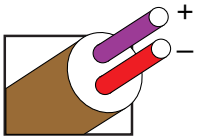
Revised Thermocouple Reference Tables

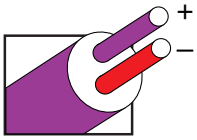
TYPE E

Reference Tables N.I.S.T. Monograph 175 Revised to ITS-90



Thermocouple Grade

Nickel-Chromium vs. Copper-Nickel



Extension Grade

MAXIMUM TEMPERATURE RANGE

Thermocouple Grade
– 328 to 1652°F
– 200 to 900°C

Extension Grade
32 to 392°F
0 to 200°C

LIMITS OF ERROR
(whichever is greater)
Standard: 1.7°C or 0.5% Above 0°C
1.7°C or 1.0°C Below 0°C
Special: 1.0°C or 0.4%

COMMENTS, BARE WIRE ENVIRONMENT:
Oxidizing or Inert; Limited Use in Vacuum or Reducing; Highest EMF Change per Degree

TEMPERATURE IN DEGREES °F
REFERENCE JUNCTION AT 32°F

Thermoelectric Voltage in Millivolts

°F	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	°F
-450							-9.835	-9.834	-9.833	-9.832	-9.830	-450
-440	-9.830	-9.829	-9.827	-9.825	-9.823	-9.821	-9.819	-9.817	-9.814	-9.812	-9.809	-440
-430	-9.809	-9.806	-9.803	-9.800	-9.797	-9.793	-9.790	-9.786	-9.782	-9.779	-9.775	-430
-420	-9.775	-9.771	-9.766	-9.762	-9.758	-9.753	-9.749	-9.744	-9.739	-9.734	-9.729	-420
-410	-9.729	-9.724	-9.718	-9.713	-9.707	-9.702	-9.696	-9.690	-9.684	-9.678	-9.672	-410
-400	-9.672	-9.666	-9.659	-9.653	-9.646	-9.639	-9.632	-9.625	-9.618	-9.611	-9.604	-400
-390	-9.604	-9.597	-9.589	-9.581	-9.574	-9.566	-9.558	-9.550	-9.542	-9.534	-9.525	-390
-380	-9.525	-9.517	-9.508	-9.500	-9.491	-9.482	-9.473	-9.464	-9.455	-9.446	-9.436	-380
-370	-9.436	-9.427	-9.417	-9.408	-9.398	-9.388	-9.378	-9.368	-9.358	-9.348	-9.338	-370
-360	-9.338	-9.327	-9.317	-9.306	-9.295	-9.285	-9.274	-9.263	-9.252	-9.241	-9.229	-360
-350	-9.229	-9.218	-9.207	-9.195	-9.184	-9.172	-9.160	-9.148	-9.136	-9.124	-9.112	-350
-340	-9.112	-9.100	-9.088	-9.075	-9.063	-9.050	-9.038	-9.025	-9.012	-8.999	-8.986	-340
-330	-8.986	-8.973	-8.960	-8.947	-8.934	-8.920	-8.907	-8.893	-8.880	-8.866	-8.852	-330
-320	-8.852	-8.839	-8.825	-8.811	-8.797	-8.782	-8.768	-8.754	-8.739	-8.725	-8.710	-320
-310	-8.710	-8.696	-8.681	-8.666	-8.652	-8.637	-8.622	-8.607	-8.591	-8.576	-8.561	-310
-300	-8.561	-8.546	-8.530	-8.515	-8.499	-8.483	-8.468	-8.452	-8.436	-8.420	-8.404	-300
-290	-8.404	-8.388	-8.372	-8.356	-8.339	-8.323	-8.307	-8.290	-8.273	-8.257	-8.240	-290
-280	-8.240	-8.223	-8.206	-8.189	-8.173	-8.155	-8.138	-8.121	-8.104	-8.087	-8.069	-280
-270	-8.069	-8.052	-8.034	-8.017	-7.999	-7.981	-7.963	-7.945	-7.928	-7.910	-7.891	-270
-260	-7.891	-7.873	-7.855	-7.837	-7.819	-7.800	-7.782	-7.763	-7.745	-7.726	-7.707	-260
-250	-7.707	-7.688	-7.670	-7.651	-7.632	-7.613	-7.593	-7.574	-7.555	-7.536	-7.516	-250
-240	-7.516	-7.497	-7.478	-7.458	-7.438	-7.419	-7.399	-7.379	-7.359	-7.339	-7.319	-240
-230	-7.319	-7.299	-7.279	-7.259	-7.239	-7.219	-7.198	-7.178	-7.157	-7.137	-7.116	-230
-220	-7.116	-7.096	-7.075	-7.054	-7.033	-7.013	-6.992	-6.971	-6.950	-6.928	-6.907	-220
-210	-6.907	-6.886	-6.865	-6.843	-6.822	-6.801	-6.779	-6.757	-6.736	-6.714	-6.692	-210
-200	-6.692	-6.671	-6.649	-6.627	-6.605	-6.583	-6.561	-6.539	-6.516	-6.494	-6.472	-200
-190	-6.472	-6.449	-6.427	-6.405	-6.382	-6.359	-6.337	-6.314	-6.291	-6.269	-6.246	-190
-180	-6.246	-6.223	-6.200	-6.177	-6.154	-6.130	-6.107	-6.084	-6.061	-6.037	-6.014	-180
-170	-6.014	-5.991	-5.967	-5.943	-5.920	-5.896	-5.872	-5.849	-5.825	-5.801	-5.777	-170
-160	-5.777	-5.753	-5.729	-5.705	-5.681	-5.656	-5.632	-5.608	-5.584	-5.559	-5.535	-160
-150	-5.535	-5.510	-5.486	-5.461	-5.436	-5.412	-5.387	-5.362	-5.337	-5.312	-5.287	-150
-140	-5.287	-5.262	-5.237	-5.212	-5.187	-5.162	-5.136	-5.111	-5.086	-5.060	-5.035	-140
-130	-5.035	-5.009	-4.984	-4.958	-4.932	-4.907	-4.881	-4.855	-4.829	-4.803	-4.777	-130
-120	-4.777	-4.751	-4.725	-4.699	-4.673	-4.647	-4.621	-4.594	-4.568	-4.542	-4.515	-120
-110	-4.515	-4.489	-4.462	-4.436	-4.409	-4.382	-4.355	-4.329	-4.302	-4.275	-4.248	-110
-100	-4.248	-4.221	-4.194	-4.167	-4.140	-4.113	-4.086	-4.058	-4.031	-4.004	-3.976	-100
-90	-3.976	-3.949	-3.922	-3.894	-3.867	-3.839	-3.811	-3.784	-3.756	-3.728	-3.700	-90
-80	-3.700	-3.672	-3.645	-3.617	-3.589	-3.561	-3.532	-3.504	-3.476	-3.448	-3.420	-80
-70	-3.420	-3.391	-3.363	-3.335	-3.306	-3.278	-3.249	-3.221	-3.192	-3.163	-3.135	-70
-60	-3.135	-3.106	-3.077	-3.048	-3.020	-2.991	-2.962	-2.933	-2.904	-2.875	-2.846	-60
-50	-2.846	-2.816	-2.787	-2.758	-2.729	-2.699	-2.670	-2.641	-2.611	-2.582	-2.552	-50
-40	-2.552	-2.523	-2.493	-2.463	-2.434	-2.404	-2.374	-2.344	-2.315	-2.285	-2.255	-40
-30	-2.255	-2.225	-2.195	-2.165	-2.135	-2.105	-2.074	-2.044	-2.014	-1.984	-1.953	-30
-20	-1.953	-1.923	-1.893	-1.862	-1.832	-1.801	-1.771	-1.740	-1.709	-1.679	-1.648	-20
-10	-1.648	-1.617	-1.587	-1.556	-1.525	-1.494	-1.463	-1.432	-1.401	-1.370	-1.339	-10
0	-1.339	-1.308	-1.277	-1.245	-1.214	-1.183	-1.152	-1.120	-1.089	-1.057	-1.026	0
0	-1.026	-0.994	-0.963	-0.931	-0.900	-0.868	-0.836	-0.805	-0.773	-0.741	-0.709	0
10	-0.709	-0.677	-0.645	-0.614	-0.582	-0.550	-0.517	-0.485	-0.453	-0.421	-0.389	10
20	-0.389	-0.357	-0.324	-0.292	-0.260	-0.227	-0.195	-0.163	-0.130	-0.098	-0.065	20
30	-0.065	-0.033	0.000	0.033	0.065	0.098	0.131	0.163	0.196	0.229	0.262	30
40	0.262	0.294	0.327	0.360	0.393	0.426	0.459	0.492	0.525	0.558	0.591	40
50	0.591	0.624	0.657	0.691	0.724	0.757	0.790	0.824	0.857	0.890	0.924	50
60	0.924	0.957	0.990	1.024	1.057	1.091	1.124	1.158	1.192	1.225	1.259	60
70	1.259	1.292	1.326	1.360	1.394	1.427	1.461	1.495	1.529	1.563	1.597	70
80	1.597	1.631	1.665	1.699	1.733	1.767	1.801	1.835	1.869	1.904	1.938	80
90	1.938	1.972	2.006	2.041	2.075	2.109	2.144	2.178	2.212	2.247	2.281	90
°F	0	1	2	3	4	5	6	7	8	9	10	°F

°F	0	1	2	3	4	5	6	7	8	9	10	°F
100	2.281	2.316	2.351	2.385	2.420	2.454	2.489	2.524	2.558	2.593	2.628	100
110	2.628	2.663	2.698	2.733	2.767	2.802	2.837	2.872	2.907	2.942	2.977	110
120	2.977	3.012	3.048	3.083	3.118	3.153	3.188	3.224	3.259	3.294	3.330	120
130	3.330	3.365	3.400	3.436	3.471	3.507	3.542	3.578	3.613	3.649	3.685	130
140	3.685	3.720	3.756	3.792	3.827	3.863	3.899	3.935	3.970	4.006	4.042	140
150	4.042	4.078	4.114	4.150	4.186	4.222	4.258	4.294	4.330	4.366	4.403	150
160	4.403	4.439	4.475	4.511	4.547	4.584	4.620	4.656	4.693	4.729	4.766	160
170	4.766	4.802	4.839	4.875	4.912	4.948	4.985	5.021	5.058	5.095	5.131	170
180	5.131	5.168	5.205	5.242	5.278	5.315	5.352	5.389	5.426	5.463	5.500	180
190	5.500	5.537	5.574	5.611	5.648	5.685	5.722	5.759	5.796	5.833	5.871	190
200	5.871	5.908	5.945	5.982	6.020	6.057	6.094	6.132	6.169	6.207	6.244	200
210	6.244	6.281	6.319	6.356	6.394	6.432	6.469	6.507	6.544	6.582	6.620	210
220	6.620	6.658	6.695	6.733	6.771	6.809	6.847	6.884	6.922	6.960	6.998	220
230	6.998	7.036	7.074	7.112	7.150	7.188	7.226	7.264	7.302	7.341	7.379	230
240	7.379	7.417	7.455	7.493	7.532	7.570	7.608	7.647	7.685	7.723	7.762	240
250	7.762	7.800	7.839	7.877	7.916	7.954	7.993	8.031	8.070	8.108	8.147	250
260	8.147	8.186	8.224	8.263	8.302	8.340	8.379	8.418	8.457	8.496	8.535	260
270	8.535	8.573	8.612	8.651	8.690	8.729	8.768	8.807	8.846	8.885	8.924	270
280	8.924	8.963	9.002	9.041	9.081	9.120	9.159	9.198	9.237	9.277	9.316	280
290	9.316	9.355	9.395	9.434	9.473	9.513	9.552	9.591	9.631	9.670	9.710	290
300	9.710	9.749	9.789	9.828	9.868	9.907	9.947	9.987	10.026	10.066	10.106	300
310	10.106	10.145	10.185	10.225	10.265	10.304	10.344	10.384	10.424	10.464	10.503	310
320	10.503	10.543	10.583	10.623	10.663	10.703	10.743	10.783	10.823	10.863	10.903	320
330	10.903	10.943	10.983	11.024	11.064	11.104	11.144	11.184	11.224	11.265	11.305	330
340	11.305	11.345	11.385	11.426	11.466	11.506	11.547	11.587	11.627	11.668	11.708	340
350	11.708	11.749	11.789	11.830	11.870	11.911	11.951	11.992	12.032	12.073	12.113	350
360	12.113	12.154	12.195	12.235	12.276	12.317	12.357	12.398	12.439	12.480	12.520	360
370	12.520	12.561	12.602	12.643	12.684	12.724	12.765	12.806	12.847	12.888	12.929	370
380	12.929	12.970	13.011	13.052	13.093	13.134	13.175	13.216	13.257	13.298	13.339	380
390	13.339	13.380	13.421	13.462	13.504	13.545	13.586	13.627	13.668	13.710	13.751	390
400	13.751	13.792	13.833	13.875	13.916	13.957	13.999	14.040	14.081	14.123	14.164	400
410	14.164	14.205	14.247	14.288	14.330	14.371	14.413	14.454	14.496	14.537	14.579	410
420	14.579	14.620	14.662	14.704	14.745	14.787	14.828	14.870	14.912	14.953	14.995	420
430	14.995	15.037	15.078	15.120	15.162	15.204	15.245	15.287	15.329	15.371	15.413	430
440	15.413	15.454	15.496	15.538	15.580	15.622	15.664	15.706	15.748	15.790	15.831	440
450	15.831	15.873	15.915	15.957	15.999	16.041	16.083	16.125	16.168	16.210	16.252	450
460	16.252	16.294	16.336	16.378	16.420	16.462	16.504	16.547	16.589	16.631	16.673	460
470	16.673	16.715	16.758	16.800	16.842	16.884	16.927	16.969	17.011	17.054	17.096	470
480	17.096	17.138	17.181	17.223	17.265	17.308	17.350	17.392	17.435	17.477	17.520	480
490	17.520	17.562	17.605	17.647	17.690	17.732	17.775	17.817	17.860	17.902	17.945	490
500	17.945	17.987	18.030	18.073	18.115	18.158	18.200	18.243	18.286	18.328	18.371	500
510	18.371	18.414	18.456	18.499	18.542	18.585	18.627	18.670	18.713	18.756	18.798	510
520	18.798	18.841	18.884	18.927	18.969	19.012	19.055	19.098	19.141	19.184	19.227	520
530	19.227	19.269	19.312	19.355	19.398	19.441	19.484	19.527	19.570	19.613	19.656	530
540	19.656	19.699	19.742	19.785	19.828	19.871	19.914	19.957	20.000	20.043	20.086	540
550	20.086	20.129	20.172	20.216	20.259	20.302	20.345	20.388	20.431	20.474	20.517	550
560	20.517	20.561	20.604	20.647	20.690	20.733	20.777	20.820	20.863	20.906	20.950	560
570	20.950	20.993	21.036	21.080	21.123	21.166	21.209	21.253	21.296	21.339	21.383	570
580	21.383	21.426	21.470	21.513	21.556	21.600	21.643	21.686	21.730	21.773	21.817	580
590	21.817	21.860	21.904	21.947	21.991	22.034	22.078	22.121	22.165	22.208	22.252	590
600	22.252	22.295	22.339	22.382	22.426	22.469	22.513	22.556	22.600	22.644	22.687	600
610	22.687	22.731	22.774	22.818	22.862	22.905	22.949	22.993	23.036	23.080	23.124	610
620	23.124	23.167	23.211	23.255	23.298	23.342	23.386	23.429	23.473	23.517	23.561	620
630	23.561	23.604	23.648	23.692	23.736	23.780	23.823	23.867	23.911	23.955	23.999	630
640	23.999	24.042	24.086	24.130	24.174	24.218	24.262	24.305	24.349	24.393	24.437	640
650	24.437	24.481	24.525	24.569	24.613	24.657	24.701	24.745	24.789	24.832	24.876	650
660	24.876	24.920	24.964	25.008	25.052	25.096	25.140	25.184	25.228	25.272	25.316	660
670	25.316	25.360	25.404	25.448	25.493	25.537	25.581	25.625	25.669	25.713	25.757	670
680	25.757	25.801	25.845	25.889	25.933	25.977	26.022	26.066	26.110	26.154	26.198	680
690	26.198	26.242	26.286	26.331	26.375	26.419	26.463	26.507	26.552	26.596	26.640	690
°F	0	1	2	3	4	5	6	7	8	9	10	°F

MAXIMUM TEMPERATURE RANGE

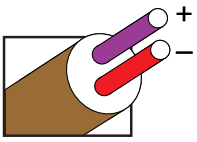
Thermocouple Grade
– 328 to 1652°F
– 200 to 900°C

Extension Grade
32 to 392°F
0 to 200°C

LIMITS OF ERROR
(whichever is greater)
Standard: 1.7°C or 0.5% Above 0°C
1.7°C or 1.0°C Below 0°C
Special: 1.0°C or 0.4%

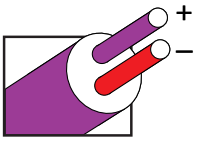
COMMENTS, BARE WIRE ENVIRONMENT:
Oxidizing or Inert; Limited Use in Vacuum or Reducing; Highest EMF Change per Degree

TEMPERATURE IN DEGREES °F
REFERENCE JUNCTION AT 32°F



Thermocouple Grade

Nickel-Chromium vs. Copper-Nickel



Extension Grade

Revised Thermocouple Reference Tables

TYPE E

Reference Tables N.I.S.T. Monograph 175 Revised to ITS-90

Z

Thermoelectric Voltage in Millivolts

°F	0	1	2	3	4	5	6	7	8	9	10	°F
700	26.640	26.684	26.728	26.773	26.817	26.861	26.905	26.950	26.994	27.038	27.082	700
710	27.082	27.127	27.171	27.215	27.259	27.304	27.348	27.392	27.437	27.481	27.525	710
720	27.525	27.570	27.614	27.658	27.703	27.747	27.791	27.836	27.880	27.924	27.969	720
730	27.969	28.013	28.057	28.102	28.146	28.191	28.235	28.279	28.324	28.368	28.413	730
740	28.413	28.457	28.501	28.546	28.590	28.635	28.679	28.724	28.768	28.813	28.857	740
750	28.857	28.901	28.946	28.990	29.035	29.079	29.124	29.168	29.213	29.257	29.302	750
760	29.302	29.346	29.391	29.435	29.480	29.525	29.569	29.614	29.658	29.703	29.747	760
770	29.747	29.792	29.836	29.881	29.925	29.970	30.015	30.059	30.104	30.148	30.193	770
780	30.193	30.238	30.282	30.327	30.371	30.416	30.461	30.505	30.550	30.595	30.639	780
790	30.639	30.684	30.728	30.773	30.818	30.862	30.907	30.952	30.996	31.041	31.086	790
800	31.086	31.130	31.175	31.220	31.264	31.309	31.354	31.398	31.443	31.488	31.533	800
810	31.533	31.577	31.622	31.667	31.711	31.756	31.801	31.846	31.890	31.935	31.980	810
820	31.980	32.025	32.069	32.114	32.159	32.204	32.248	32.293	32.338	32.383	32.427	820
830	32.427	32.472	32.517	32.562	32.606	32.651	32.696	32.741	32.786	32.830	32.875	830
840	32.875	32.920	32.965	33.010	33.054	33.099	33.144	33.189	33.234	33.278	33.323	840
850	33.323	33.368	33.413	33.458	33.503	33.547	33.592	33.637	33.682	33.727	33.772	850
860	33.772	33.816	33.861	33.906	33.951	33.996	34.041	34.086	34.130	34.175	34.220	860
870	34.220	34.265	34.310	34.355	34.400	34.445	34.489	34.534	34.579	34.624	34.669	870
880	34.669	34.714	34.759	34.804	34.849	34.893	34.938	34.983	35.028	35.073	35.118	880
890	35.118	35.163	35.208	35.253	35.298	35.343	35.387	35.432	35.477	35.522	35.567	890
900	35.567	35.612	35.657	35.702	35.747	35.792	35.837	35.882	35.927	35.972	36.016	900
910	36.016	36.061	36.106	36.151	36.196	36.241	36.286	36.331	36.376	36.421	36.466	910
920	36.466	36.511	36.556	36.601	36.646	36.691	36.736	36.781	36.826	36.870	36.915	920
930	36.915	36.960	37.005	37.050	37.095	37.140	37.185	37.230	37.275	37.320	37.365	930
940	37.365	37.410	37.455	37.500	37.545	37.590	37.635	37.680	37.725	37.770	37.815	940
950	37.815	37.860	37.905	37.950	37.995	38.040	38.085	38.130	38.175	38.220	38.265	950
960	38.265	38.309	38.354	38.399	38.444	38.489	38.534	38.579	38.624	38.669	38.714	960
970	38.714	38.759	38.804	38.849	38.894	38.939	38.984	39.029	39.074	39.119	39.164	970
980	39.164	39.209	39.254	39.299	39.344	39.389	39.434	39.479	39.524	39.569	39.614	980
990	39.614	39.659	39.704	39.749	39.794	39.839	39.884	39.929	39.974	40.019	40.064	990
1000	40.064	40.109	40.154	40.199	40.243	40.288	40.333	40.378	40.423	40.468	40.513	1000
1010	40.513	40.558	40.603	40.648	40.693	40.738	40.783	40.828	40.873	40.918	40.963	1010
1020	40.963	41.008	41.053	41.098	41.143	41.188	41.233	41.278	41.323	41.368	41.412	1020
1030	41.412	41.457	41.502	41.547	41.592	41.637	41.682	41.727	41.772	41.817	41.862	1030
1040	41.862	41.907	41.952	41.997	42.042	42.087	42.132	42.176	42.221	42.266	42.311	1040
1050	42.311	42.356	42.401	42.446	42.491	42.536	42.581	42.626	42.671	42.715	42.760	1050
1060	42.760	42.805	42.850	42.895	42.940	42.985	43.030	43.075	43.120	43.165	43.209	1060
1070	43.209	43.254	43.299	43.344	43.389	43.434	43.479	43.524	43.569	43.613	43.658	1070
1080	43.658	43.703	43.748	43.793	43.838	43.883	43.928	43.972	44.017	44.062	44.107	1080
1090	44.107	44.152	44.197	44.242	44.286	44.331	44.376	44.421	44.466	44.511	44.555	1090
1100	44.555	44.600	44.645	44.690	44.735	44.780	44.824	44.869	44.914	44.959	45.004	1100
1110	45.004	45.049	45.093	45.138	45.183	45.228	45.273	45.317	45.362	45.407	45.452	1110
1120	45.452	45.497	45.541	45.586	45.631	45.676	45.720	45.765	45.810	45.855	45.900	1120
1130	45.900	45.944	45.989	46.034	46.079	46.123	46.168	46.213	46.258	46.302	46.347	1130
1140	46.347	46.392	46.437	46.481	46.526	46.571	46.616	46.660	46.705	46.750	46.794	1140
1150	46.794	46.839	46.884	46.929	46.973	47.018	47.063	47.107	47.152	47.197	47.241	1150
1160	47.241	47.286	47.331	47.375	47.420	47.465	47.509	47.554	47.599	47.643	47.688	1160
1170	47.688	47.733	47.777	47.822	47.867	47.911	47.956	48.001	48.045	48.090	48.135	1170
1180	48.135	48.179	48.224	48.268	48.313	48.358	48.402	48.447	48.492	48.536	48.581	1180
1190	48.581	48.625	48.670	48.715	48.759	48.804	48.848	48.893	48.937	48.982	49.027	1190
1200	49.027	49.071	49.116	49.160	49.205	49.249	49.294	49.338	49.383	49.428	49.472	1200
1210	49.472	49.517	49.561	49.606	49.650	49.695	49.739	49.784	49.828	49.873	49.917	1210
1220	49.917	49.962	50.006	50.051	50.095	50.140	50.184	50.229	50.273	50.318	50.362	1220
1230	50.362	50.407	50.451	50.495	50.540	50.584	50.629	50.673	50.718	50.762	50.807	1230
1240	50.807	50.851	50.895	50.940	50.984	51.029	51.073	51.118	51.162	51.206	51.251	1240
1250	51.251	51.295	51.340	51.384	51.428	51.473	51.517	51.561	51.606	51.650	51.695	1250
1260	51.695	51.739	51.783	51.828	51.872	51.916	51.961	52.005	52.049	52.094	52.138	1260
1270	52.138	52.182	52.227	52.271	52.315	52.360	52.404	52.448	52.493	52.537	52.581	1270
1280	52.581	52.625	52.670	52.714	52.758	52.803	52.847	52.891	52.935	52.980	53.024	1280
1290	53.024	53.068	53.112	53.157	53.201	53.245	53.289	53.334	53.378	53.422	53.466	1290
°F	0	1	2	3	4	5	6	7	8	9	10	°F

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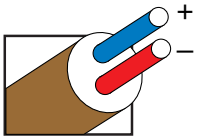
1300	53.466	53.510	53.555	53.599	53.643	53.687	53.732	53.776	53.820	53.864	53.908	1300
1310	53.908	53.952	53.997	54.041	54.085	54.129	54.173	54.218	54.262	54.306	54.350	1310
1320	54.350	54.394	54.438	54.482	54.527	54.571	54.615	54.659	54.703	54.747	54.791	1320
1330	54.791	54.835	54.879	54.924	54.968	55.012	55.056	55.100	55.144	55.188	55.232	1330
1340	55.232	55.276	55.320	55.364	55.408	55.453	55.497	55.541	55.585	55.629	55.673	1340
1350	55.673	55.717	55.761	55.805	55.849	55.893	55.937	55.981	56.025	56.069	56.113	1350
1360	56.113	56.157	56.201	56.245	56.289	56.333	56.377	56.421	56.465	56.509	56.553	1360
1370	56.553	56.597	56.641	56.685	56.729	56.773	56.816	56.860	56.904	56.948	56.992	1370
1380	56.992	57.036	57.080	57.124	57.168	57.212	57.256	57.300	57.344	57.387	57.431	1380
1390	57.431	57.475	57.519	57.563	57.607	57.651	57.695	57.738	57.782	57.826	57.870	1390
1400	57.870	57.914	57.958	58.002	58.045	58.089	58.133	58.177	58.221	58.265	58.308	1400
1410	58.308	58.352	58.396	58.440	58.484	58.527	58.571	58.615	58.659	58.702	58.746	1410
1420	58.746	58.790	58.834	58.878	58.921	58.965	59.009	59.053	59.096	59.140	59.184	1420
1430	59.184	59.228	59.271	59.315	59.359	59.402	59.446	59.490	59.534	59.577	59.621	1430
1440	59.621	59.665	59.708	59.752	59.796	59.839	59.883	59.927	59.970	60.014	60.058	1440
1450	60.058	60.101	60.145	60.189	60.232	60.276	60.320	60.363	60.407	60.451	60.494	1450
1460	60.494	60.538	60.581	60.625	60.669	60.712	60.756	60.799	60.843	60.887	60.930	1460
1470	60.930	60.974	61.017	61.061	61.105	61.148	61.192	61.235	61.279	61.322	61.366	1470
1480	61.366	61.409	61.453	61.496	61.540	61.583	61.627	61.671	61.714	61.758	61.801	1480
1490	61.801	61.845	61.888	61.932	61.975	62.018	62.062	62.105	62.149	62.192	62.236	1490
1500	62.236	62.279	62.323	62.366	62.410	62.453	62.496	62.540	62.583	62.627	62.670	1500
1510	62.670	62.714	62.757	62.800	62.844	62.887	62.931	62.974	63.017	63.061	63.104	1510
1520	63.104	63.148	63.191	63.234	63.278	63.321	63.364	63.408	63.451	63.494	63.538	1520
1530	63.538	63.581	63.624	63.668	63.711	63.754	63.798	63.841	63.884	63.927	63.971	1530
1540	63.971	64.014	64.057	64.101	64.144	64.187	64.230	64.274	64.317	64.360	64.403	1540
1550	64.403	64.447	64.490	64.533	64.576	64.619	64.663	64.706	64.749	64.792	64.835	1550
1560	64.835	64.879	64.922	64.965	65.008	65.051	65.094	65.138	65.181	65.224	65.267	1560
1570	65.267	65.310	65.353	65.396	65.440	65.483	65.526	65.569	65.612	65.655	65.698	1570
1580	65.698	65.741	65.784	65.827	65.871	65.914	65.957	66.000	66.043	66.086	66.129	1580
1590	66.129	66.172	66.215	66.258	66.301	66.344	66.387	66.430	66.473	66.516	66.559	1590
1600	66.559	66.602	66.645	66.688	66.731	66.774	66.817	66.860	66.903	66.946	66.989	1600
1610	66.989	67.031	67.074	67.117	67.160	67.203	67.246	67.289	67.332	67.375	67.418	1610
1620	67.418	67.460	67.503	67.546	67.589	67.632	67.675	67.718	67.760	67.803	67.846	1620
1630	67.846	67.889	67.932	67.974	68.017	68.060	68.103	68.146	68.188	68.231	68.274	1630
1640	68.274	68.317	68.359	68.402	68.445	68.488	68.530	68.573	68.616	68.659	68.701	1640
1650	68.701	68.744	68.787	68.829	68.872	68.915	68.957	69.000	69.043	69.085	69.128	1650
1660	69.128	69.171	69.213	69.256	69.298	69.341	69.384	69.426	69.469	69.511	69.554	1660
1670	69.554	69.597	69.639	69.682	69.724	69.767	69.809	69.852	69.894	69.937	69.979	1670
1680	69.979	70.022	70.064	70.107	70.149	70.192	70.234	70.277	70.319	70.362	70.404	1680
1690	70.404	70.447	70.489	70.531	70.574	70.616	70.659	70.701	70.744	70.786	70.828	1690
1700	70.828	70.871	70.913	70.955	70.998	71.040	71.082	71.125	71.167	71.209	71.252	1700
1710	71.252	71.294	71.336	71.379	71.421	71.463	71.506	71.548	71.590	71.632	71.675	1710
1720	71.675	71.717	71.759	71.801	71.844	71.886	71.928	71.970	72.012	72.055	72.097	1720
1730	72.097	72.139	72.181	72.223	72.266	72.308	72.350	72.392	72.434	72.476	72.518	1730
1740	72.518	72.561	72.603	72.645	72.687	72.729	72.771	72.813	72.855	72.897	72.939	1740
1750	72.939	72.981	73.023	73.066	73.108	73.150	73.192	73.234	73.276	73.318	73.360	1750
1760	73.360	73.402	73.444	73.486	73.528	73.570	73.612	73.654	73.696	73.738	73.780	1760
1770	73.780	73.821	73.863	73.905	73.947	73.989	74.031	74.073	74.115	74.157	74.199	1770
1780	74.199	74.241	74.283	74.324	74.366	74.408	74.450	74.492	74.534	74.576	74.618	1780
1790	74.618	74.659	74.701	74.743	74.785	74.827	74.869	74.910	74.952	74.994	75.036	1790
1800	75.036	75.078	75.120	75.161	75.203	75.245	75.287	75.329	75.370	75.412	75.454	1800
1810	75.454	75.496	75.538	75.579	75.621	75.663	75.705	75.746	75.788	75.830	75.872	1810
1820	75.872	75.913	75.955	75.997	76.039	76.081	76.122	76.164	76.206	76.248	76.289	1820
1830	76.289	76.331	76.373									1830
°F	0	1	2	3	4	5	6	7	8	9	10	°F

Revised Thermocouple Reference Tables

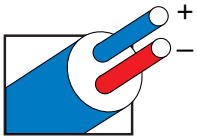
TYPE T

Reference Tables N.I.S.T. Monograph 175 Revised to ITS-90



Thermocouple Grade

Copper vs. Copper-Nickel



Extension Grade

MAXIMUM TEMPERATURE RANGE

Thermocouple Grade
– 328 to 662°F
– 200 to 350°C

Extension Grade
– 76 to 212°F
– 60 to 100°C

LIMITS OF ERROR
(whichever is greater)
Standard: 1.0°C or 0.75% Above 0°C
1.0°C or 1.5% Below 0°C
Special: 0.5°C or 0.4%

COMMENTS, BARE WIRE ENVIRONMENT:
Mild Oxidizing, Reducing Vacuum or Insert; Good Where Moisture Is Present; Low Temperature and Cryogenic Applications

TEMPERATURE IN DEGREES °F
REFERENCE JUNCTION AT 32°F

Thermoelectric Voltage in Millivolts

°F	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	°F
-450							-6.258	-6.257	-6.256	-6.255	-6.254	-450
-440	-6.254	-6.253	-6.252	-6.251	-6.250	-6.248	-6.247	-6.245	-6.243	-6.242	-6.240	-440
-430	-6.240	-6.238	-6.236	-6.234	-6.232	-6.230	-6.227	-6.225	-6.222	-6.220	-6.217	-430
-420	-6.217	-6.215	-6.212	-6.209	-6.206	-6.203	-6.200	-6.197	-6.194	-6.191	-6.187	-420
-410	-6.187	-6.184	-6.180	-6.177	-6.173	-6.170	-6.166	-6.162	-6.158	-6.154	-6.150	-410
-400	-6.150	-6.146	-6.141	-6.137	-6.133	-6.128	-6.124	-6.119	-6.115	-6.110	-6.105	-400
-390	-6.105	-6.100	-6.095	-6.090	-6.085	-6.080	-6.075	-6.069	-6.064	-6.059	-6.053	-390
-380	-6.053	-6.047	-6.042	-6.036	-6.030	-6.025	-6.019	-6.013	-6.007	-6.001	-5.994	-380
-370	-5.994	-5.988	-5.982	-5.976	-5.969	-5.963	-5.956	-5.950	-5.943	-5.937	-5.930	-370
-360	-5.930	-5.923	-5.916	-5.909	-5.902	-5.896	-5.888	-5.881	-5.874	-5.867	-5.860	-360
-350	-5.860	-5.853	-5.845	-5.838	-5.830	-5.823	-5.815	-5.808	-5.800	-5.792	-5.785	-350
-340	-5.785	-5.777	-5.769	-5.761	-5.753	-5.745	-5.737	-5.729	-5.721	-5.713	-5.705	-340
-330	-5.705	-5.697	-5.688	-5.680	-5.672	-5.663	-5.655	-5.646	-5.638	-5.629	-5.620	-330
-320	-5.620	-5.612	-5.603	-5.594	-5.585	-5.577	-5.568	-5.559	-5.550	-5.541	-5.532	-320
-310	-5.532	-5.523	-5.513	-5.504	-5.495	-5.486	-5.476	-5.467	-5.458	-5.448	-5.439	-310
-300	-5.439	-5.429	-5.420	-5.410	-5.400	-5.391	-5.381	-5.371	-5.361	-5.351	-5.341	-300
-290	-5.341	-5.332	-5.322	-5.312	-5.301	-5.291	-5.281	-5.271	-5.261	-5.250	-5.240	-290
-280	-5.240	-5.230	-5.219	-5.209	-5.198	-5.188	-5.177	-5.167	-5.156	-5.145	-5.135	-280
-270	-5.135	-5.124	-5.113	-5.102	-5.091	-5.081	-5.070	-5.059	-5.048	-5.036	-5.025	-270
-260	-5.025	-5.014	-5.003	-4.992	-4.980	-4.969	-4.958	-4.946	-4.935	-4.923	-4.912	-260
-250	-4.912	-4.900	-4.889	-4.877	-4.865	-4.854	-4.842	-4.830	-4.818	-4.806	-4.794	-250
-240	-4.794	-4.783	-4.771	-4.759	-4.746	-4.734	-4.722	-4.710	-4.698	-4.685	-4.673	-240
-230	-4.673	-4.661	-4.648	-4.636	-4.624	-4.611	-4.599	-4.586	-4.573	-4.561	-4.548	-230
-220	-4.548	-4.535	-4.523	-4.510	-4.497	-4.484	-4.471	-4.458	-4.445	-4.432	-4.419	-220
-210	-4.419	-4.406	-4.393	-4.380	-4.366	-4.353	-4.340	-4.326	-4.313	-4.300	-4.286	-210
-200	-4.286	-4.273	-4.259	-4.246	-4.232	-4.218	-4.205	-4.191	-4.177	-4.163	-4.149	-200
-190	-4.149	-4.136	-4.122	-4.108	-4.094	-4.080	-4.066	-4.052	-4.037	-4.023	-4.009	-190
-180	-4.009	-3.995	-3.980	-3.966	-3.952	-3.937	-3.923	-3.908	-3.894	-3.879	-3.865	-180
-170	-3.865	-3.850	-3.836	-3.821	-3.806	-3.791	-3.777	-3.762	-3.747	-3.732	-3.717	-170
-160	-3.717	-3.702	-3.687	-3.672	-3.657	-3.642	-3.626	-3.611	-3.596	-3.581	-3.565	-160
-150	-3.565	-3.550	-3.535	-3.519	-3.504	-3.488	-3.473	-3.457	-3.441	-3.426	-3.410	-150
-140	-3.410	-3.394	-3.379	-3.363	-3.347	-3.331	-3.315	-3.299	-3.283	-3.267	-3.251	-140
-130	-3.251	-3.235	-3.219	-3.203	-3.187	-3.171	-3.154	-3.138	-3.122	-3.105	-3.089	-130
-120	-3.089	-3.072	-3.056	-3.040	-3.023	-3.006	-2.990	-2.973	-2.956	-2.940	-2.923	-120
-110	-2.923	-2.906	-2.889	-2.873	-2.856	-2.839	-2.822	-2.805	-2.788	-2.771	-2.754	-110
-100	-2.754	-2.737	-2.719	-2.702	-2.685	-2.668	-2.651	-2.633	-2.616	-2.598	-2.581	-100
-90	-2.581	-2.564	-2.546	-2.529	-2.511	-2.493	-2.476	-2.458	-2.440	-2.423	-2.405	-90
-80	-2.405	-2.387	-2.369	-2.351	-2.334	-2.316	-2.298	-2.280	-2.262	-2.244	-2.225	-80
-70	-2.225	-2.207	-2.189	-2.171	-2.153	-2.134	-2.116	-2.098	-2.079	-2.061	-2.043	-70
-60	-2.043	-2.024	-2.006	-1.987	-1.969	-1.950	-1.931	-1.913	-1.894	-1.875	-1.857	-60
-50	-1.857	-1.838	-1.819	-1.800	-1.781	-1.762	-1.743	-1.724	-1.705	-1.686	-1.667	-50
-40	-1.667	-1.648	-1.629	-1.610	-1.591	-1.572	-1.552	-1.533	-1.514	-1.494	-1.475	-40
-30	-1.475	-1.456	-1.436	-1.417	-1.397	-1.378	-1.358	-1.338	-1.319	-1.299	-1.279	-30
-20	-1.279	-1.260	-1.240	-1.220	-1.200	-1.181	-1.161	-1.141	-1.121	-1.101	-1.081	-20
-10	-1.081	-1.061	-1.041	-1.021	-1.001	-0.980	-0.960	-0.940	-0.920	-0.900	-0.879	-10
0	-0.879	-0.859	-0.839	-0.818	-0.798	-0.777	-0.757	-0.736	-0.716	-0.695	-0.675	0
0	-0.675	-0.654	-0.633	-0.613	-0.592	-0.571	-0.550	-0.530	-0.509	-0.488	-0.467	0
10	-0.467	-0.446	-0.425	-0.404	-0.383	-0.362	-0.341	-0.320	-0.299	-0.278	-0.256	10
20	-0.256	-0.235	-0.214	-0.193	-0.171	-0.150	-0.129	-0.107	-0.086	-0.064	-0.043	20
30	-0.043	-0.022	0.000	0.022	0.043	0.065	0.086	0.108	0.130	0.151	0.173	30
40	0.173	0.195	0.216	0.238	0.260	0.282	0.303	0.325	0.347	0.369	0.391	40
50	0.391	0.413	0.435	0.457	0.479	0.501	0.523	0.545	0.567	0.589	0.611	50
60	0.611	0.634	0.656	0.678	0.700	0.723	0.745	0.767	0.790	0.812	0.834	60
70	0.834	0.857	0.879	0.902	0.924	0.947	0.969	0.992	1.015	1.037	1.060	70
80	1.060	1.083	1.105	1.128	1.151	1.174	1.196	1.219	1.242	1.265	1.288	80
90	1.288	1.311	1.334	1.357	1.380	1.403	1.426	1.449	1.472	1.496	1.519	90
100	1.519	1.542	1.565	1.588	1.612	1.635	1.658	1.682	1.705	1.729	1.752	100
110	1.752	1.776	1.799	1.823	1.846	1.870	1.893	1.917	1.941	1.964	1.988	110
120	1.988	2.012	2.036	2.060	2.083	2.107	2.131	2.155	2.179	2.203	2.227	120
130	2.227	2.251	2.275	2.299	2.323	2.347	2.371	2.395	2.420	2.444	2.468	130
140	2.468	2.492	2.517	2.541	2.565	2.590	2.614	2.639	2.663	2.687	2.712	140
°F	0	1	2	3	4	5	6	7	8	9	10	°F

°F	0	1	2	3	4	5	6	7	8	9	10	°F
150	2.712	2.737	2.761	2.786	2.810	2.835	2.860	2.884	2.909	2.934	2.958	150
160	2.958	2.983	3.008	3.033	3.058	3.082	3.107	3.132	3.157	3.182	3.207	160
170	3.207	3.232	3.257	3.282	3.307	3.333	3.358	3.383	3.408	3.433	3.459	170
180	3.459	3.484	3.509	3.534	3.560	3.585	3.610	3.636	3.661	3.687	3.712	180
190	3.712	3.738	3.763	3.789	3.814	3.840	3.866	3.891	3.917	3.943	3.968	190
200	3.968	3.994	4.020	4.046	4.071	4.097	4.123	4.149	4.175	4.201	4.227	200
210	4.227	4.253	4.279	4.305	4.331	4.357	4.383	4.409	4.435	4.461	4.487	210
220	4.487	4.513	4.540	4.566	4.592	4.618	4.645	4.671	4.697	4.724	4.750	220
230	4.750	4.776	4.803	4.829	4.856	4.882	4.909	4.935	4.962	4.988	5.015	230
240	5.015	5.042	5.068	5.095	5.122	5.148	5.175	5.202	5.228	5.255	5.282	240
250	5.282	5.309	5.336	5.363	5.389	5.416	5.443	5.470	5.497	5.524	5.551	250
260	5.551	5.578	5.605	5.632	5.660	5.687	5.714	5.741	5.768	5.795	5.823	260
270	5.823	5.850	5.877	5.904	5.932	5.959	5.986	6.014	6.041	6.068	6.096	270
280	6.096	6.123	6.151	6.178	6.206	6.233	6.261	6.288	6.316	6.343	6.371	280
290	6.371	6.399	6.426	6.454	6.482	6.510	6.537	6.565	6.593	6.621	6.648	290
300	6.648	6.676	6.704	6.732	6.760	6.788	6.816	6.844	6.872	6.900	6.928	300
310	6.928	6.956	6.984	7.012	7.040	7.068	7.096	7.124	7.152	7.181	7.209	310
320	7.209	7.237	7.265	7.294	7.322	7.350	7.378	7.407	7.435	7.463	7.492	320
330	7.492	7.520	7.549	7.577	7.606	7.634	7.663	7.691	7.720	7.748	7.777	330
340	7.777	7.805	7.834	7.863	7.891	7.920	7.949	7.977	8.006	8.035	8.064	340
350	8.064	8.092	8.121	8.150	8.179	8.208	8.237	8.266	8.294	8.323	8.352	350
360	8.352	8.381	8.410	8.439	8.468	8.497	8.526	8.555	8.585	8.614	8.643	360
370	8.643	8.672	8.701	8.730	8.759	8.789	8.818	8.847	8.876	8.906	8.935	370
380	8.935	8.964	8.994	9.023	9.052	9.082	9.111	9.141	9.170	9.200	9.229	380
390	9.229	9.259	9.288	9.318	9.347	9.377	9.406	9.436	9.466	9.495	9.525	390
400	9.525	9.555	9.584	9.614	9.644	9.673	9.703	9.733	9.763	9.793	9.822	400
410	9.822	9.852	9.882	9.912	9.942	9.972	10.002	10.032	10.062	10.092	10.122	410
420	10.122	10.152	10.182	10.212	10.242	10.272	10.302	10.332	10.362	10.392	10.423	420
430	10.423	10.453	10.483	10.513	10.543	10.574	10.604	10.634	10.664	10.695	10.725	430
440	10.725	10.755	10.786	10.816	10.847	10.877	10.907	10.938	10.968	10.999	11.029	440
450	11.029	11.060	11.090	11.121	11.151	11.182	11.213	11.243	11.274	11.304	11.335	450
460	11.335	11.366	11.396	11.427	11.458	11.489	11.519	11.550	11.581	11.612	11.643	460
470	11.643	11.673	11.704	11.735	11.766	11.797	11.828	11.859	11.890	11.920	11.951	470
480	11.951	11.982	12.013	12.044	12.075	12.106	12.138	12.169	12.200	12.231	12.262	480
490	12.262	12.293	12.324	12.355	12.386	12.418	12.449	12.480	12.511	12.543	12.574	490
500	12.574	12.605	12.636	12.668	12.699	12.730	12.762	12.793	12.824	12.856	12.887	500
510	12.887	12.919	12.950	12.982	13.013	13.045	13.076	13.108	13.139	13.171	13.202	510
520	13.202	13.234	13.265	13.297	13.328	13.360	13.392	13.423	13.455	13.487	13.518	520
530	13.518	13.550	13.582	13.614	13.645	13.677	13.709	13.741	13.772	13.804	13.836	530
540	13.836	13.868	13.900	13.932	13.964	13.995	14.027	14.059	14.091	14.123	14.155	540
550	14.155	14.187	14.219	14.251	14.283	14.315	14.347	14.379	14.411	14.444	14.476	550
560	14.476	14.508	14.540	14.572	14.604	14.636	14.669	14.701	14.733	14.765	14.797	560
570	14.797	14.830	14.862	14.894	14.926	14.959	14.991	15.023	15.056	15.088	15.121	570
580	15.121	15.153	15.185	15.218	15.250	15.283	15.315	15.347	15.380	15.412	15.445	580
590	15.445	15.477	15.510	15.543	15.575	15.608	15.640	15.673	15.705	15.738	15.771	590
600	15.771	15.803	15.836	15.869	15.901	15.934	15.967	15.999	16.032	16.065	16.098	600
610	16.098	16.130	16.163	16.196	16.229	16.262	16.295	16.327	16.360	16.393	16.426	610
620	16.426	16.459	16.492	16.525	16.558	16.591	16.624	16.657	16.690	16.723	16.756	620
630	16.756	16.789	16.822	16.855	16.888	16.921	16.954	16.987	17.020	17.053	17.086	630
640	17.086	17.120	17.153	17.186	17.219	17.252	17.286	17.319	17.352	17.385	17.418	640
650	17.418	17.452	17.485	17.518	17.552	17.585	17.618	17.652	17.685	17.718	17.752	650
660	17.752	17.785	17.819	17.852	17.886	17.919	17.952	17.986	18.019	18.053	18.086	660
670	18.086	18.120	18.153	18.187	18.221	18.254	18.288	18.321	18.355	18.389	18.422	670
680	18.422	18.456	18.490	18.523	18.557	18.591	18.624	18.658	18.692	18.725	18.759	680
690	18.759	18.793	18.827	18.861	18.894	18.928	18.962	18.996	19.030	19.064	19.097	690
700	19.097	19.131	19.165	19.199	19.233	19.267	19.301	19.335	19.369	19.403	19.437	700
710	19.437	19.471	19.505	19.539	19.573	19.607	19.641	19.675	19.709	19.743	19.777	710
720	19.777	19.811	19.845	19.879	19.913	19.947	19.982	20.016	20.050	20.084	20.118	720
730	20.118	20.152	20.187	20.221	20.255	20.289	20.323	20.358	20.392	20.426	20.460	730
740	20.460	20.495	20.529	20.563	20.597	20.632	20.666	20.700	20.735	20.769	20.803	740
750	20.803	20.838	20.872									750
°F	0	1	2	3	4	5	6	7	8	9	10	°F

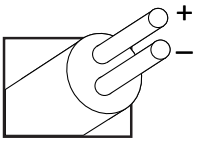
MAXIMUM TEMPERATURE RANGE

Thermocouple Grade
32 to 2642°F
0 to 1450°C
Extension Grade
32 to 300°F
0 to 150°C

LIMITS OF ERROR
(whichever is greater)
Standard: 1.5°C or 0.25%
Special: 0.6°C or 0.1%

COMMENTS, BARE WIRE ENVIRONMENT:
Oxidizing or Inert; Do Not Insert in Metal Tubes; Beware of Contamination; High Temperature

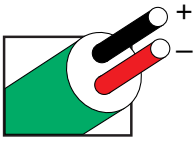
TEMPERATURE IN DEGREES °F
FREFERENCE JUNCTION AT 32°F



Thermocouple Grade

NONE ESTABLISHED

Platinum-10% Rhodium vs. Platinum



Extension Grade

Revised Thermocouple Reference Tables

TYPE S

Reference Tables
N.I.S.T. Monograph 175
Revised to ITS-90

Z

Thermoelectric Voltage in Millivolts

°F	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	°F
-50			-0.236	-0.233	-0.231	-0.229	-0.227	-0.224	-0.222	-0.220	-0.218	-50
-40	-0.218	-0.215	-0.213	-0.211	-0.208	-0.206	-0.204	-0.201	-0.199	-0.197	-0.194	-40
-30	-0.194	-0.192	-0.190	-0.187	-0.185	-0.182	-0.180	-0.178	-0.175	-0.173	-0.170	-30
-20	-0.170	-0.168	-0.165	-0.163	-0.160	-0.158	-0.155	-0.153	-0.150	-0.148	-0.145	-20
-10	-0.145	-0.142	-0.140	-0.137	-0.135	-0.132	-0.129	-0.127	-0.124	-0.122	-0.119	-10
0	-0.119	-0.116	-0.114	-0.111	-0.108	-0.106	-0.103	-0.100	-0.097	-0.095	-0.092	0
0	-0.092	-0.089	-0.086	-0.084	-0.081	-0.078	-0.075	-0.073	-0.070	-0.067	-0.064	0
10	-0.064	-0.061	-0.058	-0.056	-0.053	-0.050	-0.047	-0.044	-0.041	-0.038	-0.035	10
20	-0.035	-0.033	-0.030	-0.027	-0.024	-0.021	-0.018	-0.015	-0.012	-0.009	-0.006	20
30	-0.006	-0.003	0.000	0.003	0.006	0.009	0.012	0.015	0.018	0.021	0.024	30
40	0.024	0.027	0.030	0.033	0.037	0.040	0.043	0.046	0.049	0.052	0.055	40
50	0.055	0.058	0.062	0.065	0.068	0.071	0.074	0.077	0.081	0.084	0.087	50
60	0.087	0.090	0.093	0.097	0.100	0.103	0.106	0.110	0.113	0.116	0.119	60
70	0.119	0.123	0.126	0.129	0.133	0.136	0.139	0.143	0.146	0.149	0.153	70
80	0.153	0.156	0.159	0.163	0.166	0.169	0.173	0.176	0.180	0.183	0.186	80
90	0.186	0.190	0.193	0.197	0.200	0.204	0.207	0.210	0.214	0.217	0.221	90
100	0.221	0.224	0.228	0.231	0.235	0.238	0.242	0.245	0.249	0.252	0.256	100
110	0.256	0.260	0.263	0.267	0.270	0.274	0.277	0.281	0.285	0.288	0.292	110
120	0.292	0.295	0.299	0.303	0.306	0.310	0.313	0.317	0.321	0.324	0.328	120
130	0.328	0.332	0.335	0.339	0.343	0.346	0.350	0.354	0.357	0.361	0.365	130
140	0.365	0.369	0.372	0.376	0.380	0.384	0.387	0.391	0.395	0.399	0.402	140
150	0.402	0.406	0.410	0.414	0.417	0.421	0.425	0.429	0.433	0.436	0.440	150
160	0.440	0.444	0.448	0.452	0.456	0.459	0.463	0.467	0.471	0.475	0.479	160
170	0.479	0.483	0.487	0.490	0.494	0.498	0.502	0.506	0.510	0.514	0.518	170
180	0.518	0.522	0.526	0.530	0.534	0.538	0.541	0.545	0.549	0.553	0.557	180
190	0.557	0.561	0.565	0.569	0.573	0.577	0.581	0.585	0.589	0.593	0.597	190
200	0.597	0.601	0.605	0.609	0.613	0.617	0.622	0.626	0.630	0.634	0.638	200
210	0.638	0.642	0.646	0.650	0.654	0.658	0.662	0.666	0.670	0.675	0.679	210
220	0.679	0.683	0.687	0.691	0.695	0.699	0.703	0.708	0.712	0.716	0.720	220
230	0.720	0.724	0.728	0.732	0.737	0.741	0.745	0.749	0.753	0.758	0.762	230
240	0.762	0.766	0.770	0.774	0.779	0.783	0.787	0.791	0.795	0.800	0.804	240
250	0.804	0.808	0.812	0.817	0.821	0.825	0.829	0.834	0.838	0.842	0.847	250
260	0.847	0.851	0.855	0.859	0.864	0.868	0.872	0.877	0.881	0.885	0.889	260
270	0.889	0.894	0.898	0.902	0.907	0.911	0.915	0.920	0.924	0.928	0.933	270
280	0.933	0.937	0.942	0.946	0.950	0.955	0.959	0.963	0.968	0.972	0.977	280
290	0.977	0.981	0.985	0.990	0.994	0.998	1.003	1.007	1.012	1.016	1.021	290
300	1.021	1.025	1.029	1.034	1.038	1.043	1.047	1.052	1.056	1.061	1.065	300
310	1.065	1.069	1.074	1.078	1.083	1.087	1.092	1.096	1.101	1.105	1.110	310
320	1.110	1.114	1.119	1.123	1.128	1.132	1.137	1.141	1.146	1.150	1.155	320
330	1.155	1.159	1.164	1.168	1.173	1.177	1.182	1.186	1.191	1.196	1.200	330
340	1.200	1.205	1.209	1.214	1.218	1.223	1.227	1.232	1.237	1.241	1.246	340
350	1.246	1.250	1.255	1.260	1.264	1.269	1.273	1.278	1.283	1.287	1.292	350
360	1.292	1.296	1.301	1.306	1.310	1.315	1.319	1.324	1.329	1.333	1.338	360
370	1.338	1.343	1.347	1.352	1.357	1.361	1.366	1.371	1.375	1.380	1.385	370
380	1.385	1.389	1.394	1.399	1.403	1.408	1.413	1.417	1.422	1.427	1.431	380
390	1.431	1.436	1.441	1.445	1.450	1.455	1.460	1.464	1.469	1.474	1.478	390
°F	0	1	2	3	4	5	6	7	8	9	10	°F

°F	0	1	2	3	4	5	6	7	8	9	10	°F
400	1.478	1.483	1.488	1.493	1.497	1.502	1.507	1.512	1.516	1.521	1.526	400
410	1.526	1.531	1.535	1.540	1.545	1.550	1.554	1.559	1.564	1.569	1.573	410
420	1.573	1.578	1.583	1.588	1.592	1.597	1.602	1.607	1.612	1.616	1.621	420
430	1.621	1.626	1.631	1.636	1.640	1.645	1.650	1.655	1.660	1.664	1.669	430
440	1.669	1.674	1.679	1.684	1.689	1.693	1.698	1.703	1.708	1.713	1.718	440
450	1.718	1.722	1.727	1.732	1.737	1.742	1.747	1.752	1.756	1.761	1.766	450
460	1.766	1.771	1.776	1.781	1.786	1.790	1.795	1.800	1.805	1.810	1.815	460
470	1.815	1.820	1.825	1.829	1.834	1.839	1.844	1.849	1.854	1.859	1.864	470
480	1.864	1.869	1.874	1.878	1.883	1.888	1.893	1.898	1.903	1.908	1.913	480
490	1.913	1.918	1.923	1.928	1.933	1.938	1.942	1.947	1.952	1.957	1.962	490
500	1.962	1.967	1.972	1.977	1.982	1.987	1.992	1.997	2.002	2.007	2.012	500
510	2.012	2.017	2.022	2.027	2.032	2.037	2.042	2.047	2.052	2.057	2.062	510
520	2.062	2.067	2.072	2.076	2.081	2.086	2.091	2.096	2.101	2.106	2.111	520
530	2.111	2.116	2.121	2.126	2.131	2.136	2.141	2.147	2.152	2.157	2.162	530
540	2.162	2.167	2.172	2.177	2.182	2.187	2.192	2.197	2.202	2.207	2.212	540
550	2.212	2.217	2.222	2.227	2.232	2.237	2.242	2.247	2.252	2.257	2.262	550
560	2.262	2.267	2.272	2.277	2.283	2.288	2.293	2.298	2.303	2.308	2.313	560
570	2.313	2.318	2.323	2.328	2.333	2.338	2.343	2.348	2.354	2.359	2.364	570
580	2.364	2.369	2.374	2.379	2.384	2.389	2.394	2.399	2.404	2.410	2.415	580
590	2.415	2.420	2.425	2.430	2.435	2.440	2.445	2.450	2.455	2.461	2.466	590
600	2.466	2.471	2.476	2.481	2.486	2.491	2.496	2.502	2.507	2.512	2.517	600
610	2.517	2.522	2.527	2.532	2.537	2.543	2.548	2.553	2.558	2.563	2.568	610
620	2.568	2.574	2.579	2.584	2.589	2.594	2.599	2.604	2.610	2.615	2.620	620
630	2.620	2.625	2.630	2.635	2.641	2.646	2.651	2.656	2.661	2.666	2.672	630
640	2.672	2.677	2.682	2.687	2.692	2.697	2.703	2.708	2.713	2.718	2.723	640
650	2.723	2.729	2.734	2.739	2.744	2.749	2.755	2.760	2.765	2.770	2.775	650
660	2.775	2.781	2.786	2.791	2.796	2.801	2.807	2.812	2.817	2.822	2.827	660
670	2.827	2.833	2.838	2.843	2.848	2.854	2.859	2.864	2.869	2.874	2.880	670
680	2.880	2.885	2.890	2.895	2.901	2.906	2.911	2.916	2.922	2.927	2.932	680
690	2.932	2.937	2.943	2.948	2.953	2.958	2.964	2.969	2.974	2.979	2.985	690
700	2.985	2.990	2.995	3.000	3.006	3.011	3.016	3.021	3.027	3.032	3.037	700
710	3.037	3.042	3.048	3.053	3.058	3.063	3.069	3.074	3.079	3.085	3.090	710
720	3.090	3.095	3.100	3.106	3.111	3.116	3.122	3.127	3.132	3.137	3.143	720
730	3.143	3.148	3.153	3.159	3.164	3.169	3.174	3.180	3.185	3.190	3.196	730
740	3.196	3.201	3.206	3.212	3.217	3.222	3.227	3.233	3.238	3.243	3.249	740
750	3.249	3.254	3.259	3.265	3.270	3.275	3.281	3.286	3.291	3.297	3.302	750
760	3.302	3.307	3.313	3.318	3.323	3.329	3.334	3.339	3.345	3.350	3.355	760
770	3.355	3.361	3.366	3.371	3.377	3.382	3.387	3.393	3.398	3.403	3.409	770
780	3.409	3.414	3.419	3.425	3.430	3.435	3.441	3.446	3.451	3.457	3.462	780
790	3.462	3.468	3.473	3.478	3.484	3.489	3.494	3.500	3.505	3.510	3.516	790
800	3.516	3.521	3.527	3.532	3.537	3.543	3.548	3.553	3.559	3.564	3.570	800
810	3.570	3.575	3.580	3.586	3.591	3.596	3.602	3.607	3.613	3.618	3.623	810
820	3.623	3.629	3.634	3.640	3.645	3.650	3.656	3.661	3.667	3.672	3.677	820
830	3.677	3.683	3.688	3.694	3.699	3.704	3.710	3.715	3.721	3.726	3.731	830
840	3.731	3.737	3.742	3.748	3.753	3.758	3.764	3.769	3.775	3.780	3.786	840
850	3.786	3.791	3.796	3.802	3.807	3.813	3.818	3.823	3.829	3.834	3.840	850
860	3.840	3.845	3.851	3.856	3.862	3.867	3.872	3.878	3.883	3.889	3.894	860
870	3.894	3.900	3.905	3.910	3.916	3.921	3.927	3.932	3.938	3.943	3.949	870
880	3.949	3.954	3.959	3.965	3.970	3.976	3.981	3.987	3.992	3.998	4.003	880
890	4.003	4.009	4.014	4.020	4.025	4.030	4.036	4.041	4.047	4.052	4.058	890
°F	0	1	2	3	4	5	6	7	8	9	10	°F