52.907	52.939	52.971	53.003	53.035	53.067	53.100	53.132	53.164	53.196
1330	53.228	53.260	53.292	53.324	53.355	53.387	53.419	53.451	53.483	53.515
1340	53.546	53.578	53.610	53.641	53.673	53.705	53.736	53.768	53.800	53.831
1350	53.863	53.894	53.926	53.957	53.989	54.020	54.051	54.083	54.114	54.145
1360	54.177	54.208	54.239	54.270	54.302	54.333	54.364	54.395	54.426	54.457
1370	54.488	54.519	54.550	54.581	54.612	54.643	54.674	54.705	54.736	54.767
1380	54.798	43.818	43.859	54.890	54.921	54.951	54.982	55.013	55.043	55.074
1390	55.104	55.135	55.165	55.196	55.226	55.257				

Coefficients Used to Compute the Reference Table

$$E = C_0 + C_n T^n$$

For 0°C to 746°C

$$C_0 = 0.000\,000\,0$$

$$C_1 = 2.981\,971\,6 \times 10^{-02}$$

$$C_2 = 3.517\,515\,2 \times 10^{-05}$$

$$C_3 = -3.487\,842\,8 \times 10^{-08}$$

$$C_4 = 1.485\,132\,7 \times 10^{-11}$$

$$C_5 = -3.637\,46\,7 \times 10^{-15}$$

For 746.6°C to 1395°C

$$C_0 = -8.962\,183\,8$$

$$C_1 = 8.537\,720\,0 \times 10^{-02}$$

$$C_2 = -1.057\,023\,3 \times 10^{-04}$$

$$C_3 = 1.542\,493\,7 \times 10^{-07}$$

$$C_4 = -1.285\,511\,5 \times 10^{-10}$$

$$C_5 = 5.443\,876\,0 \times 10^{-14}$$

$$C_6 = -9.321\,126\,9 \times 10^{-18}$$



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