

TECHNICAL REFERENCE

Temperature (°F)	Type J	Type K	Type T	Type E	Type N	Type R	Type S	Type B	Type W	Type W ₃	Type W ₅
-340	-8.030	-5.989	-5.705	-8.986	-4.054						
-330	-7.915	-5.908	-5.620	-8.852	-4.001						
-320	-7.791	-5.822	-5.532	-8.710	-3.945						
-310	-7.659	-5.730	-5.439	-8.561	-3.884						
-300	-7.519	-5.632	-5.341	-8.404	-3.820						
-290	-7.373	-5.529	-5.240	-8.240	-3.752						
-280	-7.219	-5.421	-5.135	-8.069	-3.679						
-270	-7.058	-5.308	-5.025	-7.891	-3.604						
-260	-6.890	-5.190	-4.912	-7.707	-3.524						
-250	-6.716	-5.067	-4.794	-7.516	-3.441						
-240	-6.536	-4.939	-4.673	-7.319	-3.354						
-230	-6.351	-4.806	-4.548	-7.116	-3.264						
-220	-6.159	-4.669	-4.419	-6.907	-3.171						
-210	-5.962	-4.527	-4.286	-6.692	-3.074						
-200	-5.760	-4.381	-4.149	-6.472	-2.974						
-190	-5.553	-4.246	-4.009	-6.246	-2.871						
-180	-5.341	-4.091	-3.865	-6.014	-2.765						
-170	-5.125	-3.933	-3.717	-5.777	-2.658						
-160	-4.903	-3.771	-3.565	-5.535	-2.544						
-150	-4.678	-3.604	-3.410	-5.287	-2.430						
-140	-4.449	-3.434	-3.251	-5.035	-2.313						
-130	-4.215	-3.260	-3.089	-4.777	-2.193						
-120	-3.978	-3.083	-2.923	-4.515	-2.072						
-110	-3.737	-2.902	-2.754	-4.248	-1.947						
-100	-3.493	-2.718	-2.581	-3.976	-1.821						
-90	-3.245	-2.530	-2.405	-3.700	-1.692						
-80	-2.994	-2.339	-2.225	-3.420	-1.562						
-70	-2.740	-2.146	-2.043	-3.135	-1.430						
-60	-2.483	-1.949	-1.857	-2.846	-1.296						
-50	-2.223	-1.749	-1.667	-2.552	-1.160	-0.210	-0.218				
-40	-1.961	-1.547	-1.475	-2.255	-1.023	-0.188	-0.194				
-30	-1.695	-1.343	-1.279	-1.953	-0.884	-0.165	-0.170				
-20	-1.428	-1.135	-1.081	-1.648	-0.744	-0.141	-0.145				
-10	-1.158	-0.926	-0.879	-1.339	-0.603	-0.116	-0.119				
0	-0.886	-0.714	-0.675	-1.026	-0.461	-0.090	-0.092				
0	-0.886	-0.692	-0.675	-1.026	-0.461	-0.090	-0.092				
10	-0.611	-0.478	-0.467	-0.709	-0.318	-0.063	-0.064				
20	-0.334	-0.044	-0.256	-0.389	-0.174	-0.035	-0.035				
30	-0.056	0.176	-0.043	-0.065	-0.029	-0.006	-0.006				
40	0.225	0.397	0.173	0.262	0.116	0.024	0.024	-0.001			
50	0.507	0.397	0.391	0.591	0.261	0.054	0.055	-0.002			
60	0.791	0.619	0.611	0.924	0.407	0.086	0.087	-0.002			
70	1.076	0.843	0.834	1.259	0.555	0.118	0.119	-0.003			
80	1.364	1.068	1.060	1.597	0.703	0.151	0.153	-0.002			
90	1.652	1.294	1.288	1.938	0.853	0.184	0.186	-0.002			
100	1.942	1.521	1.519	2.281	1.004	0.218	0.221	-0.001	0.079	0.390	0.522
110	2.234	1.749	1.752	2.628	1.156	0.254	0.256	0.000			
120	2.527	1.977	1.988	2.977	1.309	0.289	0.292	0.002	0.113	0.515	0.682
130	2.821	2.207	2.227	3.330	1.463	0.326	0.328	0.004			
140	3.116	2.436	2.468	3.685	1.619	0.363	0.365	0.006	0.153	0.644	0.845
150	3.412	2.667	2.712	4.042	1.776	0.400	0.402	0.009			
160	3.709	2.897	2.958	4.403	1.934	0.439	0.440	0.012	0.197	0.778	1.010
170	4.007	3.128	3.207	4.766	2.093	0.478	0.479	0.015			
180	4.306	3.359	3.459	5.131	2.253	0.517	0.518	0.019	0.246	0.916	1.178
190	4.606	3.590	3.712	5.500	2.415	0.557	0.557	0.023			
200	4.907	3.820	3.968	5.871	2.577	0.598	0.597	0.027	0.299	1.058	1.348
210	5.209	4.050	4.227	6.244	2.741	0.639	0.638	0.032			
220	5.511	4.280	4.487	6.620	2.906	0.681	0.679	0.037	0.357	1.204	1.520
230	5.814	4.509	4.750	6.998	3.072	0.723	0.720	0.043			
240	6.117	4.738	5.015	7.379	3.240	0.766	0.762	0.049	0.420	1.354	1.695
250	6.421	4.965	5.282	7.762	3.408	0.809	0.804	0.055			
260	6.726	5.192	5.551	8.147	3.578	0.853	0.847	0.061	0.487	1.507	1.872
270	7.031	5.419	5.823	8.535	3.748	0.897	0.889	0.068			
280	7.336	5.644	6.096	8.924	3.920	0.941	0.933	0.075	0.559	1.664	2.051
290	7.642	5.869	6.371	9.316	4.093	0.986	0.977	0.083			



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Doc. No.: TE-CO010109-TECH-250

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Temperature (°F)	Type J	Type K	Type T	Type E	Type N	Type R	Type S	Type B	Type W	Type W ₃	Type W ₅
300	7.949	6.094	6.648	9.710	4.267	1.032	1.021	0.090	0.634	1.824	2.232
310	8.255	6.317	6.928	10.106	4.442	1.078	1.065	0.099			
320	8.562	6.540	7.209	10.504	4.618	1.124	1.110	0.107	0.714	1.988	2.415
330	8.869	6.763	7.492	10.903	4.795	1.171	1.155	0.116			
340	9.177	6.985	7.777	11.305	4.973	1.218	1.200	0.125	0.799	2.154	2.600
350	9.485	7.207	8.064	11.708	5.152	1.265	1.246	0.135			
360	9.793	7.429	8.352	12.113	5.332	1.313	1.292	0.145	0.887	2.324	2.786
370	10.101	7.650	8.643	12.520	5.512	1.361	1.338	0.155			
380	10.409	7.872	8.935	12.929	5.694	1.410	1.385	0.165	0.979	2.497	2.975
390	10.717	8.094	9.229	13.339	5.877	1.459	1.431	0.176			
400	11.025	8.316	9.525	13.751	6.060	1.508	1.478	0.187	1.075	2.673	3.165
410	11.334	8.539	9.882	14.164	6.245	1.558	1.526	0.199			
420	11.642	8.761	10.122	14.579	6.430	1.607	1.573	0.211	1.175	2.851	3.357
430	11.951	8.985	10.423	14.995	6.616	1.658	1.621	0.223			
440	12.260	9.208	10.725	15.413	6.803	1.708	1.669	0.235	1.279	3.032	3.551
450	12.568	9.432	11.029	15.831	6.991	1.759	1.718	0.248			
460	12.877	9.657	11.335	16.252	7.179	1.810	1.766	0.261	1.387	3.216	3.746
470	13.185	9.882	11.643	16.673	7.369	1.861	1.815	0.275			
480	13.494	10.108	11.951	17.096	7.559	1.913	1.864	0.288	1.498	3.402	3.942
490	13.802	10.334	12.262	17.520	7.750	1.965	1.913	0.303			
500	14.110	10.561	12.574	17.945	7.941	2.017	1.962	0.317	1.613	3.590	4.140
510	14.418	10.789	12.887	18.371	8.134	2.070	2.012	0.332			
520	14.727	11.017	13.202	18.798	8.327	2.122	2.062	0.347	1.731	3.781	4.339
530	15.035	11.245	13.518	19.227	8.520	2.175	2.111	0.362			
540	15.343	11.474	13.836	19.656	8.715	2.229	2.162	0.378	1.853	3.973	4.540
550	15.650	11.703	14.155	20.086	8.910	2.282	2.212	0.394			
560	15.958	11.933	14.476	20.517	9.105	2.336	2.262	0.411	1.978	4.168	4.742
570	16.266	12.163	14.797	20.950	9.302	2.390	2.313	0.427			
580	16.573	12.393	15.121	21.383	9.499	2.444	2.364	0.444	2.106	4.365	4.945
590	16.881	12.624	15.445	21.817	9.696	2.498	2.415	0.462			
600	17.188	12.855	15.771	22.252	9.895	2.553	2.466	0.479	2.238	4.564	5.149
610	17.495	13.086	16.098	22.687	10.093	2.608	2.517	0.497			
620	17.802	13.318	16.426	23.124	10.293	2.663	2.568	0.516	2.373	4.765	5.354
630	18.109	13.549	16.756	23.561	10.493	2.718	2.620	0.534			
640	18.416	13.782	17.086	23.999	10.693	2.773	2.672	0.553	2.511	4.967	5.560
650	18.722	14.014	17.418	24.437	10.894	2.829	2.723	0.572			
660	19.029	14.247	17.752	24.876	11.096	2.885	2.775	0.592	2.652	5.171	5.757
670	19.336	14.479	18.086	25.316	11.298	2.941	2.827	0.612			
680	19.642	14.713	18.422	25.757	11.501	2.997	2.880	0.632	2.796	5.337	5.975
690	19.949	14.946	18.759	26.198	11.704	3.054	2.932	0.653			
700	20.255	15.179	19.097	26.640	11.907	3.110	2.985	0.673	2.943	5.584	6.184
710	20.561	15.413	19.437	27.082	12.111	3.167	3.037	0.694			
720	20.868	15.647	19.777	27.525	12.316	3.224	3.090	0.716	3.093	5.793	6.394
730	21.174	15.881	20.118	27.969	12.521	3.281	3.143	0.738			
740	21.480	16.116	20.460	28.413	12.726	3.339	3.196	0.760	3.246	6.003	6.604
750	21.787	16.350	20.803	28.857	12.932	3.396	3.249	0.782			
760	22.093	16.585		29.302	13.139	3.454	3.302	0.805	3.401	6.214	6.815
770	22.400	16.820		29.747	13.346	3.512	3.355	0.828			
780	22.706	17.055		30.193	13.553	3.570	3.409	0.851	3.559	6.427	7.027
790	23.013	17.290		30.639	13.760	3.628	3.462	0.875			
800	23.320	17.526		31.086	13.969	3.686	3.516	0.898	3.720	6.640	7.240
810	23.627	17.761		31.533	14.177	3.745	3.570	0.923			
820	23.934	17.997		31.980	14.386	3.803	3.623	0.947	3.884	6.855	7.453
830	24.241	18.233		32.427	14.595	3.862	3.677	0.972			
840	24.549	18.469		32.875	14.804	3.921	3.731	0.997	4.049	7.071	7.667
850	24.856	18.705		33.323	15.014	3.980	3.786	1.022			
860	25.164	18.941		33.772	15.225	4.040	3.840	1.048	4.218	7.288	7.881
870	25.473	19.177		34.220	15.435	4.099	3.894	1.074			
880	25.781	19.414		34.669	15.646	4.159	3.949	1.100	4.389	7.506	8.095
890	26.090	19.650		35.118	15.857	4.219	4.003	1.127			
900	26.400	19.887		35.567	16.069	4.279	4.058	1.154	4.562	7.725	8.310
910	26.710	20.123		36.016	16.281	4.339	4.113	1.181			
920	27.020	20.360		36.466	16.493	4.399	4.167	1.208	4.737	7.945	8.526
930	27.330	20.597		36.915	16.705	4.459	4.222	1.236			
940	27.642	20.834		37.365	16.918	4.520	4.277	1.264	4.915	8.165	8.741



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TECHNICAL REFERENCE

Temperature (°F)	Type J	Type K	Type T	Type E	Type N	Type R	Type S	Type B	Type W	Type W ₃	Type W ₅
950	27.953	21.071		37.815	17.131	4.580	4.332	1.293			
960	28.266	21.308		38.265	17.344	4.641	4.388	1.321	5.095	8.386	8.957
970	28.579	21.544		38.714	17.558	4.702	4.443	1.350			
980	28.892	21.781		39.164	17.772	4.763	4.498	1.379	5.277	8.608	9.174
990	29.206	22.018		39.614	17.986	4.824	4.554	1.409			
1000	29.521	22.255		40.064	18.200	4.886	4.610	1.439	5.461	8.830	9.390
1010	29.836	22.492		40.513	18.414	4.947	4.665	1.469			
1020	30.153	22.729		40.963	18.629	5.009	4.721	1.499	5.647	9.053	9.607
1030	30.470	22.966		41.412	18.844	5.071	4.777	1.530			
1040	30.788	23.203		41.862	19.059	5.133	4.833	1.561	5.836	9.277	9.824
1050	31.106	23.439		42.311	19.274	5.195	4.889	1.592			
1060	31.426	23.676		42.760	19.490	5.257	4.945	1.624	6.026	9.501	10.041
1070	31.746	23.913		43.209	19.705	5.320	5.001	1.655			
1080	32.068	24.149		43.658	19.921	5.382	5.058	1.687	6.218	9.726	10.258
1090	32.390	24.386		44.107	20.137	5.445	5.114	1.720			
1100	32.713	24.622		44.555	20.353	5.508	5.171	1.752	6.412	9.951	10.475
1110	33.037	24.858		45.004	20.570	5.571	5.227	1.785			
1120	33.363	25.094		45.452	20.786	5.634	5.284	1.818	6.607	10.176	10.693
1130	33.689	25.330		45.900	21.003	5.697	5.341	1.852			
1140	34.016	25.566		46.347	21.220	5.761	5.398	1.886	6.805	10.402	10.910
1150	34.345	25.802		46.794	21.437	5.824	5.455	1.920			
1160	34.674	26.037		47.241	21.654	5.888	5.512	1.954	7.004	10.628	11.127
1170	35.005	26.273		47.688	21.871	5.952	5.569	1.988			
1180	35.337	26.508		48.135	22.088	6.016	5.627	2.023	7.205	10.854	11.344
1190	35.670	26.743		48.581	22.305	6.080	5.684	2.058			
1200	36.004	26.978		49.027	22.523	6.144	5.741	2.094	7.407	11.080	11.561
1210	36.339	27.213		49.472	22.740	6.209	5.799	2.129			
1220	36.675	27.447		49.917	22.958	6.273	5.857	2.165	7.611	11.307	11.778
1230	37.013	27.681		50.362	23.176	6.338	5.915	2.201			
1240	37.352	27.915		50.807	23.393	6.403	5.972	2.237	7.816	11.534	11.995
1250	37.692	28.149		51.251	23.611	6.468	6.030	2.274			
1260	38.033	28.383		51.695	23.829	6.533	6.089	2.311	8.023	11.761	12.212
1270	38.375	28.616		52.138	24.047	6.598	6.147	2.348			
1280	38.718	28.849		52.581	24.265	6.664	6.205	2.385	8.232	11.988	12.429
1290	39.063	29.082		53.024	24.483	6.730	6.264	2.423			
1300	39.408	29.315		53.466	24.701	6.795	6.322	2.461	8.441	12.215	12.645
1310	39.755	29.548		53.908	24.919	6.861	6.381	2.499			
1320	40.103	29.780		54.350	25.137	6.927	6.439	2.538	8.652	12.443	12.861
1330	40.452	30.012		54.791	25.356	6.994	6.498	2.576			
1340	40.801	30.243		55.232	25.574	7.060	6.557	2.615	8.865	12.670	13.077
1350	41.152	30.475		55.673	25.792	7.126	6.616	2.654			
1360	41.504	30.706		56.113	26.010	7.193	6.675	2.694	9.078	12.897	13.292
1370	41.856	30.937		56.553	26.229	7.260	6.735	2.734			
1380	42.210	31.167		56.992	26.447	7.327	6.794	2.774	9.293	13.125	13.508
1390	42.564	31.398		57.431	26.665	7.394	6.853	2.814			
1400	42.919	31.628		57.870	26.883	7.461	6.913	2.854	9.509	13.352	13.723
1410	43.274	31.857		58.308	27.102	7.529	6.973	2.895			
1420	43.631	32.087		58.746	27.320	7.596	7.032	2.936	9.726	13.579	13.937
1430	43.988	32.316		59.184	27.538	7.664	7.092	2.978			
1440	44.346	32.545		59.621	27.756	7.732	7.152	3.019	9.945	13.807	14.152
1450	44.705	32.774		60.058	27.975	7.800	7.212	3.061			
1460	45.064	33.002		60.494	28.193	7.868	7.273	3.103	10.164	14.034	14.366
1470	45.423	33.230		60.930	28.411	7.936	7.333	3.145			
1480	45.782	33.458		61.366	28.629	8.005	7.393	3.188	10.384	14.262	14.579
1490	46.141	33.685		61.801	28.847	8.073	7.454	3.230			
1500	46.500	33.912		62.236	29.065	8.142	7.514	3.273	10.606	14.489	14.792
1510	46.858	34.139		62.670	29.283	8.211	7.575	3.317			
1520	47.216	34.365		63.104	29.501	8.280	7.636	3.360	10.828	14.717	15.005
1530	47.574	34.591		63.538	29.719	8.349	7.697	3.404			
1540	47.931	34.817		63.971	29.937	8.418	7.758	3.448	11.051	14.944	15.217
1550	48.288	35.043		64.403	30.154	8.488	7.819	3.492			
1560	48.644	35.268		64.835	30.372	8.557	7.881	3.537	11.275	15.171	15.429
1570	48.999	35.493		65.267	30.590	8.627	7.942	3.581			
1580	49.353	35.718		65.698	30.807	8.697	8.003	3.626	11.500	15.398	15.640
1590	49.707	35.942		66.129	31.025	8.767	8.065	3.672			



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Doc. No.: TE-CO010109-TECH-270

TECHNICAL REFERENCE

Temperature (°F)	Type J	Type K	Type T	Type E	Type N	Type R	Type S	Type B	Type W	Type W ₃	Type W ₅
1600	50.060	36.166		66.559	31.242	8.837	8.127	3.717	11.725	15.624	15.851
1610	50.411	36.390		66.989	31.459	8.908	8.189	3.763			
1620	50.762	36.613		67.418	31.677	8.978	8.250	3.809	11.952	15.850	16.062
1630	51.112	36.836		67.846	31.894	9.049	8.312	3.855			
1640	51.460	37.059		68.274	32.111	9.120	8.375	3.901	12.179	16.076	16.271
1650	51.808	37.281		68.701	32.328	9.191	8.437	3.948			
1660	52.154	37.504		69.128	32.545	9.262	8.499	3.994	12.407	16.302	16.481
1670	52.500	37.725		69.554	32.761	9.333	8.562	4.041			
1680	52.844	37.947		69.979	32.978	9.404	8.624	4.089	12.635	16.527	16.689
1690	53.188	38.168		70.404	33.195	9.476	8.687	4.136			
1700		38.389		70.828	33.411	9.547	8.749	4.184	12.864	16.752	16.898
1710		38.610		71.252	33.627	9.619	8.812	4.232			
1720		38.830		71.675	33.844	9.691	8.875	4.280	13.094	16.976	17.105
1730		39.050		72.097	34.060	9.763	8.938	4.328			
1740		39.270		72.518	34.276	9.835	9.001	4.377	13.324	17.200	17.312
1750		39.489		72.939	34.491	9.908	9.065	4.426			
1760		39.708		73.360	34.707	9.980	9.128	4.475	13.555	17.424	17.519
1770		39.927		73.780	34.923	10.053	9.192	4.524			
1780		40.145		74.199	35.138	10.126	9.255	4.574	13.786	17.647	17.725
1790		40.363		74.618	35.353	10.198	9.319	4.623			
1800		40.581		75.036	35.568	10.271	9.382	4.673	14.018	17.870	17.930
1810		40.798		75.454	35.783	10.345	9.446	4.723			
1820		41.015		75.872	35.998	10.418	9.510	4.774	14.250	18.093	18.134
1830		41.232		76.289	36.213	10.491	9.574	4.824			
1840		41.449			36.427	10.565	9.638	4.875	14.482	18.315	18.339
1850		41.665			36.641	10.638	9.703	4.926			
1860		41.881			36.855	10.712	9.767	4.977	14.715	18.537	18.542
1870		42.096			37.069	10.786	9.831	5.028			
1880		42.311			37.283	10.860	9.896	5.080	14.948	18.758	18.745
1890		42.526			37.497	10.934	9.961	5.132			
1900		42.741			37.710	11.009	10.025	5.184	15.182	18.979	18.947
1910		42.955			37.923	11.083	10.090	5.236			
1920		43.169			38.136	11.158	10.155	5.288	15.415	19.199	19.148
1930		43.382			38.349	11.233	10.220	5.341			
1940		43.595			38.562	11.307	10.285	5.394	15.649	19.419	19.349
1950		43.808			38.774	11.382	10.350	5.447			
1960		44.020			38.986	11.457	10.416	5.500	15.884	19.638	19.549
1970		44.232			39.198	11.533	10.481	5.553			
1980		44.444			39.410	11.608	10.547	5.607	16.118	19.857	19.748
1990		44.655			39.622	11.683	10.612	5.661			
2000		44.866			39.833	11.759	10.678	5.715	16.353	20.075	19.947
2010		45.077			40.044	11.834	10.743	5.769			
2020		45.287			40.255	11.910	10.809	5.823	16.587	20.293	20.145
2030		45.497			40.466	11.986	10.875	5.878			
2040		45.706			40.677	12.062	10.941	5.932	16.822	20.510	20.343
2050		45.915			40.887	12.138	11.007	5.987			
2060		46.124			41.097	12.214	11.073	6.042	17.057	20.726	20.539
2070		46.332			41.307	12.291	11.139	6.098			
2080		46.540			41.516	12.367	11.205	6.153	17.292	20.943	20.735
2090		46.747			41.725	12.443	11.272	6.209			
2100		46.954			41.935	12.520	11.338	6.264	17.527	21.158	20.930
2110		47.161			42.143	12.597	11.404	6.320			
2120		47.367			42.352	12.673	11.471	6.377	17.762	21.373	21.125
2130		47.573			42.560	12.750	11.537	6.433			
2140		47.778			42.768	12.827	11.604	6.490	17.997	21.588	21.319
2150		47.983			42.976	12.904	11.670	6.546			
2160		48.187			43.184	12.981	11.737	6.603	18.232	21.802	21.512
2170		48.391			43.391	13.058	11.804	6.660			
2180		48.595			43.598	13.135	11.870	6.718	18.467	22.015	21.704
2190		48.798			43.805	13.213	11.937	6.775			
2200		49.000			44.012	13.290	12.004	6.833	18.701	22.228	21.896
2210		49.202			44.218	13.367	12.071	6.890			
2220		49.404			44.424	13.445	12.138	6.948	18.936	22.440	22.087
2230		49.605			44.629	13.522	12.205	7.006			
2240		49.806			44.835	13.600	12.272	7.065	19.170	22.651	22.277



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TECHNICAL REFERENCE

Temperature (°F)	Type J	Type K	Type T	Type E	Type N	Type R	Type S	Type B	Type W	Type W ₃	Type W ₅
2250		50.006			45.040	13.677	12.339	7.123			
2260		50.206			45.245	13.755	12.406	7.182	19.405	22.863	22.466
2270		50.405			45.449	13.833	12.473	7.240			
2280		50.604			45.653	13.911	12.540	7.299	19.639	23.073	22.655
2290		50.802			45.857	13.989	12.607	7.358			
2300		51.000			46.060	14.066	12.675	7.417	19.873	23.283	22.843
2310		51.198			46.263	14.144	12.742	7.477			
2320		51.395			46.466	14.222	12.809	7.536	20.106	23.492	23.030
2330		51.591			46.668	14.300	12.876	7.596			
2340		51.787			46.870	14.379	12.944	7.656	20.340	23.701	23.217
2350		51.982			47.071	14.457	13.011	7.716			
2360		52.177			47.272	14.535	13.078	7.776	20.573	23.909	23.403
2370		52.371			47.473	14.613	13.146	7.836			
2380		52.565				14.691	13.213	7.897	20.806	24.116	23.588
2390		52.759				14.770	13.280	7.957			
2400		52.952				14.848	13.348	8.018	21.038	24.323	23.772
2410		53.144				14.926	13.415	8.079			
2420		53.336				15.005	13.483	8.140	21.270	24.529	23.956
2430		53.528				15.083	13.550	8.201			
2440		53.719				15.161	13.617	8.262	21.502	24.735	24.138
2450		53.910				15.240	13.685	8.323			
2460		54.100				15.318	13.752	8.385	21.734	24.940	24.320
2470		54.289				15.397	13.820	8.446			
2480		54.479				15.475	13.887	8.508	21.965	25.145	24.502
2490		54.668				15.553	13.955	8.570			
2500		54.856				15.632	14.022	8.632	22.195	25.348	24.682
2510						15.710	14.089	8.694			
2520						15.789	14.157	8.756	22.425	25.551	24.862
2530						15.867	14.224	8.819			
2540						15.946	14.292	8.881	22.655	25.754	25.041
2550						16.024	14.359	8.944			
2560						16.103	14.426	9.006	22.884	25.956	25.219
2570						16.181	14.494	9.069			
2580						16.260	14.561	9.132	23.113	26.157	25.397
2590						16.338	14.629	9.195			
2600						16.417	14.696	9.258	23.341	26.358	25.574
2610						16.495	14.763	9.321			
2620						16.574	14.830	9.385	23.569	26.558	25.750
2630						16.652	14.898	9.448			
2640						16.731	14.965	9.511	23.796	26.757	25.925
2650						16.809	15.032	9.575			
2660						16.887	15.099	9.639	24.023	26.956	26.100
2670						16.966	15.166	9.702			
2680						17.044	15.233	9.766	24.249	27.154	26.274
2690						17.122	15.300	9.830			
2700						17.200	15.367	9.894	24.474	27.352	26.447
2710						17.279	15.434	9.958			
2720						17.357	15.501	10.022	24.699	27.548	26.619
2730						17.435	15.568	10.086			
2740						17.513	15.635	10.150	24.923	27.745	26.791
2750						17.591	15.702	10.215			
2760						17.669	15.769	10.279	25.146	27.940	26.962
2770						17.747	15.835	10.344			
2780						17.825	15.902	10.408	25.369	28.135	27.132
2790						17.903	15.969	10.473			
2800						17.981	16.035	10.537	25.591	28.329	27.301
2810						18.059	16.102	10.602			
2820						18.137	16.168	10.666	25.812	28.523	27.470
2830						18.214	16.235	10.731			
2840						18.292	16.301	10.796	26.033	28.715	27.637
2850						18.369	16.367	10.861			
2860						18.447	16.434	10.925	26.253	28.908	27.805
2870						18.524	16.500	10.990			
2880						18.602	16.566	11.055	26.472	29.099	27.971
2890						18.679	16.632	11.120			



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Doc. No.: TE-CO010109-TECH-290

TECHNICAL REFERENCE

Temperature (°F)	Type J	Type K	Type T	Type E	Type N	Type R	Type S	Type B	Type W	Type W ₃	Type W ₅
2900						18.756	16.698	11.185	26.690	29.290	28.137
2910						18.834	16.764	11.250			
2920						18.911	16.829	11.315	26.907	29.480	28.301
2930						18.988	16.895	11.380			
2940						19.065	16.961	11.445	27.124	29.669	28.466
2950						19.141	17.026	11.510			
2960						19.218	17.092	11.575	27.340	29.858	28.629
2970						19.295	17.157	11.640			
2980						19.372	17.223	11.705	27.555	30.046	28.791
2990						19.448	17.288	11.770			
3000						19.525	17.353	11.835	27.769	30.233	28.953
3010						19.601	17.418	11.900			
3020						19.677	17.483	11.965	27.983	30.419	29.114
3030						19.753	17.548	12.030			
3040						19.829	17.613	12.095	28.195	30.605	29.275
3050						19.905	17.678	12.160			
3060						19.981	17.742	12.225	28.407	30.790	29.434
3070						20.056	17.807	12.290			
3080						20.132	17.871	12.355	28.618	30.974	29.593
3090						20.207	17.935	12.420			
3100						20.281	17.998	12.484	28.827	31.158	29.751
3110						20.356	18.061	12.549			
3120						20.430	18.124	12.614	29.036	31.340	29.908
3130						20.503	18.187	12.679			
3140						20.576	18.248	12.743	29.244	31.522	30.065
3150						20.649	18.310	12.808			
3160						20.721	18.371	12.872	29.451	31.703	30.221
3170						20.792	18.431	12.937			
3180						20.863	18.491	13.001	29.657	31.884	30.376
3190						20.933	18.551	13.066			
3200						21.003	18.609	13.130	29.862	32.063	30.530
3210						21.071	18.667	13.194			
3220								13.259	30.066	32.242	30.683
3230								13.323			
3240								13.387	30.269	32.420	30.836
3250								13.451			
3260								13.515	30.471	32.596	30.988
3270								13.579			
3280								13.642	30.672	32.772	31.139
3290								13.706			
3300								13.769	30.871	32.948	31.289
3310											
3320									31.070	33.122	31.438
3330											
3340									31.268	33.295	31.587
3350											
3360									31.464	33.467	31.735
3370											
3380									31.660	33.639	31.882
3390											
3400									31.854	33.809	32.028
3410											
3420									32.047	33.979	32.173
3430											
3440									32.240	34.147	32.318
3450											
3460									32.430	34.314	32.461
3470											
3480									32.620	34.481	32.604
3490											
3500									32.809	34.646	32.746
3510											
3520									32.996	34.810	32.887
3530											
3540									33.182	34.973	33.027



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Doc. No.: TE-CO010109-TECH-300

TECHNICAL REFERENCE

Temperature (°F)	Type J	Type K	Type T	Type E	Type N	Type R	Type S	Type B	Type W	Type W ₃	Type W ₅
3550											
3560									33.367	35.135	33.166
3570											
3580									33.551	35.295	33.305
3590											
3600									33.733	35.455	33.442
3610											
3620									33.914	35.613	33.579
3630											
3640									34.094	35.770	33.714
3650											
3660									34.273	35.926	33.849
3670											
3680									34.450	36.080	33.982
3690											
3700									34.626	36.233	34.115
3710											
3720									34.801	36.384	34.247
3730											
3740									34.974	36.535	34.378
3750											
3760									35.146	36.683	34.507
3770											
3780									35.317	36.831	34.636
3790											
3800									35.486	36.976	34.763
3810											
3820									35.654	37.120	34.890
3830											
3840									35.821	37.263	35.015
3850											
3860									35.986	37.404	35.140
3870											
3880									36.150	37.543	35.263
3890											
3900									36.312	37.681	35.385
3910											
3920									36.473	37.816	35.506
3930											
3940									36.632	37.950	35.626
3950											
3960									36.790	38.082	35.744
3970											
3980									36.946	38.213	35.862
3990											
4000									37.101	38.341	35.978
4010											
4020									37.853	38.467	36.093
4030											
4040									37.998	38.591	36.206
4050											
4060									38.142	38.714	36.319
4070											
4080									38.285	38.834	36.430
4090											
4110									38.425	38.951	36.539
4120											
4130									38.564	39.067	36.647
4140											
4150										39.180	36.754
4160											
4170										39.291	.XXXX
4180											
4190										39.400	.XXXX
4200											



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Doc. No.: TE-CO010109-TECH-310

TECHNICAL REFERENCE

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
-180	27.10	25.80	25.80	1.884	
-179	27.52	26.24	26.23	1.925	
-178	27.95	26.67	26.67	1.967	
-177	28.37	27.10	27.10	2.008	
-176	28.80	27.53	27.53	2.049	
-175	29.22	27.97	27.96	2.090	
-174	29.64	28.40	28.39	2.131	
-173	30.07	28.83	28.82	2.172	
-172	30.49	29.26	29.25	2.213	
-171	30.91	29.69	29.68	2.254	
-170	31.34	30.12	30.11	2.295	
-169	31.76	30.56	30.54	2.336	
-168	32.18	30.99	30.97	2.377	
-167	32.60	31.42	31.40	2.418	
-166	33.02	31.85	31.83	2.459	
-165	33.44	32.28	32.26	2.500	
-164	33.86	32.70	32.69	2.541	
-163	34.28	33.13	33.11	2.582	
-162	34.70	33.56	33.54	2.623	
-161	35.12	33.99	33.97	2.664	
-160	35.54	34.42	34.39	2.705	
-159	35.96	34.85	34.82	2.746	
-158	36.38	35.27	35.25	2.786	
-157	36.80	35.70	35.67	2.827	
-156	37.22	36.13	36.10	2.868	
-155	37.64	36.55	36.52	2.909	
-154	38.05	36.98	36.95	2.950	
-153	38.47	37.41	37.37	2.990	
-152	38.89	37.83	37.80	3.031	
-151	39.31	38.26	38.22	3.072	
-150	39.72	38.68	38.65	3.113	
-149	40.14	39.10	39.07	3.153	
-148	40.56	39.53	39.49	3.194	
-147	40.97	39.95	39.92	3.235	
-146	41.39	40.38	40.34	3.275	
-145	41.80	40.80	40.76	3.316	
-144	42.22	41.22	41.19	3.356	
-143	42.63	41.64	41.61	3.397	
-142	43.05	42.07	42.03	3.438	
-141	43.46	42.49	42.45	3.478	
-140	43.88	42.91	42.87	3.519	
-139	44.29	43.33	43.29	3.559	
-138	44.70	43.75	43.72	3.600	
-137	45.12	44.17	44.14	3.640	
-136	45.53	44.59	44.56	3.681	
-135	45.94	45.01	44.98	3.721	
-134	46.36	45.43	45.40	3.762	
-133	46.77	45.85	45.82	3.802	
-132	47.18	46.27	46.24	3.843	
-131	47.59	46.69	46.66	3.883	
-130	48.00	47.11	47.07	3.923	
-129	48.42	47.53	47.49	3.964	
-128	48.83	47.95	47.91	4.004	
-127	49.24	48.37	48.33	4.045	
-126	49.65	48.78	48.75	4.085	
-125	50.06	49.20	49.17	4.125	
-124	50.47	49.62	49.58	4.165	
-123	50.88	50.04	50.00	4.206	
-122	51.29	50.45	50.42	4.246	
-121	51.70	50.87	50.84	4.286	
-120	52.11	51.29	51.25	4.327	
-119	52.52	51.70	51.67	4.367	
-118	52.93	52.12	52.09	4.407	
-117	53.34	52.53	52.50	4.447	
-116	53.75	52.95	52.92	4.487	
-115	54.15	53.36	53.33	4.527	
-114	54.56	53.78	53.75	4.568	
-113	54.97	54.19	54.16	4.608	
-112	55.38	54.61	54.58	4.648	
-111	55.79	55.02	54.99	4.688	
-110	56.19	55.44	55.41	4.728	
-109	56.60	55.85	55.82	4.768	
-108	57.01	56.26	56.24	4.808	
-107	57.41	56.68	56.65	4.848	
-106	57.82	57.09	57.06	4.888	

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
-105	58.23	57.50	57.48	4.928	
-104	58.63	57.92	57.89	4.968	
-103	59.04	58.33	58.30	5.008	
-102	59.44	58.74	58.72	5.048	
-101	59.85	59.16	59.13	5.088	
-100	60.26	59.57	59.54	5.128	
-99	60.66	59.98	59.96	5.168	
-98	61.07	60.39	60.37	5.208	
-97	61.47	60.80	60.78	5.248	
-96	61.88	61.21	61.19	5.288	
-95	62.28	61.63	61.60	5.327	
-94	62.68	62.04	62.01	5.367	
-93	63.09	62.45	62.43	5.407	
-92	63.49	62.86	62.84	5.447	
-91	63.90	63.27	63.25	5.487	
-90	64.30	63.68	63.66	5.526	
-89	64.70	64.09	64.07	5.566	
-88	65.11	64.50	64.48	5.606	
-87	65.51	64.91	64.89	5.646	
-86	65.91	65.32	65.30	5.685	
-85	66.31	65.73	65.71	5.725	
-84	66.72	66.14	66.12	5.765	
-83	67.12	66.55	66.53	5.804	
-82	67.52	66.96	66.94	5.844	
-81	67.92	67.36	67.35	5.884	
-80	68.33	67.77	67.76	5.923	66.60
-79	68.73	68.18	68.17	5.963	67.25
-78	69.13	68.59	68.57	6.002	67.90
-77	69.53	69.00	68.98	6.042	68.55
-76	69.93	69.41	69.39	6.081	69.20
-75	70.33	69.81	69.80	6.121	69.85
-74	70.73	70.22	70.21	6.160	70.50
-73	71.13	70.63	70.61	6.200	71.15
-72	71.53	71.04	71.02	6.239	71.80
-71	71.93	71.44	71.43	6.279	72.45
-70	72.33	71.85	71.84	6.318	73.10
-69	72.72	72.26	72.24	6.358	73.75
-68	73.13	72.66	72.65	6.397	74.41
-67	73.53	73.07	73.06	6.437	75.06
-66	73.93	73.43	73.47	6.476	75.71
-65	74.33	73.88	73.87	6.515	76.36
-64	74.73	74.29	74.28	6.555	77.01
-63	75.13	74.70	74.68	6.594	77.66
-62	75.53	75.10	75.09	6.633	78.31
-61	75.93	75.51	75.50	6.673	78.97
-60	76.33	75.91	75.90	6.712	79.62
-59	76.73	76.32	76.31	6.751	80.27
-58	77.12	76.72	76.71	6.791	80.93
-57	77.52	77.13	77.12	6.830	81.58
-56	77.92	77.53	77.52	6.869	82.23
-55	78.32	77.94	77.93	6.908	82.89
-54	78.72	78.34	78.33	6.947	83.54
-53	79.11	78.75	78.74	6.987	84.20
-52	79.51	79.15	79.14	7.026	84.85
-51	79.91	79.56	79.55	7.065	85.51
-50	80.31	79.96	79.95	7.104	86.16
-49	80.70	80.36	80.36	7.143	86.82
-48	81.10	80.77	80.76	7.181	87.48
-47	81.50	81.17	81.16	7.220	88.14
-46	81.89	81.58	81.57	7.259	88.79
-45	82.29	81.98	81.97	7.297	89.45
-44	82.69	82.38	82.38	7.336	90.11
-43	83.08	82.79	82.78	7.374	90.77
-42	83.48	83.19	83.18	7.413	91.43
-41	83.87	83.59	83.58	7.452	92.09
-40	84.27	83.99	83.99	7.490	92.76
-39	84.67	84.40	84.39	7.529	93.42
-38	85.06	84.80	84.79	7.568	94.08
-37	85.46	85.20	85.20	7.606	94.74
-36	85.85	85.60	85.60	7.645	95.41
-35	86.25	86.01	86.00	7.683	96.07
-34	86.64	86.41	86.40	7.722	96.74
-33	87.04	86.81	86.80	7.761	97.41
-32	87.43	87.21	87.21	7.799	98.07
-31	87.83	87.61	87.61	7.838	98.74



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RTD TEMPERATURE TABLES

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Doc. No.: TE-CO010109-TECH-320

TECHNICAL REFERENCE

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
-30	88.22	88.01	88.01	7.876	99.41
-29	88.62	88.42	88.41	7.915	100.08
-28	89.01	88.82	88.81	7.954	100.75
-27	89.40	89.22	89.21	7.992	101.42
-26	89.80	89.62	89.61	8.031	102.09
-25	90.19	90.02	90.02	8.070	102.77
-24	90.59	90.42	90.42	8.108	103.44
-23	90.98	90.82	90.82	8.147	104.12
-22	91.37	91.22	91.22	8.185	104.79
-21	91.77	91.62	91.62	8.224	105.47
-20	92.16	92.02	92.02	8.263	106.15
-19	92.55	92.42	92.42	8.301	106.83
-18	92.95	92.82	92.82	8.340	107.51
-17	93.34	93.22	93.22	8.378	108.19
-16	93.73	93.62	93.62	8.417	108.88
-15	94.12	94.02	94.02	8.456	109.56
-14	94.52	94.42	94.42	8.494	110.25
-13	94.91	94.82	94.82	8.533	110.93
-12	95.30	95.22	95.22	8.572	111.62
-11	95.69	95.62	95.62	8.610	112.31
-10	96.09	96.02	96.02	8.649	113.00
-9	96.48	96.42	96.41	8.687	113.70
-8	96.87	96.81	96.81	8.726	114.39
-7	97.26	97.21	97.21	8.765	115.09
-6	97.65	97.61	97.61	8.803	115.78
-5	98.04	98.01	98.01	8.842	116.48
-4	98.44	98.41	98.41	8.881	117.18
-3	98.83	98.81	98.81	8.919	117.88
-2	99.22	99.20	99.20	8.958	118.59
-1	99.61	99.60	99.60	8.996	119.29
0	100.00	100.00	100.00	9.035	120.00
1	100.39	100.40	100.40	9.074	120.71
2	100.78	100.80	100.80	9.112	121.42
3	101.17	101.19	101.19	9.151	122.13
4	101.56	101.59	101.59	9.189	122.85
5	101.95	101.99	101.99	9.228	123.56
6	102.34	102.38	102.39	9.267	124.28
7	102.73	102.78	102.78	9.305	125.00
8	103.12	103.18	103.18	9.344	125.72
9	103.51	103.57	103.58	9.383	126.44
10	103.90	103.97	103.97	9.421	127.17
11	104.29	104.37	104.37	9.460	127.89
12	104.68	104.76	104.77	9.498	128.62
13	105.07	105.16	105.16	9.537	129.35
14	105.46	105.56	105.56	9.576	130.09
15	105.85	105.95	105.95	9.614	130.82
16	106.24	106.35	106.35	9.653	131.56
17	106.63	106.74	106.75	9.692	132.29
18	107.02	107.14	107.14	9.730	133.03
19	107.40	107.53	107.54	9.769	133.77
20	107.79	107.93	107.93	9.807	134.52
21	108.18	108.32	108.33	9.846	135.26
22	108.57	108.72	108.72	9.885	136.01
23	108.96	109.11	109.12	9.923	136.76
24	109.35	109.51	109.52	9.962	137.51
25	109.73	109.90	109.91	10.000	138.26
26	110.12	110.30	110.30	10.039	139.02
27	110.51	110.69	110.70	10.078	139.78
28	110.90	111.09	111.09	10.116	140.54
29	111.29	111.48	111.49	10.155	141.30
30	111.67	111.88	111.88	10.194	142.06
31	112.06	112.27	112.28	10.232	142.82
32	112.45	112.66	112.67	10.271	143.59
33	112.83	113.06	113.07	10.309	144.36
34	113.22	113.45	113.46	10.348	145.13
35	113.61	113.84	113.85	10.387	145.90
36	114.00	114.24	114.25	10.425	146.68
37	114.38	114.63	114.64	10.464	147.46
38	114.77	115.02	115.03	10.502	148.24
39	115.15	115.42	115.43	10.541	149.02
40	115.54	115.81	115.82	10.580	149.80
41	115.93	116.20	116.21	10.618	150.59
42	116.31	116.59	116.61	10.657	151.37
43	116.70	116.99	117.00	10.696	152.16
44	117.08	117.38	117.39	10.734	152.95

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
45	117.47	117.77	117.79	10.773	153.75
46	117.86	118.16	118.18	10.811	154.54
47	118.24	118.56	118.57	10.850	155.34
48	118.63	118.95	118.96	10.889	156.14
49	119.01	119.34	119.35	10.927	156.94
50	119.40	119.73	119.75	10.966	157.75
51	119.78	120.12	120.14	11.005	158.55
52	120.17	120.51	120.53	11.043	159.36
53	120.55	120.91	120.92	11.082	160.17
54	120.94	121.30	121.31	11.120	160.98
55	121.32	121.69	121.71	11.159	161.80
56	121.71	122.08	122.10	11.198	162.61
57	122.09	122.47	122.49	11.236	163.43
58	122.47	122.86	122.88	11.275	164.25
59	122.86	123.25	123.27	11.313	165.07
60	123.24	123.64	123.66	11.352	165.90
61	123.63	124.03	124.05	11.391	166.73
62	124.01	124.42	124.44	11.429	167.56
63	124.39	124.81	124.83	11.468	168.39
64	124.78	125.20	125.22	11.507	169.22
65	125.16	125.59	125.61	11.545	170.06
66	125.54	125.98	126.00	11.584	170.90
67	125.93	126.37	126.39	11.622	171.74
68	126.31	126.76	126.78	11.661	172.58
69	126.69	127.15	127.17	11.700	173.42
70	127.08	127.54	127.56	11.738	174.27
71	127.46	127.93	127.95	11.777	175.12
72	127.84	128.32	128.34	11.816	175.97
73	128.22	128.71	128.73	11.854	176.82
74	128.61	129.09	129.12	11.893	177.68
75	128.99	129.48	129.51	11.931	178.53
76	129.37	129.87	129.90	11.970	179.39
77	129.75	130.26	130.29	12.009	180.25
78	130.13	130.65	130.68	12.047	181.12
79	130.52	131.04	131.07	12.086	181.98
80	130.90	131.42	131.45	12.124	182.85
81	131.28	131.81	131.84	12.163	183.72
82	131.66	132.20	132.23	12.202	184.59
83	132.04	132.59	132.62	12.240	185.46
84	132.42	132.98	133.01	12.279	186.34
85	132.80	133.36	133.39	12.318	187.22
86	133.18	133.75	133.78	12.356	188.10
87	133.57	134.14	134.17	12.395	188.98
88	133.95	134.52	134.56	12.433	189.87
89	134.33	134.91	134.95	12.472	190.75
90	134.71	135.30	135.33	12.511	191.64
91	135.09	135.68	135.72	12.549	192.53
92	135.47	136.07	136.11	12.588	193.42
93	135.85	136.46	136.49	12.627	194.32
94	136.23	136.84	136.88	12.665	195.21
95	136.61	137.23	137.27	12.704	196.11
96	136.99	137.62	137.65	12.742	197.01
97	137.37	138.00	138.04	12.781	197.92
98	137.75	138.39	138.43	12.820	198.82
99	138.13	138.77	138.81	12.858	199.73
100	138.51	139.16	139.20	12.897	200.64
101	138.88	139.55	139.59	12.935	201.55
102	139.26	139.93	139.97	12.974	202.47
103	139.64	140.32	140.36	13.013	203.38
104	140.02	140.70	140.74	13.051	204.30
105	140.40	141.09	141.13	13.090	205.22
106	140.78	141.47	141.51	13.129	206.14
107	141.16	141.86	141.90	13.167	207.07
108	141.54	142.24	142.29	13.206	207.99
109	141.91	142.63	142.67	13.244	208.92
110	142.29	143.01	143.06	13.283	209.85
111	142.67	143.39	143.44	13.322	210.79
112	143.05	143.78	143.83	13.360	211.72
113	143.43	144.16	144.21	13.399	212.66
114	143.80	144.55	144.59	13.437	213.60
115	144.18	144.93	144.98	13.476	214.54
116	144.56	145.31	145.36	13.515	215.49
117	144.94	145.70	145.75	13.553	216.43
118	145.31	146.08	146.13	13.592	217.38
119	145.69	146.46	146.52	13.631	218.34



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TECHNICAL REFERENCE

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
120	146.07	146.85	146.90	13.669	219.29
121	146.44	147.23	147.28	13.708	220.25
122	146.82	147.61	147.67	13.746	221.20
123	147.20	148.00	148.05	13.785	222.16
124	147.57	148.38	148.43	13.824	223.13
125	147.95	148.76	148.82	13.862	224.09
126	148.33	149.15	149.20	13.901	225.06
127	148.70	149.53	149.58	13.940	226.03
128	149.08	149.91	149.97	13.978	227.00
129	149.46	150.29	150.35	14.017	227.97
130	149.83	150.67	150.73	14.055	228.95
131	150.21	151.06	151.11	14.094	229.93
132	150.58	151.44	151.50	14.133	230.91
133	150.96	151.82	151.88	14.171	231.89
134	151.33	152.20	152.26	14.210	232.88
135	151.71	152.58	152.64	14.248	233.86
136	152.08	152.96	153.02	14.287	234.85
137	152.46	153.35	153.41	14.326	235.85
138	152.83	153.73	153.79	14.364	236.84
139	153.21	154.11	154.17	14.403	237.84
140	153.58	154.49	154.55	14.442	238.84
141	153.96	154.87	154.93	14.480	239.84
142	154.33	155.25	155.31	14.519	240.84
143	154.71	155.63	155.70	14.557	241.85
144	155.08	156.01	156.08	14.596	242.85
145	155.46	156.39	156.46	14.635	243.86
146	155.83	156.77	156.84	14.673	244.88
147	156.20	157.15	157.22	14.712	245.89
148	156.58	157.53	157.60	14.751	246.91
149	156.95	157.91	157.98	14.789	247.93
150	157.33	158.29	158.36	14.828	248.95
151	157.70	158.67	158.74	14.867	249.97
152	158.07	159.05	159.12	14.906	251.00
153	158.45	159.43	159.50	14.945	252.03
154	158.82	159.81	159.88	14.984	253.06
155	159.19	160.19	160.26	15.022	254.09
156	159.56	160.57	160.64	15.061	255.13
157	159.94	160.95	161.02	15.100	256.17
158	160.31	161.33	161.40	15.139	257.21
159	160.68	161.70	161.78	15.178	258.25
160	161.05	162.08	162.16	15.217	259.30
161	161.43	162.46	162.54	15.256	260.34
162	161.80	162.84	162.91	15.295	261.39
163	162.17	163.22	163.29	15.334	262.45
164	162.54	163.60	163.67	15.373	263.50
165	162.91	163.97	164.05	15.412	264.56
166	163.29	164.35	164.43	15.451	265.62
167	163.66	164.73	164.81	15.490	266.69
168	164.03	165.11	165.19	15.529	267.75
169	164.40	165.48	165.56	15.568	268.82
170	164.77	165.86	165.94	15.607	269.89
171	165.14	166.24	166.32	15.646	270.97
172	165.51	166.62	166.70	15.685	272.05
173	165.89	166.99	167.07	15.724	273.13
174	166.26	167.37	167.45	15.763	274.21
175	166.63	167.75	167.83	15.802	275.30
176	167.00	168.12	168.21	15.840	276.38
177	167.37	168.50	168.58	15.879	277.48
178	167.74	168.88	168.96	15.918	278.57
179	168.11	169.25	169.34	15.957	279.67
180	168.48	169.63	169.71	15.996	280.77
181	168.85	170.00	170.09	16.035	281.87
182	169.22	170.38	170.47	16.074	282.98
183	169.59	170.76	170.84	16.113	284.09
184	169.96	171.13	171.22	16.152	285.20
185	170.33	171.51	171.60	16.191	286.32
186	170.70	171.88	171.97	16.230	287.44
187	171.07	172.26	172.35	16.269	288.56
188	171.43	172.63	172.73	16.308	289.69
189	171.80	173.01	173.10	16.347	290.82
190	172.17	173.38	173.48	16.386	291.95
191	172.54	173.76	173.85	16.425	293.08
192	172.91	174.13	174.23	16.464	294.22
193	173.28	174.51	174.60	16.503	295.37
194	173.65	174.88	174.98	16.542	296.51

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
195	174.02	175.26	175.35	16.581	297.66
196	174.38	175.63	175.73	16.620	298.81
197	174.75	176.01	176.10	16.659	299.97
198	175.12	176.38	176.48	16.698	301.13
199	175.49	176.75	176.85	16.737	302.29
200	175.86	177.13	177.23	16.776	303.45
201	176.22	177.50	177.60	16.815	304.62
202	176.59	177.88	177.97	16.854	305.80
203	176.96	178.25	178.35	16.893	306.97
204	177.33	178.62	178.72	16.932	308.15
205	177.69	179.00	179.10	16.971	309.34
206	178.06	179.37	179.47	17.010	310.52
207	178.43	179.74	179.84	17.049	311.72
208	178.79	180.12	180.22	17.088	312.91
209	179.16	180.49	180.59	17.127	314.11
210	179.53	180.86	180.96	17.166	315.31
211	179.89	181.23	181.34	17.205	316.52
212	180.26	181.61	181.71	17.244	317.73
213	180.63	181.98	182.08	17.283	318.94
214	180.99	182.35	182.46	17.322	320.16
215	181.36	182.72	182.83	17.360	321.28
216	181.72	183.09	183.20	17.399	322.60
217	182.09	183.47	183.57	17.438	323.83
218	182.46	183.84	183.95	17.477	325.06
219	182.82	184.21	184.32	17.516	326.30
220	183.19	184.58	184.69	17.555	327.54
221	183.55	184.95	185.06	17.594	328.78
222	183.92	185.32	185.43	17.633	330.03
223	184.28	185.70	185.81	17.672	331.28
224	184.65	186.07	186.18	17.711	332.53
225	185.01	186.44	186.55	17.750	333.79
226	185.38	186.81	186.92	17.789	335.05
227	185.74	187.18	187.29	17.828	336.32
228	186.11	187.55	187.66	17.867	337.59
229	186.47	187.92	188.03	17.906	338.87
230	186.84	188.29	188.41	17.945	340.14
231	187.20	188.66	188.78	17.984	341.43
232	187.56	189.03	189.15	18.023	342.71
233	187.93	189.40	189.52	18.062	344.00
234	188.29	189.77	189.89	18.101	345.29
235	188.66	190.14	190.26	18.140	346.59
236	189.02	190.51	190.63	18.179	347.89
237	189.38	190.88	191.00	18.218	349.20
238	189.75	191.25	191.37	18.257	350.51
239	190.11	191.62	191.74	18.296	351.82
240	190.47	191.99	192.11	18.335	353.14
241	190.84	192.36	192.48	18.374	354.46
242	191.20	192.73	192.85	18.413	355.79
243	191.56	193.09	193.22	18.452	357.12
244	191.92	193.46	193.59	18.491	358.45
245	192.29	193.83	193.96	18.530	359.79
246	192.65	194.20	194.32	18.569	361.13
247	193.01	194.57	194.69	18.609	362.47
248	193.37	194.94	195.06	18.648	363.82
249	193.74	195.31	195.43	18.687	365.17
250	194.10	195.67	195.80	18.726	366.53
251	194.46	196.04	196.17	18.765	367.89
252	194.82	196.41	196.54	18.804	369.26
253	195.18	196.78	196.90	18.843	370.62
254	195.55	197.14	197.27	18.882	372.00
255	195.91	197.51	197.64	18.921	373.37
256	196.27	197.88	198.01	18.960	374.75
257	196.63	198.25	198.38	18.999	376.14
258	196.99	198.61	198.74	19.038	377.52
259	197.35	198.98	199.11	19.077	378.91
260	197.71	199.35	199.48	19.116	380.31
261	198.07	199.71	199.85		
262	198.43	200.08	200.21		
263	198.79	200.45	200.58		
264	199.15	200.81	200.95		
265	199.51	201.18	201.31		
266	199.87	201.55	201.68		
267	200.23	201.91	202.05		
268	200.59	202.28	202.41		
269	200.95	202.64	202.78		



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Doc. No.: TE-CO010109-TECH-340

TECHNICAL REFERENCE

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
270	201.31	203.01	203.15		
271	201.67	203.38	203.51		
272	202.03	203.74	203.88		
273	202.39	204.11	204.24		
274	202.75	204.47	204.61		
275	203.11	204.84	204.98		
276	203.47	205.20	205.34		
277	203.83	205.57	205.71		
278	204.19	205.93	206.07		
279	204.55	206.30	206.44		
280	204.90	206.66	206.80		
281	205.26	207.02	207.17		
282	205.62	207.39	207.53		
283	205.98	207.75	207.90		
284	206.34	208.12	208.26		
285	206.70	208.48	208.63		
286	207.05	208.85	208.99		
287	207.41	209.21	209.35		
288	207.77	209.57	209.72		
289	208.13	209.94	210.08		
290	208.48	210.30	210.45		
291	208.84	210.66	210.81		
292	209.20	211.03	211.17		
293	209.56	211.39	211.54		
294	209.91	211.75	211.90		
295	210.27	212.11	212.26		
296	210.63	212.48	212.63		
297	210.98	212.84	212.99		
298	211.34	213.20	213.35		
299	211.70	213.56	213.72		
300	212.05	213.93	214.08		
301	212.41	214.29	214.44		
302	212.76	214.65	214.80		
303	213.12	215.01	215.17		
304	213.48	215.37	215.53		
305	213.83	215.74	215.89		
306	214.19	216.10	216.25		
307	214.54	216.46	216.61		
308	214.90	216.82	216.98		
309	215.25	217.18	217.34		
310	215.61	217.54	217.70		
311	215.96	217.90	218.06		
312	216.32	218.26	218.42		
313	216.67	218.63	218.78		
314	217.03	218.99	219.14		
315	217.38	219.35	219.51		
316	217.74	219.71	219.87		
317	218.09	220.07	220.23		
318	218.44	220.43	220.59		
319	218.80	220.79	220.95		
320	219.15	221.15	221.31		
321	219.51	221.51	221.67		
322	219.86	221.87	222.03		
323	220.21	222.23	222.39		
324	220.57	222.59	222.75		
325	220.92	222.94	223.11		
326	221.27	223.30	223.47		
327	221.63	223.66	223.83		
328	221.98	224.02	224.19		
329	222.33	224.38	224.55		
330	222.68	224.74	224.91		
331	223.04	225.10	225.26		
332	223.39	225.46	225.62		
333	223.74	225.81	225.98		
334	224.09	226.17	226.34		
335	224.45	226.53	226.70		
336	224.80	226.89	227.06		
337	225.15	227.25	227.42		
338	225.50	227.61	227.78		
339	225.85	227.96	228.13		
340	226.21	228.32	228.49		
341	226.56	228.68	228.85		
342	226.91	229.04	229.21		
343	227.26	229.39	229.56		
344	227.61	229.75	229.92		

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
345	227.96	230.11	230.28		
346	228.31	230.46	230.64		
347	228.66	230.82	230.99		
348	229.02	231.18	231.35		
349	229.37	231.53	231.71		
350	229.72	231.89	232.07		
351	230.07	232.25	232.42		
352	230.42	232.60	232.78		
353	230.77	232.96	233.13		
354	231.12	233.31	233.49		
355	231.47	233.67	233.85		
356	231.82	234.03	234.20		
357	232.17	234.38	234.56		
358	232.52	234.74	234.92		
359	232.87	235.09	235.27		
360	233.21	235.45	235.63		
361	233.56	235.80	235.98		
362	233.91	236.16	236.34		
363	234.26	236.51	236.69		
364	234.61	236.87	237.05		
365	234.96	237.22	237.40		
366	235.31	237.58	237.76		
367	235.66	237.93	238.11		
368	236.00	238.28	238.47		
369	236.35	238.64	238.82		
370	236.70	238.99	239.18		
371	237.05	239.35	239.53		
372	237.40	239.70	239.89		
373	237.74	240.05	240.24		
374	238.09	240.41	240.59		
375	238.44	240.76	240.95		
376	238.79	241.11	241.30		
377	239.13	241.47	241.66		
378	239.48	241.82	242.01		
379	239.83	242.17	242.36		
380	240.18	242.53	242.72		
381	240.52	242.88	243.07		
382	240.87	243.23	243.42		
383	241.22	243.58	243.78		
384	241.56	243.94	244.13		
385	241.91	244.29	244.48		
386	242.26	244.64	244.83		
387	242.60	244.99	245.19		
388	242.95	245.35	245.54		
389	243.29	245.70	245.89		
390	243.64	246.05	246.24		
391	243.99	246.40	246.59		
392	244.33	246.75	246.95		
393	244.68	247.10	247.30		
394	245.02	247.46	247.65		
395	245.37	247.81	248.00		
396	245.71	248.16	248.35		
397	246.06	248.51	248.70		
398	246.40	248.86	249.06		
399	246.75	249.21	249.41		
400	247.09	249.56	249.76		
401	247.44	249.91	250.11		
402	247.78	250.26	250.46		
403	248.13	250.61	250.81		
404	248.47	250.96	251.16		
405	248.81	251.31	251.51		
406	249.16	251.66	251.86		
407	249.50	252.01	252.21		
408	249.85	252.36	252.56		
409	250.19	252.71	252.91		
410	250.53	253.06	253.26		
411	250.88	253.41	253.61		
412	251.22	253.76	253.96		
413	251.56	254.11	254.31		
414	251.91	254.46	254.66		
415	252.25	254.80	255.01		
416	252.59	255.15	255.36		
417	252.93	255.50	255.71		
418	253.28	255.85	256.06		
419	253.62	256.20	256.40		



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Doc. No.: TE-CO010109-TECH-350

TECHNICAL REFERENCE

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
420	253.96	256.55	256.75		
421	254.30	256.89	257.10		
422	254.65	257.24	257.45		
423	254.99	257.59	257.80		
424	255.33	257.94	258.15		
425	255.67	258.29	258.49		
426	256.01	258.63	258.84		
427	256.35	258.98	259.19		
428	256.70	259.33	259.54		
429	257.04	259.67	259.89		
430	257.38	260.02	260.23		
431	257.72	260.37	260.58		
432	258.06	260.72	260.93		
433	258.40	261.06	261.27		
434	258.74	261.41	261.62		
435	259.08	261.75	261.97		
436	259.42	262.10	262.31		
437	259.76	262.45	262.66		
438	260.10	262.79	263.01		
439	260.44	263.14	263.35		
440	260.78	263.49	263.70		
441	261.12	263.83	264.05		
442	261.46	264.18	264.39		
443	261.80	264.52	264.74		
444	262.14	264.87	265.08		
445	262.48	265.21	265.43		
446	262.82	265.56	265.78		
447	263.16	265.90	266.12		
448	263.50	266.25	266.47		
449	263.84	266.59	266.81		
450	264.18	266.94	267.16		
451	264.52	267.28	267.50		
452	264.86	267.63	267.85		
453	265.20	267.97	268.19		
454	265.53	268.31	268.54		
455	265.87	268.66	268.88		
456	266.21	269.00	269.23		
457	266.55	269.35	269.57		
458	266.89	269.69	269.91		
459	267.22	270.03	270.26		
460	267.56	270.38	270.60		
461	267.90	270.72	270.95		
462	268.24	271.06	271.29		
463	268.57	271.41	271.63		
464	268.91	271.75	271.98		
465	269.25	272.09	272.32		
466	269.59	272.44	272.66		
467	269.92	272.78	273.01		
468	270.26	273.12	273.35		
469	270.60	273.46	273.69		
470	270.93	273.80	274.03		
471	271.27	274.15	274.38		
472	271.61	274.49	274.72		
473	271.94	274.83	275.06		
474	272.28	275.17	275.40		
475	272.61	275.51	275.75		
476	272.95	275.86	276.09		
477	273.29	276.20	276.43		
478	273.62	276.54	276.77		
479	273.96	276.88	277.11		
480	274.29	277.22	277.46		
481	274.63	277.56	277.80		
482	274.96	277.90	278.14		
483	275.30	278.24	278.48		
484	275.63	278.58	278.82		
485	275.97	278.92	279.16		
486	276.30	279.26	279.50		
487	276.64	279.61	279.84		
488	276.97	279.95	280.18		
489	277.31	280.29	280.52		
490	277.64	280.63	280.87		
491	277.98	280.96	281.21		
492	278.31	281.30	281.55		
493	278.64	281.64	281.89		
494	278.98	281.98	282.23		

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
495	279.31	282.32	282.57		
496	279.64	282.66	282.91		
497	279.98	283.00	283.24		
498	280.31	283.34	283.58		
499	280.64	283.68	283.92		
500	280.98	284.02	284.26		
501	281.31	284.36	284.60		
502	281.64	284.69	284.94		
503	281.98	285.03	285.28		
504	282.31	285.37	285.62		
505	282.64	285.71	285.96		
506	282.97	286.05	286.30		
507	283.31	286.39	286.63		
508	283.64	286.72	286.97		
509	283.97	287.06	287.31		
510	284.30	287.40	287.65		
511	284.63	287.74	287.99		
512	284.97	288.07	288.32		
513	285.30	288.41	288.66		
514	285.63	288.75	289.00		
515	285.96	289.08	289.34		
516	286.29	289.42	289.67		
517	286.62	289.76	290.01		
518	286.95	290.09	290.35		
519	287.29	290.43	290.69		
520	287.62	290.77	291.02		
521	287.95	291.10	291.36		
522	288.28	291.44	291.70		
523	288.61	291.77	292.03		
524	288.94	292.11	292.37		
525	289.27	292.45	292.71		
526	289.60	292.78	293.04		
527	289.93	293.12	293.38		
528	290.26	293.45	293.71		
529	290.59	293.79	294.05		
530	290.92	294.12	294.39		
531	291.25	294.46	294.72		
532	291.58	294.79	295.06		
533	291.91	295.13	295.39		
534	292.24	295.46	295.73		
535	292.56	295.80	296.06		
536	292.89	296.13	296.40		
537	293.22	296.46	296.73		
538	293.55	296.80	297.07		
539	293.88	297.13	297.40		
540	294.21	297.47	297.74		
541	294.54	297.80	298.07		
542	294.86	298.13	298.41		
543	295.19	298.47	298.74		
544	295.52	298.80	299.07		
545	295.85	299.13	299.41		
546	296.18	299.47	299.74		
547	296.50	299.80	300.07		
548	296.83	300.13	300.41		
549	297.16	300.47	300.74		
550	297.49	300.80	301.08		
551	297.81	301.13	301.41		
552	298.14	301.46	301.74		
553	298.47	301.80	302.07		
554	298.80	302.13	302.41		
555	299.12	302.46	302.74		
556	299.45	302.79	303.07		
557	299.78	303.12	303.41		
558	300.10	303.46	303.74		
559	300.43	303.79	304.07		
560	300.75	304.12	304.40		
561	301.08	304.45	304.73		
562	301.41	304.78	305.07		
563	301.73	305.11	305.40		
564	302.06	305.44	305.73		
565	302.38	305.77	306.06		
566	302.71	306.11	306.39		
567	303.03	306.44	306.72		
568	303.36	306.77	307.06		
569	303.69	307.10	307.39		



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Doc. No.: TE-CO010109-TECH-360

TECHNICAL REFERENCE

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
570	304.01	307.43	307.72		
571	304.34	307.76	308.05		
572	304.66	308.09	308.38		
573	304.98	308.42	308.71		
574	305.31	308.75	309.04		
575	305.63	309.08	309.37		
576	305.96	309.41	309.70		
577	306.28	309.74	310.03		
578	306.61	310.06	310.36		
579	306.93	310.39	310.69		
580	307.25	310.72	311.02		
581	307.58	311.05	311.35		
582	307.90	311.38	311.68		
583	308.23	311.71	312.01		
584	308.55	312.04	312.34		
585	308.87	312.37	312.67		
586	309.20	312.69	313.00		
587	309.52	313.02	313.33		
588	309.84	313.35	313.66		
589	310.16	313.68	313.99		
590	310.49	314.01	314.31		
591	310.81	314.33	314.64		
592	311.13	314.66	314.97		
593	311.45	314.99	315.30		
594	311.78	315.32	315.63		
595	312.10	315.64	315.96		
596	312.42	315.97	316.28		
597	312.74	316.30	316.61		
598	313.06	316.62	316.94		
599	313.39	316.95	317.27		
600	313.71	317.28	317.59		
601	314.03	317.60	317.92		
602	314.35	317.93	318.25		
603	314.67	318.26	318.58		
604	314.99	318.58	318.90		
605	315.31	318.91	319.23		
606	315.64	319.23	319.56		
607	315.96	319.56	319.88		
608	316.28	319.89	320.21		
609	316.60	320.21	320.54		
610	316.92	320.54	320.86		

Temperature (°C)	Platinum 100 OHMs 0.00385TRC	Platinum 100 OHMs 0.003916TRC	Platinum 95.129 OHMs 0.003923TRC	Copper 10 OHMs 0.00427TRC	Nickel 120 OHMs 0.00672TRC
611	317.24	320.86	321.19		
612	317.56	321.19	321.52		
613	317.88	321.51	321.84		
614	318.20	321.84	322.17		
615	318.52	322.16	322.49		
616	318.84	322.49	322.82		
617	319.16	322.81	323.14		
618	319.48	323.13	323.47		
619	319.80	323.46	323.79		
620	320.12	323.78	324.12		
621	320.43	324.11	324.44		
622	320.75	324.43	324.77		
623	321.07	324.75	325.09		
624	321.39	325.08	325.42		
625	321.71	325.40	325.74		
626	322.03	325.72	326.07		
627	322.35	326.05	326.39		
628	322.67	326.37	326.72		
629	322.98	326.69	327.04		
630	323.30		327.36		
631	323.62		327.69		
632	323.94		328.01		
633	324.26		328.34		
634	324.57		328.66		
635	324.89		328.98		
636	325.21		329.31		
637	325.53		329.63		
638	325.84		329.95		
639	326.16		330.28		
640	326.48		330.60		
641	326.79		330.92		
642	327.11		331.24		
643	327.43		331.57		
644	327.74		331.89		
645	328.06		332.21		
646	328.38		332.53		
647	328.69		332.85		
648	329.01		333.18		
649	329.32		333.50		
650	329.64		333.82		

ELEMENT MATERIAL	NOMINAL RESISTANCE	TEMPERATURE COEFFICIENT OHMS/OHM/° C	RELATED STANDARDS
PLATINUM	50 Ohms @ 0° C	0.003916	JIS C1604-1997, US STANDARD*
PLATINUM	98.129 Ohms @ 0° C	0.003923	SAMA RC21-4-1966
PLATINUM	100 Ohms @ 0° C	0.00385	ASTM-1137, IEC-60751, DIN 43760, ITS-90 BS EN 60751:1998(Replaces BS 1904:1984)
PLATINUM	100 Ohms @ 0° C	0.003916	JIS C1604-1997, US STANDARD*
PLATINUM	100 Ohms @ 0° C	0.003902	US STANDARD*
PLATINUM	130 Ohms @ 0° C	0.003900	BS 2G 148 (British Aircraft Industry)
PLATINUM	200 Ohms @ 0° C	0.00385	DIN 43760
PLATINUM	500 Ohms @ 0° C	0.00385	DIN 43760
PLATINUM	1000 Ohms @ 0° C	0.00385	DIN 43760
NICKEL	100 Ohms @ 0° C	0.00617	DIN 43760
NICKEL	120 Ohms @ 0° C	0.00672	Edison No. 7
NICKEL/IRON	604 Ohms @ 0° C	0.00518	N/A
COPPER	10 Ohms @ 25° C	0.00427	Edison No. 15

*No document exists for US Standard.



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SECTION TECH

RTD TEMPERATURE TABLES

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Doc. No.: TE-CO010109-TECH-370

TECHNICAL REFERENCE

Temperature Conversion Table

$$^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32)$$

$$^{\circ}\text{F} = 9/5 (^{\circ}\text{C} + 32)$$

$$\text{Kelvin} = ^{\circ}\text{C} + 273.15$$

$$^{\circ}\text{Rankine} = ^{\circ}\text{F} + 459.67$$

$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$
-292	-180.00	-256.0	-160	-106.67	-18.4	-28	-33.33	219.2	104	40.00	456.8	236	113.33	694.4	368	186.67	
-290	-178.89	-252.4	-158	-105.56	-14.8	-26	-32.22	222.8	106	41.11	460.4	238	114.44	698.0	370	187.78	
-288	-177.78	-248.8	-156	-104.44	-11.2	-24	-31.11	226.4	108	42.22	464.0	240	115.56	701.6	372	188.89	
-286	-176.67	-245.2	-154	-103.33	-7.6	-22	-30.00	230.0	110	43.33	467.6	242	116.67	705.2	374	190.00	
-284	-175.56	-241.6	-152	-102.22	-4.0	-20	-28.89	233.6	112	44.44	471.2	244	117.78	708.8	376	191.11	
-282	-174.44	-238.0	-150	-101.11	-0.4	-18	-27.78	237.2	114	45.56	474.8	246	118.89	712.4	378	192.22	
-280	-173.33	-234.4	-148	-100.00	3.2	-16	-26.67	240.8	116	46.67	478.4	248	120.00	716.0	380	193.33	
-278	-172.22	-230.8	-146	-98.89	6.8	-14	-25.56	244.4	118	47.78	482.0	250	121.11	719.6	382	194.44	
-276	-171.11	-227.2	-144	-97.78	10.4	-12	-24.44	248.0	120	48.89	485.6	252	122.22	723.2	384	195.56	
-274	-170.00	-223.6	-142	-96.67	14.0	-10	-23.33	251.6	122	50.00	489.2	254	123.33	726.8	386	196.67	
-457.6	-168.89	-220.0	-140	-95.56	17.6	-8	-22.22	255.2	124	51.11	492.8	256	124.44	730.4	388	197.78	
-454.0	-167.78	-216.4	-138	-94.44	21.2	-6	-21.11	258.8	126	52.22	496.4	258	125.56	734.0	390	198.89	
-450.4	-166.67	-212.8	-136	-93.33	24.8	-4	-20.00	262.4	128	53.33	500.0	260	126.67	737.6	392	200.00	
-446.8	-165.56	-209.2	-134	-92.22	28.4	-2	-18.89	266.0	130	54.44	503.6	262	127.78	741.2	394	201.11	
-443.2	-164.44	-205.6	-132	-91.11	32.0	0	-17.78	269.6	132	55.56	507.2	264	128.89	744.8	396	202.22	
-439.6	-163.33	-202.0	-130	-90.00	35.6	2	-16.67	273.2	134	56.67	510.8	266	130.00	748.4	398	203.33	
-436.0	-162.22	-198.4	-128	-88.89	39.2	4	-15.56	276.8	136	57.78	514.4	268	131.11	752.0	400	204.44	
-432.4	-161.11	-194.8	-126	-87.78	42.8	6	-14.44	280.4	138	58.89	518.0	270	132.22	755.6	402	205.56	
-428.8	-160.00	-191.2	-124	-86.67	46.4	8	-13.33	284.0	140	60.00	521.6	272	133.33	759.2	404	206.67	
-425.2	-158.89	-187.6	-122	-85.56	50.0	10	-12.22	287.6	142	61.11	525.2	274	134.44	762.8	406	207.78	
-421.6	-157.78	-184.0	-120	-84.44	53.6	12	-11.11	291.2	144	62.22	528.8	276	135.56	766.4	408	208.89	
-418.0	-156.67	-180.4	-118	-83.33	57.2	14	-10.00	294.8	146	63.33	532.4	278	136.67	770.0	410	210.00	
-414.4	-155.56	-176.8	-116	-82.22	60.8	16	-8.89	298.4	148	64.44	536.0	280	137.78	773.6	412	211.11	
-410.8	-154.44	-173.2	-114	-81.11	64.4	18	-7.78	302.0	150	65.56	539.6	282	138.89	777.2	414	212.22	
-407.2	-153.33	-169.6	-112	-80.00	68.0	20	-6.67	305.6	152	66.67	543.2	284	140.00	780.8	416	213.33	
-403.6	-152.22	-166.0	-110	-78.89	71.6	22	-5.56	309.2	154	67.78	546.8	286	141.11	784.4	418	214.44	
-400.0	-151.11	-162.4	-108	-77.78	75.2	24	-4.44	312.8	156	68.89	550.4	288	142.22	788.0	420	215.56	
-396.4	-150.00	-158.8	-106	-76.67	78.8	26	-3.33	316.4	158	70.00	554.0	290	143.33	791.6	422	216.67	
-392.8	-148.89	-155.2	-104	-75.56	82.4	28	-2.22	320.0	160	71.11	557.6	292	144.44	795.2	424	217.78	
-389.2	-147.78	-151.6	-102	-74.44	86.0	30	-1.11	323.6	162	72.22	561.2	294	145.56	798.8	426	218.89	
-385.6	-146.67	-148.0	-100	-73.33	89.6	32	0.00	327.2	164	73.33	564.8	296	146.67	802.4	428	220.00	
-382.0	-145.56	-144.4	-98	-72.22	93.2	34	1.11	330.8	166	74.44	568.4	298	147.78	806.0	430	221.11	
-378.4	-144.44	-140.8	-96	-71.11	96.8	36	2.22	334.4	168	75.56	572.0	300	148.89	809.6	432	222.22	
-374.8	-143.33	-137.2	-94	-70.00	100.4	38	3.33	338.0	170	76.67	575.6	302	150.00	813.2	434	223.33	
-371.2	-142.22	-133.6	-92	-68.89	104.0	40	4.44	341.6	172	77.78	579.2	304	151.11	816.8	436	224.44	
-367.6	-141.11	-130.0	-90	-67.78	107.6	42	5.56	345.2	174	78.89	582.8	306	152.22	820.4	438	225.56	
-364.0	-140.00	-126.4	-88	-66.67	111.2	44	6.67	348.8	176	80.00	586.4	308	153.33	824.0	440	226.67	
-360.4	-138.89	-122.8	-86	-65.56	114.8	46	7.78	352.4	178	81.11	590.0	310	154.44	827.6	442	227.78	
-356.8	-137.78	-119.2	-84	-64.44	118.4	48	8.89	356.0	180	82.22	593.6	312	155.56	831.2	444	228.89	
-353.2	-136.67	-115.6	-82	-63.33	122.0	50	10.00	359.6	182	83.33	597.2	314	156.67	834.8	446	230.00	
-349.6	-135.56	-112.0	-80	-62.22	125.6	52	11.11	363.2	184	84.44	600.8	316	157.78	838.4	448	231.11	
-346.0	-134.44	-108.4	-78	-61.11	129.2	54	12.22	366.8	186	85.56	604.4	318	158.89	842.0	450	232.22	
-342.4	-133.33	-104.8	-76	-60.00	132.8	56	13.33	370.4	188	86.67	608.0	320	160.00	845.6	452	233.33	
-338.8	-132.22	-101.2	-74	-58.89	136.4	58	14.44	374.0	190	87.78	611.6	322	161.11	849.2	454	234.44	
-335.2	-131.11	-97.6	-72	-57.78	140.0	60	15.56	377.6	192	88.89	615.2	324	162.22	852.8	456	235.56	
-331.6	-130.00	-94.0	-70	-56.67	143.6	62	16.67	381.2	194	90.00	618.8	326	163.33	856.4	458	236.67	
-328.0	-128.89	-90.4	-68	-55.56	147.2	64	17.78	384.8	196	91.11	622.4	328	164.44	860.0	460	237.78	
-324.4	-127.78	-86.8	-66	-54.44	150.8	66	18.89	388.4	198	92.22	626.0	330	165.56	863.6	462	238.89	
-320.8	-126.67	-83.2	-64	-53.33	154.4	68	20.00	392.0	200	93.33	629.6	332	166.67	867.2	464	240.00	
-317.2	-125.56	-79.6	-62	-52.22	158.0	70	21.11	395.6	202	94.44	633.2	334	167.78	870.8	466	241.11	
-313.6	-124.44	-76.0	-60	-51.11	161.6	72	22.22	399.2	204	95.56	636.8	336	168.89	874.4	468	242.22	
-310.0	-123.33	-72.4	-58	-50.00	165.2	74	23.33	402.8	206	96.67	640.4	338	170.00	878.0	470	243.33	
-306.4	-122.22	-68.8	-56	-48.89	168.8	76	24.44	406.4	208	97.78	644.0	340	171.11	881.6	472	244.44	
-302.8	-121.11	-65.2	-54	-47.78	172.4	78	25.56	410.0	210	98.89	647.6	342	172.22	885.2	474	245.56	
-299.2	-120.00	-61.6	-52	-46.67	176.0	80	26.67	413.6	212	100.00	651.2	344	173.33	888.8	476	246.67	
-295.6	-118.89	-58.0	-50	-45.56	179.6	82	27.78	417.2	214	101.11	654.8	346	174.44	892.4	478	247.78	
-292.0	-117.78	-54.4	-48	-44.44	183.2	84	28.89	420.8	216	102.22	658.4	348	175.56	896.0	480	248.89	
-288.4	-116.67	-50.8	-46	-43.33	186.8	86	30.00	424.4	218	103.33	662.0	350	176.67	899.6	482	250.00	
-284.8	-115.56	-47.2	-44	-42.22	190.4	88	31.11	428.0	220	104.44	665.6	352	177.78	903.2	484	251.11	
-281.2	-114.44	-43.6	-42	-41.11	194.0	90	32.22	431.6	222	105.56	669.2	354	178.89	906.8	486	252.22	
-277.6	-113.33	-40.0	-40	-40.00	197.6	92	33.33	435.2	224	106.67	672.8	356	180.00	910.4	488	253.33	
-274.0	-112.22	-36.4	-38	-38.89	201.2	94	34.44	438.8	226	107.78	676.4	358	181.11	914.0	490	254.44	
-270.4	-111.11	-32.8	-36	-37.78	204.8	96	35.56	442.4	228	108.89	680.0	360	182.22	917.6	492	255.56	
-266.8	-110.00	-29.2	-34	-36.67	208.4	98	36.67	446.0	230	110.00	683.6	362	183.33	921.2	494	256.67	
-263.2	-108.89	-25.6	-32	-35.56	212.0	100	37.78	449.6	232	111.11	687.2	364	184.44	924.8	496	257.78	
-259.6	-107.78	-22.0	-30	-34.44	215.6	102	38.89	453.2	234	112.22	690.8	366	185.56	928.4	498	258.89	



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SECTION TECH

TEMPERATURE CONVERSION TABLE

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Doc. No.: TE-CO010109-TECH-380

TECHNICAL REFERENCE

Temperature Conversion Table

$$^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32)$$

$$^{\circ}\text{F} = 9/5 (^{\circ}\text{C} + 32)$$

$$\text{Kelvin} = ^{\circ}\text{C} + 273.15$$

$$^{\circ}\text{Rankine} = ^{\circ}\text{F} + 459.67$$

		°C	°F		°C	°F		°C	°F		°C	°F		°C	°F		°C
932.0	500	260.00	1742.0	950	510.00	2912.0	1600	871.11	4082.0	2250	1232.22	5252.0	2900	1593.33	6422.0	3550	1954.44
935.6	502	261.11	1760.0	960	515.56	2930.0	1610	876.67	4100.0	2260	1237.78	5270.0	2910	1598.89	6440.0	3560	1960.00
939.2	504	262.22	1778.0	970	521.11	2948.0	1620	882.22	4118.0	2270	1243.33	5288.0	2920	1604.44	6458.0	3570	1965.56
942.8	506	263.33	1796.0	980	526.67	2966.0	1630	887.78	4136.0	2280	1248.89	5306.0	2930	1610.00	6476.0	3580	1971.11
946.4	508	264.44	1814.0	990	532.22	2984.0	1640	893.33	4154.0	2290	1254.44	5324.0	2940	1615.56	6494.0	3590	1976.67
950.0	510	265.56	1832.0	1000	537.78	3002.0	1650	898.89	4172.0	2300	1260.00	5342.0	2950	1621.11	6512.0	3600	1982.22
953.6	512	266.67	1850.0	1010	543.33	3020.0	1660	904.44	4190.0	2310	1265.56	5360.0	2960	1626.67	6530.0	3610	1987.78
957.2	514	267.78	1868.0	1020	548.89	3038.0	1670	910.00	4208.0	2320	1271.11	5378.0	2970	1632.22	6548.0	3620	1993.33
960.8	516	268.89	1886.0	1030	554.44	3056.0	1680	915.56	4226.0	2330	1276.67	5396.0	2980	1637.78	6566.0	3630	1998.89
964.4	518	270.00	1904.0	1040	560.00	3074.0	1690	921.11	4244.0	2340	1282.22	5414.0	2990	1643.33	6584.0	3640	2004.44
968.0	520	271.11	1922.0	1050	565.56	3092.0	1700	926.67	4262.0	2350	1287.78	5432.0	3000	1648.89	6602.0	3650	2010.00
971.6	522	272.22	1940.0	1060	571.11	3110.0	1710	932.22	4280.0	2360	1293.33	5450.0	3010	1654.44	6620.0	3660	2015.56
975.2	524	273.33	1958.0	1070	576.67	3128.0	1720	937.78	4298.0	2370	1298.89	5468.0	3020	1660.00	6638.0	3670	2021.11
978.8	526	274.44	1976.0	1080	582.22	3146.0	1730	943.33	4316.0	2380	1304.44	5486.0	3030	1665.56	6656.0	3680	2026.67
982.4	528	275.56	1994.0	1090	587.78	3164.0	1740	948.89	4334.0	2390	1310.00	5504.0	3040	1671.11	6674.0	3690	2032.22
986.0	530	276.67	2012.0	1100	593.33	3182.0	1750	954.44	4352.0	2400	1315.56	5522.0	3050	1676.67	6692.0	3700	2037.78
989.6	532	277.78	2030.0	1110	598.89	3200.0	1760	960.00	4370.0	2410	1321.11	5540.0	3060	1682.22	6710.0	3710	2043.33
993.2	534	278.89	2048.0	1120	604.44	3218.0	1770	965.56	4388.0	2420	1326.67	5558.0	3070	1687.78	6728.0	3720	2048.89
996.8	536	280.00	2066.0	1130	610.00	3236.0	1780	971.11	4406.0	2430	1332.22	5576.0	3080	1693.33	6746.0	3730	2054.44
1000.4	538	281.11	2084.0	1140	615.56	3254.0	1790	976.67	4424.0	2440	1337.78	5594.0	3090	1698.89	6764.0	3740	2060.00
1004.0	540	282.22	2102.0	1150	621.11	3272.0	1800	982.22	4442.0	2450	1343.33	5612.0	3100	1704.44	6782.0	3750	2065.56
1007.6	542	283.33	2120.0	1160	626.67	3290.0	1810	987.78	4460.0	2460	1348.89	5630.0	3110	1710.00	6800.0	3760	2071.11
1011.2	544	284.44	2138.0	1170	632.22	3308.0	1820	993.33	4478.0	2470	1354.44	5648.0	3120	1715.56	6818.0	3770	2076.67
1014.8	546	285.56	2156.0	1180	637.78	3326.0	1830	998.89	4496.0	2480	1360.00	5666.0	3130	1721.11	6836.0	3780	2082.22
1018.4	548	286.67	2174.0	1190	643.33	3344.0	1840	1004.44	4514.0	2490	1365.56	5684.0	3140	1726.67	6854.0	3790	2087.78
1022.0	550	287.78	2192.0	1200	648.89	3362.0	1850	1010.00	4532.0	2500	1371.11	5702.0	3150	1732.22	6872.0	3800	2093.33
1040.0	560	293.33	2210.0	1210	654.44	3380.0	1860	1015.56	4550.0	2510	1376.67	5720.0	3160	1737.78	6890.0	3810	2098.89
1058.0	570	298.89	2228.0	1220	660.00	3398.0	1870	1021.11	4568.0	2520	1382.22	5738.0	3170	1743.33	6908.0	3820	2104.44
1076.0	580	304.44	2246.0	1230	665.56	3416.0	1880	1026.67	4586.0	2530	1387.78	5756.0	3180	1748.89	6926.0	3830	2110.00
1094.0	590	310.00	2264.0	1240	671.11	3434.0	1890	1032.22	4604.0	2540	1393.33	5774.0	3190	1754.44	6944.0	3840	2115.56
1112.0	600	315.56	2282.0	1250	676.67	3452.0	1900	1037.78	4622.0	2550	1398.89	5792.0	3200	1760.00	6962.0	3850	2121.11
1130.0	610	321.11	2300.0	1260	682.22	3470.0	1910	1043.33	4640.0	2560	1404.44	5810.0	3210	1765.56	6980.0	3860	2126.67
1148.0	620	326.67	2318.0	1270	687.78	3488.0	1920	1048.89	4658.0	2570	1410.00	5828.0	3220	1771.11	6998.0	3870	2132.22
1166.0	630	332.22	2336.0	1280	693.33	3506.0	1930	1054.44	4676.0	2580	1415.56	5846.0	3230	1776.67	7016.0	3880	2137.78
1184.0	640	337.78	2354.0	1290	698.89	3524.0	1940	1060.00	4694.0	2590	1421.11	5864.0	3240	1782.22	7034.0	3890	2143.33
1202.0	650	343.33	2372.0	1300	704.44	3542.0	1950	1065.56	4712.0	2600	1426.67	5882.0	3250	1787.78	7052.0	3900	2148.89
1220.0	660	348.89	2390.0	1310	710.00	3560.0	1960	1071.11	4730.0	2610	1432.22	5900.0	3260	1793.33	7070.0	3910	2154.44
1238.0	670	354.44	2408.0	1320	715.56	3578.0	1970	1076.67	4748.0	2620	1437.78	5918.0	3270	1798.89	7088.0	3920	2160.00
1256.0	680	360.00	2426.0	1330	721.11	3596.0	1980	1082.22	4766.0	2630	1443.33	5936.0	3280	1804.44	7106.0	3930	2165.56
1274.0	690	365.56	2444.0	1340	726.67	3614.0	1990	1087.78	4784.0	2640	1448.89	5954.0	3290	1810.00	7124.0	3940	2171.11
1292.0	700	371.11	2462.0	1350	732.22	3632.0	2000	1093.33	4802.0	2650	1454.44	5972.0	3300	1815.56	7142.0	3950	2176.67
1310.0	710	376.67	2480.0	1360	737.78	3650.0	2010	1098.89	4820.0	2660	1460.00	5990.0	3310	1821.11	7160.0	3960	2182.22
1328.0	720	382.22	2498.0	1370	743.33	3668.0	2020	1104.44	4838.0	2670	1465.56	6008.0	3320	1826.67	7178.0	3970	2187.78
1346.0	730	387.78	2516.0	1380	748.89	3686.0	2030	1110.00	4856.0	2680	1471.11	6026.0	3330	1832.22	7196.0	3980	2193.33
1364.0	740	393.33	2534.0	1390	754.44	3704.0	2040	1115.56	4874.0	2690	1476.67	6044.0	3340	1837.78	7214.0	3990	2198.89
1382.0	750	398.89	2552.0	1400	760.00	3722.0	2050	1121.11	4892.0	2700	1482.22	6062.0	3350	1843.33	7232.0	4000	2204.44
1400.0	760	404.44	2570.0	1410	765.56	3740.0	2060	1126.67	4910.0	2710	1487.78	6080.0	3360	1848.89	7250.0	4010	2210.00
1418.0	770	410.00	2588.0	1420	771.11	3758.0	2070	1132.22	4928.0	2720	1493.33	6098.0	3370	1854.44	7268.0	4020	2215.56
1436.0	780	415.56	2606.0	1430	776.67	3776.0	2080	1137.78	4946.0	2730	1498.89	6116.0	3380	1860.00	7286.0	4030	2221.11
1454.0	790	421.11	2624.0	1440	782.22	3794.0	2090	1143.33	4964.0	2740	1504.44	6134.0	3390	1865.56	7304.0	4040	2226.67
1472.0	800	426.67	2642.0	1450	787.78	3812.0	2100	1148.89	4982.0	2750	1510.00	6152.0	3400	1871.11	7322.0	4050	2232.22
1490.0	810	432.22	2660.0	1460	793.33	3830.0	2110	1154.44	5000.0	2760	1515.56	6170.0	3410	1876.67	7340.0	4060	2237.78
1508.0	820	437.78	2678.0	1470	798.89	3848.0	2120										

TECHNICAL REFERENCE

Pipe Size	O.D.	Sched. 40	Sched. 60	Sched. 80	Sched. 100	Sched. 120	Sched. 140	Sched. 160	XS	XXS
		Wall Thick.	Wall Thick.	Wall Thick.	Wall Thick.	Wall Thick.	Wall Thick.	Wall Thick.	Wall Thick.	Wall Thick.
1/8"	0.405	0.068	0.095	0.095	0.000	0.000	0.000	0.124	0.000	0.190
1/4"	0.540	0.088	0.119	0.119	0.000	0.000	0.000	0.145	0.000	0.238
3/8"	0.675	0.091	0.126	0.126	0.000	0.000	0.000	0.158	0.000	0.252
1/2"	0.840	0.109	0.147	0.147	0.000	0.000	0.000	0.188	0.000	0.294
3/4"	1.050	0.113	0.154	0.154	0.000	0.000	0.000	0.219	0.000	0.308
1"	1.315	0.133	0.179	0.179	0.000	0.000	0.000	0.250	0.000	0.358
1-1/4"	1.660	0.140	0.191	0.191	0.000	0.000	0.000	0.281	0.000	0.382
1-1/2"	1.900	0.145	0.200	0.200	0.000	0.000	0.000	0.344	0.000	0.400
2"	2.375	0.154	0.218	0.218	0.000	0.000	0.000	0.375	0.000	0.436
2-1/2"	2.875	0.203	0.276	0.276	0.000	0.000	0.000	0.438	0.000	0.552
3"	3.500	0.216	0.300	0.300	0.000	0.000	0.000	0.000	0.000	0.600
3-1/2"	4.000	0.226	0.318	0.318	0.000	0.000	0.000	0.531	0.000	0.636
4"	4.500	0.237	0.337	0.337	0.000	0.438	0.000	0.625	0.000	0.674
5"	5.563	0.258	0.375	0.375	0.000	0.500	0.000	0.719	0.000	0.750
6"	6.625	0.280	0.432	0.432	0.000	0.562	0.000	0.906	0.000	0.864
8"	8.625	0.322	0.500	0.500	0.594	0.719	0.812	1.125	0.406	0.875
10"	10.750	0.365	0.500	0.594	0.719	0.844	1.000	1.312	0.500	1.000
12"	12.750	0.406	0.500	0.688	0.844	1.000	1.125	1.406	0.562	1.000
14"	14.000	0.438	0.500	0.750	0.938	1.094	1.250	1.594	0.594	0.000
16"	16.000	0.500	0.500	0.844	1.031	1.219	1.438	1.781	0.656	0.000
18"	18.000	0.562	0.500	0.938	1.156	1.375	1.562	1.969	0.750	0.000
20"	20.000	0.594	0.500	1.031	1.281	1.500	1.750	2.125	0.812	0.000
24"	24.000	0.688	0.500	1.125	1.375	1.625	1.875	2.344	0.875	0.000
30"	30.000	0.000	0.500	1.219	1.531	1.812	2.062	0.000	0.969	0.000

All Dimensions are given in inches and are in accordance with ASME B36.10 or ANSI/ASME B36.19 as applicable.
The decimal thickness listed for the pipe sizes represent their nominal or average wall dimensions.
For nominal sizes through 10", Standard weight thickness is identical to schedule 40 thickness.
For nominal sized through 8", Extra strong thickness is identical to schedule 80 thickness.
These do not conform to ANSI/ASME B36.19.



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SECTION TECH

PIPE SIZES - WALL THICKNESS

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Doc. No.: TE-CO010109-TECH-400

TECHNICAL REFERENCE

Pipe Size	O.D.	Sched. 40	Sched. 60	Sched. 80	Sched. 100	Sched. 120	Sched. 140	Sched. 160	XS	XXS
		I.D.	I.D.	I.D.	I.D.	I.D.	I.D.	I.D.	I.D.	I.D.
1/8"	0.405	0.269	0.000	0.215	0.000	0.000	0.000	0.157	0.215	0.025
1/4"	0.540	0.364	0.000	0.302	0.000	0.000	0.000	0.250	0.302	0.064
3/8"	0.675	0.493	0.000	0.423	0.000	0.000	0.000	0.359	0.423	0.171
1/2"	0.840	0.622	0.000	0.546	0.000	0.000	0.000	0.464	0.546	0.252
3/4"	1.050	0.824	0.000	0.742	0.000	0.000	0.000	0.612	0.742	0.434
1"	1.315	1.049	0.000	0.957	0.000	0.000	0.000	0.815	0.957	0.599
1-1/4"	1.660	1.380	0.000	1.278	0.000	0.000	0.000	1.160	1.278	0.896
1-1/2"	1.900	1.610	0.000	1.500	0.000	0.000	0.000	1.338	1.500	1.100
2"	2.375	2.067	0.000	1.939	0.000	0.000	0.000	1.687	1.939	1.503
2-1/2"	2.875	2.469	0.000	2.323	0.000	0.000	0.000	2.125	2.323	1.771
3"	3.500	3.068	0.000	2.900	0.000	0.000	0.000	2.624	2.900	2.300
3-1/2"	4.000	3.548	0.000	3.364	0.000	0.000	0.000	0.000	3.364	2.728
4"	4.500	4.026	0.000	3.826	0.000	3.624	0.000	3.438	3.826	3.152
5"	5.563	5.047	0.000	4.813	0.000	4.563	0.000	4.313	4.813	4.063
6"	6.625	6.065	0.000	5.761	0.000	5.501	0.000	5.187	5.761	4.897
8"	8.625	7.981	7.813	7.625	7.437	7.187	7.001	6.813	7.625	6.875
10"	10.750	10.020	9.750	9.562	9.312	9.062	8.750	8.500	9.750	8.750
12"	12.750	11.938	11.626	11.374	11.062	10.750	10.500	10.126	11.750	10.750
14"	14.000	13.124	12.812	12.500	12.124	11.812	11.500	11.188	13.000	0.000
16"	16.000	15.000	14.688	14.312	13.938	13.562	13.124	12.812	15.000	0.000
18"	18.000	16.876	16.500	16.124	15.688	15.250	14.876	14.438	17.000	0.000
20"	20.000	18.812	18.376	17.938	17.438	17.000	16.500	16.062	19.000	0.000
24"	24.000	22.624	22.062	21.562	20.938	20.376	19.876	19.312	23.000	0.000
30"	30.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	29.000	0.000

All Dimensions are given in inches and are in accordance with ASME B36.10 or ANSI/ASME B36.19 as applicable.
The decimal thickness listed for the pipe sizes represent their nominal or average wall dimensions.
For nominal sizes through 10", Standard weight thickness is identical to schedule 40 thickness.
For nominal sized through 8", Extra strong thickness is identical to schedule 80 thickness.
These do not conform to ANSI/ASME B36.19.



SECTION TECH

PIPE SIZES - INSIDE DIAMETER

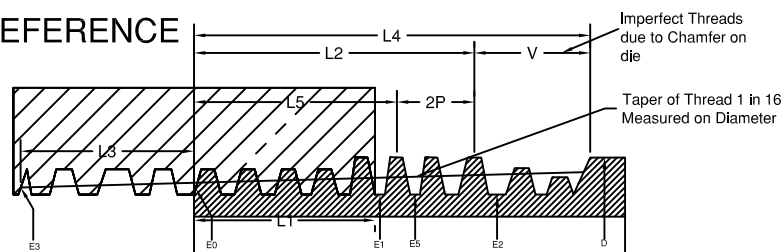
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Doc. No.: TE-CO010109-TECH-410

TECHNICAL REFERENCE

Basic NPT Dimensions



For all dimensions, see corresponding reference letter in table.

Angle between sides of thread is 60 degrees. Taper of thread, on diameter, is 3/4 inch per foot. Angle of taper with center line is 1°47'.

The basic maximum thread height, h, of the truncated thread is 0.8 x pitch of thread. The crest and root are truncated a minimum of 0.033 x pitch for all pitches.

Nominal Pipe Size	Outside Dia. of Pipe, D	Threads per Inch, n	Pitch of Thread, P	Pitch Diameter at Beginning of External Thread, E0	Handtight Engagement		Effective Thread, External	
					Length, L1	Dia., E1	Length, L2	Dia., E2
					In.		In.	
1/16	0.3125	27	0.03704	0.27118	0.160	0.28118	0.2611	0.28750
1/8	0.405	27	0.03704	0.36351	0.1615	0.37360	0.2639	0.38000
1/4	0.540	18	0.05556	0.47739	0.2278	0.49163	0.4018	0.50250
3/8	0.675	18	0.05556	0.61201	0.240	0.62701	0.4078	0.63750
1/2	0.840	14	0.07143	0.75843	0.320	0.77843	0.5337	0.79179
3/4	1.050	14	0.07143	0.96768	0.339	0.98887	0.5457	1.00179
1	1.315	11 1/2	0.08696	1.21363	0.400	1.23863	0.6828	1.25630
1 1/4	1.660	11 1/2	0.08696	1.55713	0.420	1.58338	0.7068	1.60130
1 1/2	1.900	11 1/2	0.08696	1.79609	0.420	1.82234	0.7235	1.84130
2	2.375	11 1/2	0.08696	2.26902	0.436	2.29627	0.7565	2.31630
2 1/2	2.875	8	0.12500	2.71953	0.682	2.76216	1.1375	2.79062
3	3.500	8	0.12500	3.34062	0.766	3.38850	1.2000	3.41562
3 1/2	4.000	8	0.12500	3.83750	0.821	3.88881	1.2500	3.91562
4	4.500	8	0.12500	4.33438	0.844	4.38712	1.3000	4.41562
Nominal Pipe Size	Wrench Makeup Length for Internal Thread		Vanish Thread, (3.47 thds.), V	Overall Length External Thread, L4	Nominal Perfect External Threads		Height of Thread, I1	Basic Minor Dia. at Small End of Pipe, K0
	Length, L3	Dia., E3			Length, L5	Dia., E5		
1/16	0.1111	0.26424	0.1285	0.3896	0.1870	0.28287	0.02963	0.2416
1/8	0.1111	0.35656	0.1285	0.3924	0.1898	0.37537	0.02963	0.3339
1/4	0.1667	0.46697	0.1928	0.5946	0.2907	0.49556	0.04444	0.4329
3/8	0.1667	0.60160	0.1928	0.6006	0.2967	0.63056	0.04444	0.5676
1/2	0.2143	0.74504	0.2478	0.7815	0.3909	0.78286	0.05714	0.7013
3/4	0.2143	0.95429	0.2478	0.7935	0.4029	0.99286	0.05714	0.9105
1	0.2609	1.19733	0.3017	0.9845	0.5089	1.24543	0.06957	1.1441
1 1/4	0.2609	1.54083	0.3017	1.0085	0.5329	1.59043	0.06957	1.4876
1 1/2	0.2609	1.77978	0.3017	1.0252	0.5496	1.83043	0.06957	1.7265
2	0.2609	2.25272	0.3017	1.0582	0.5826	2.30543	0.06957	2.1995
2 1/2	0.2500	2.70391	0.4337	1.5712	0.8875	2.77500	0.10000	2.6195
3	0.2500	3.32500	0.4337	1.6337	0.9500	3.40000	0.10000	3.2406
3 1/2	0.2500	3.82188	0.4337	1.6837	1.0000	3.90000	0.10000	3.7375
4	0.2500	4.31875	0.4337	1.7337	1.0500	4.40000	0.10000	4.2344

All dimensions given in inches. Increase in diameter per thread is equal to 0.0625/n.

The basic dimensions of the ANSI standard taper pipe thread are given in inches to four or five decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are the basis of gage dimensions and are so expressed for the purpose of eliminating errors in computations.



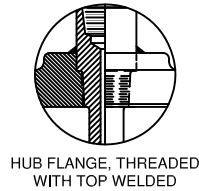
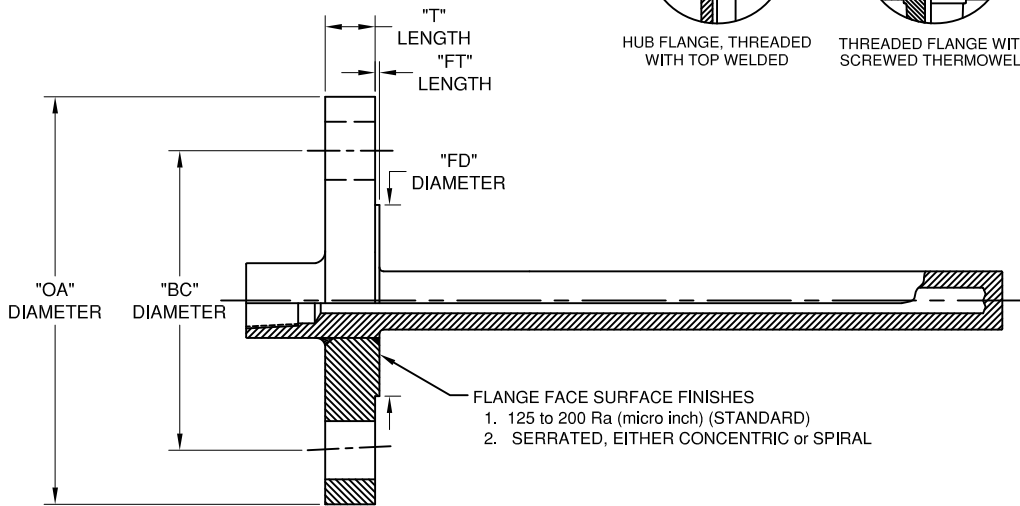
SECTION - TECH

BASIC NPT DIMENSIONS

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Doc. No.: TE-CO010109-TECH-420

TECHNICAL REFERENCE



Class 150 Forged Flanges

Nom. Pipe Size	No./Dia. of Holes (1)	BC	OA	FD	T
1/2	4-0.62	2.38	3.5	1.38	.38
3/4	4-0.62	2.75	3.88	1.69	.44
1	4-0.62	3.12	4.25	2	.50
1 1/4	4-0.62	3.5	4.62	2.5	.56
1 1/2	4-0.62	3.88	5	2.88	.62
2	4-0.75	4.75	6	3.62	.69
2 1/2	4-0.75	5.5	7	4.12	.82
3	4-0.75	6	7.5	5	.88
3 1/2	8-0.75	7	8.5	5.5	.88
4	8-0.75	7.5	9	6.19	.88

1. Bolt hole diameter 1/8 in. larger than bolt diameter
2. "FT" length equal to 1/16 in.
3. Extracted from ANSI B16.5, see complete standard for critical applications.

Class 300 Forged Flanges

Nom. Pipe Size	No./Dia. of Holes (1)	BC	OA	FD	T
1/2	4-0.62	2.62	3.75	1.38	.50
3/4	4-0.75	3.25	4.62	1.69	.56
1	4-0.75	3.5	4.88	2	.63
1 1/4	4-0.75	3.88	5.25	2.5	.69
1 1/2	4-0.88	4.5	6.12	2.88	.75
2	8-0.75	5	6.5	3.62	.82
2 1/2	8-0.88	5.88	7.5	4.12	.94
3	8-0.88	6.62	8.25	5	1.06
3 1/2	8-0.88	7.25	9	5.5	1.13
4	8-0.88	7.88	10	6.19	1.19

1. Bolt hole diameter 1/8 in. larger than bolt diameter
2. "FT" length equal to 1/16 in.
3. Extracted from ANSI B16.5, see complete standard for critical applications.



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SECTION TECH

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Doc. No.: TE-CO010109-TECH-430

TECHNICAL REFERENCE

Class 600 Forged Flanges

Nom. Pipe Size	No./Dia. of Holes (1)	BC	OA	FD	T
1/2	4-0.62	2.62	3.75	1.38	0.56
3/4	4-0.75	3.25	4.62	1.69	0.62
1	4-0.75	3.5	4.88	2	0.69
1 1/4	4-0.75	3.88	5.25	2.5	0.81
1 1/2	4-0.88	4.5	6.12	2.88	0.88
2	8-0.75	5	6.5	3.62	1
2 1/2	8-0.88	5.88	7.5	4.12	1.12
3	8-0.88	6.62	8.25	5	1.25
3 1/2	8-1.00	7.25	9	5.5	1.38
4	8-1.00	8.5	10.75	6.19	1.5

1. Bolt hole diameter 1/8 in. larger than bolt diameter
2. "FT" length equal to 1/4 in.
3. Extracted from ANSI B16.5, see complete standard for critical applications.

Class 900 Forged Flanges

Nom. Pipe Size	No./Dia. of Holes (1)	BC	OA	FD	T
1/2	4-0.88	3.25	4.75	1.38	0.88
3/4	4-0.88	3.50	5.13	1.69	1.00
1	4-1.00	4.00	5.88	2.00	1.13
1 1/4	4-1.00	4.38	6.25	2.50	1.13
1 1/2	4-1.13	4.88	7.00	2.88	1.25
2	8-1.00	6.50	8.50	3.63	1.50
2 1/2	8-1.13	7.50	9.63	4.13	1.63
3	8-1.00	7.50	9.50	5.00	1.50
4	8-1.25	9.25	11.50	6.19	1.75

1. Bolt hole diameter 1/8 in. larger than bolt diameter
2. "FT" length equal to 1/4 in.
3. Extracted from ANSI B16.5, see complete standard for critical applications.

Class 1500 Forged Flanges

Nom. Pipe Size	No./Dia. of Holes (1)	BC	OA	FD	T
1/2	4-0.88	3.25	4.75	1.38	0.88
3/4	4-0.88	3.50	5.13	1.69	1.00
1	4-1.00	4.00	5.88	2.00	1.13
1 1/4	4-1.00	4.38	6.25	2.50	1.13
1 1/2	4-1.13	4.88	7.00	2.88	1.25
2	8-1.00	6.50	8.50	3.63	1.50
2 1/2	8-1.13	7.50	9.63	4.13	1.63
3	8-1.25	8.00	10.50	5.00	1.88
4	8-1.38	9.50	12.25	6.19	2.13

1. Bolt hole diameter 1/8 in. larger than bolt diameter
2. "FT" length equal to 1/4 in.
3. Extracted from ANSI B16.5, see complete standard for critical applications.

Class 2500 Forged Flanges

Nom. Pipe Size	No./Dia. of Holes (1)	BC	OA	FD	T
1/2	4-0.88	3.50	5.25	1.38	1.19
3/4	4-0.88	3.75	5.50	1.69	1.25
1	4-1.00	4.25	6.25	2.00	1.38
1 1/4	4-1.13	5.13	7.25	2.50	1.50
1 1/2	4-1.25	5.75	8.00	2.88	1.75
2	8-1.13	6.75	9.25	3.63	2.00
2 1/2	8-1.25	7.75	10.50	4.13	2.25
3	8-1.38	9.00	12.00	5.00	2.63
4	8-1.63	10.75	14.00	6.19	3.00

1. Bolt hole diameter 1/8 in. larger than bolt diameter
2. "FT" length equal to 1/4 in.
3. Extracted from ANSI B16.5, see complete standard for critical applications.



THERMO ELECTRIC

TEMPERATURE MEASUREMENT DESIGNER'S GUIDE
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SECTION TECH

FLANGED THERMOWELLS

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Doc. No.: TE-CO010109-TECH-440

TECHNICAL REFERENCE



NEMA, created in the fall of 1926 by the merger of the Electric Power Club and the Associated Manufacturers of Electrical Supplies, provides a forum for the standardization of electrical equipment, enabling consumers to select from a range of safe, effective, and compatible electrical products. The organization has also made numerous contributions to the electrical industry by shaping public policy development and operating as a central confidential agency for gathering, compiling, and analyzing market statistics and economics data.

NON-CLASSIFIED LOCATION ENCLOSURES

Type 1 Enclosures: Intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment in locations where unusual service conditions do not exist. The enclosures shall meet the rod entry and rust resistance design tests.

Type 2 Enclosures: Intended for indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt. These enclosures shall meet rod entry, drip, and rust-resistance design tests. They are not intended to provide protection against conditions such as dust or internal condensation.

Type 3 Enclosures: Intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet, and external ice formation. They shall meet rain, external icing, dust, and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 3R Enclosures: Intended for outdoor use primarily to provide a degree of protection against falling rain, sleet, and external ice formation. They shall meet rod entry, rain external icing, and rust-resistance design tests. They are not intended to provide protection against conditions such as dust, internal condensation, or internal icing.

Type 3S Enclosures: Intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, and sleet and to provide for operation of external mechanisms when ice laden. They shall meet rain, dust, external icing, and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 4 Enclosures: Intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water. They shall meet hosedown, dust, external icing, and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 4X Enclosures: Intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, and hose-directed water. They shall meet the hosedown, dust, external icing, and corrosion-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 5 Enclosures: Intended for outdoor use primarily to provide a degree of protection against dust and falling dirt. They shall meet the dust and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation.

Type 6 Enclosures: Intended for indoor or outdoor use primarily to provide a degree of protection against the entry of water during occasional temporary submersion at a limited depth. They shall meet submersion, external icing, and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation, internal icing, or corrosive environments.

Type 6P Enclosures: Intended for indoor or outdoor use primarily to provide a degree of protection against the entry of water during prolonged submersion at a limited depth. They shall meet air pressure, external icing, and corrosion-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 11 Enclosures: Intended for indoor use primarily to provide, by oil immersion, a degree of protection to enclosed equipment against the corrosive effects of liquids and gases. They shall meet drip and corrosion-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

Type 12 Enclosures: Intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids. They shall meet drip, dust, and rust-resistance tests. They are not intended to provide protection against conditions such as internal condensation.

Type 12K Enclosures: 12K Enclosures with knockouts are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids other than at knockouts. They shall meet drip, dust, and rust-resistance design tests. Knockouts are provided in the top and/or bottom walls only. After installation, the knockout areas shall meet the environmental characteristics listed above. They are not intended to provide protection against conditions such as internal condensation.

Type 13 Enclosures: Intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and non-corrosive coolant. They shall meet oil exclusion and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation.

CLASSIFIED LOCATION ENCLOSURES

Type 7 Enclosures: Intended for indoor use in locations classified as Class I, Groups A, B, C, or D, as defined in the National Electrical Code.

Type 8 Enclosures: Intended for indoor or outdoor use in locations classified as Class I, Groups A, B, C, or D, as defined in the National Electrical Code.

Type 9 Enclosures: Intended for indoor use in locations classified as Class II, Groups E, F, or G, as defined in the National Electrical Code

Type 10 Enclosures: Shall be capable of meeting the requirements if the mine safety and health administration, 30 C.F.R., part 18 (1978).



SECTION TECH

NEMA/IP RATINGS

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Doc. No.: TE-CO010109-TECH-450

TECHNICAL REFERENCE



The IP Code defined in international standard IEC 60529 classifies the degrees of protection provided against the intrusion of solid objects (including body parts like hands and fingers), dust, accidental contact, and water in electrical enclosures.[1] It consists of the letters IP (for "international protection rating"[2], sometimes also interpreted as "ingress protection rating") followed by two digits and an optional letter. The standard aims to provide users more detailed information than vague marketing terms such as "waterproof". The digits ('characteristic numerals') indicate conformity with the conditions summarized in the tables below. Where there is no protection rating with regard to one of the criteria, the digit is replaced with the letter X.

IP CLASSIFICATIONS			
Ingress Protection class of enclosures is according to IEC 529 given in form of IP classification, a two digit coding which is shown below.			
First Digit: Protection against contact and ingress of solid objects		Second Digit: Protection against ingress of water	
0	No special protection	0	No special protection
1	Protected against ingress solid objects with a diameter of more than 50 mm. No protection against deliberate access, e.g. with a hand, but large surfaces of the body are prevented from approach.	1	Protection against dripping water falling vertically. No harmful effect must be produced (vertically falling drops).
2	Protected against penetration by solid objects with a diameter of more than 12 mm. Fingers or similar objects prevented from approach.	2	Protection against dripping water falling vertically. There must be no harmful effect when the equipment (enclosure) is tilted at an angle up to 15° from its normal position (drops falling at an angle).
3	Protected against ingress of solid objects with a diameter of more than 2.5 mm. Tools, wires, etc. with a thickness of more than 2.5 mm are prevented from approach.	3	Protection against water falling at any angle up to 60° from the vertical. There must be no harmful effect (spray water).
4	Protected against ingress of solid objects with more than 1 mm. Tools, wires, etc. with a thickness of more than 1 mm are prevented from approach.	4	Protection against water splashed against the equipment (enclosure) from any direction. There must be no harmful effect (splashing water).
5	Protected against harmful dust deposits. Ingress of dust is not totally prevented but the dust must not enter in sufficient quantity to interfere with satisfactory operation of the equipment. Complete protection against contact.	5	Protection against water projected from a nozzle against the equipment (enclosure) from any direction. There must be no harmful effect (water jet).
6	Protection against ingress of dust (dust tight). Complete protection against contact.	6	Protection against heavy seas or powerful water jets. Water must not enter the equipment (enclosure) in harmful quantities (splashing over).
		7	Protection against water when the equipment (enclosure) is immersed in water under defined conditions of pressure and time. Water must not enter in harmful quantities (immersion).
		8	The equipment (enclosure) is suitable for continuous submersion in water under conditions which must be specified by the manufacturer (submersion).



SECTION TECH

NEMA/IP RATINGS

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Doc. No.: TE-CO010109-TECH-460

TECHNICAL REFERENCE

CE 0081 EEx d IIC T6

CE Mark
Complies with
European Directive

Identification number of
the Notified Body
Responsible for Surveillance
(0081 is the Identification Number of LCIE)

EU Explosive
Atmosphere Symbol

Flameproof		
Code	Permitted Use	Standard
AEx d	Zone 1, 2	FM3618
EEx d	Zone 1, 2	EN50018
Ex d	Zone 1, 2	IEC 60079-1
Intrinsic Safety		
AEx ia	Zone 0, 1, 2	FM3610
AEx ib	Zone 1, 2	FM3610
EEx ia	Zone 0, 1, 2	EN 50 020/39
EEx ib	Zone 1, 2	EN 50 020/39
Ex ia	Zone 0, 1, 2	IEC 60079-11
Ex Ib	Zone 1, 2	IEC 60079-11

Equipment Group
II: Non-Mining

Maximum Surface Temperature	NEC 505, IEC, CENELEC	NEC 500
450° C	T1	T1
300° C	T2	T2
280° C		T2A
260° C		T2B
230° C		T2C
215° C		T2D
200° C	T3	T3
180° C		T3A
165° C		T3B
160° C		T3C
135° C	T4	T4
120° C		T4A
100° C	T5	T5
85° C	T6	T6

Area Classification

Standard	Flammable Conditions Present Continuously	Flammable Conditions Present Intermittently	Flammable Conditions Present Abnormally
IEC/CENELEC	Zone 0 Zone 20 - Dust	Zone 1 Zone 21 - Dust	Zone 2 Zone 21 - Dust
NEC 505	Zone 0	Zone 1	Zone 2
NEC 500	Division 1	Division 1	Division 2

Gas Grouping	NEC 505, IEC, CENELEC	NEC 500
Acetylene	Group IIC	Class I/Group A
Hydrogen	Group IIB + H ₂	Class I/Group B
Ethylene	Group IIB	Class I/Group C
Propane	Group IIA	Class I/Group D
Metal Dust	None	Class II/Group E
Coal Dust	None	Class II/Group F
Grain Dust	None	Class II/Group G
Fibers	None	Class III

History

Every year in the industry there are quite a number of casualties due to explosions caused by flammable gas and or dust. Especially after some major accidents from 1978 till 1984 (1984 Mexico city > 550 casualties, 1984 Bhopal > 2500 casualties) the authorities recognized the need for better regulations and specifications to limit these accidents.

Hazardous areas

Hazardous locations are areas where a flammable gas or dust mixture is present. However to cause an explosion there are three things needed:

- Flammable gas or dust
- Oxygen
- Ignition source

Hazardous location Identification

Hazardous locations in a plant are determined by experts. They must identify where there is a possibility of hazardous atmosphere being present, the kind of atmosphere, and the time it can be present.

Hazardous locations are most commonly caused by leakage of flammable gases. This leakage can occur during normal operation or due to a fault. Also deterioration of equipment can cause a hazardous situation.

The area around a location classified as hazardous is extended in such a way that there is no chance of ignition of the gas mixture anymore. The size of this area is influenced by the type of gas , natural or artificial ventilation etc.

Classification of hazardous locations and protection methods.

North America.

The classification of hazardous areas and the protection methods suitable for these areas differ from continent to continent and sometimes even from country to country.

The US for a long time followed the recommendations of the national standard NFPA 70 article 500 of the National Electrical Code (NEC). Canada follows the recommendations of the Canadian Electrical Code C 22.1 part 1. These standards divide in a similar way the hazardous locations in two divisions:

Division 1: Danger can be present during normal functioning.

Division 2: Danger can only be present in case of abnormal functioning.

Materials intended for use in the above area's are divided into three classes:

Class I: Gases or vapors

Class II: Dusts

Class III: Fibers

The above classes are sub divided into the following Groups:

Groups A,B,C and D: Specifies gases and vapors

Group E: Metal dust

Group F: Carbon black, coal or coke dust

Groups G: Flour, starch or grain dust

The protection methods used by Thermo Electric are either Explosion proof or Intrinsic safe. Products are marked with the Division, Class and gas group they are suitable for.



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SECTION TECH

CLASSIFIED HAZARDOUS AREAS

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Doc. No.: TE-CO010109-TECH-470

TECHNICAL REFERENCE

Relatively new for the US is the classification according the NEC 505. This classification follows more the old Cenelec classification and is in line with the IEC classification.

Hazardous areas are classified in zones based on the time a hazardous situation exists. IEC 79-10 and NEC 505 specifies three zones:

Zone 0: An area in which an explosive gas mixture is continuously present or for a longer period of time.

Zone 1: An area in which an explosive gas mixture could occur under normal operational conditions (Operating within design parameters).

Zone 2: An area in which an explosive gas mixture is not likely to occur under normal operational condition and if it does it will only be for a short period of time.

Any other plant location is to be classified " NON HAZARDOUS ".

Materials intended for use in the above area's are divided into two groups:

Group I: Materials intended for use in underground mines. Danger is represented by methane gas and coal dust.

Group II: Materials intended for use in all other situations. (Surface industries) Danger is represented by gases and vapors.

Group II itself is divided into three sub groups A, B, and C, depending on the types of gas present in the hazardous areas.

The most common protection methods used by Thermo Electric are :

Eexd

With this protection method the electrical parts that can cause an explosion are placed in an enclosure that can withstand the force of the explosion, while the explosion remains confined inside the enclosure.

Eexi

The Eexi (Intrinsic safety) method is based on the principle of limitation of the energy stored in the electrical circuits. An Eexi circuit is virtually incapable of generating arcs or sparks that are able to cause an explosion in both normal operation and under fault conditions.

Before a circuit enters a hazardous area a Zener barrier is placed to control the energy within that circuit.

The marking consist of one of the above protection methods, the gas group it is suitable for and the temperature class. This temperature class specifies the maximum surface temperature the product can generate. The maximum surface temperature must be lower than the minimum ignition temperature of the surrounding gasses. (Marking example Exd or Aexd IIC T4 etc.)

Europe.

As of July 1 2003 there is a new directive in place. Directive 94/9/EC. This directive is also called the ATEX (Atmospheres Explosives) directive. From July 1 2003 Only equipment complying with the new directive can be put on the market or put into service in the countries that are a member of the European Economic Area (EEA).

The new directive 94/9/EC applies to all potentially explosive atmospheres due to flammable gases, vapors, mists, or dusts. Exceptions are medical, domestic, and non commercial area's, ships and public transport.

The equipment is divided into groups and categories:

Group I : Equipment for use in underground parts of mines , and to those parts of surface installations of such mines endangered by firedamp and or combustible dusts.

Group II : Equipment intended for use in other places liable to be endangered by explosive atmospheres

The groups are sub divided into a number of different categories. Group I is sub divided into category M1 and M2:

Category M1 : Equipment of this category is required to remain functional with an explosive atmosphere present.

Category M2 : Equipment of this category is intended to be de-energized in the event of an explosive atmosphere.

Group II is sub divided into categories 1, 2, and 3:

Category 1: Equipment of this category is intended for use in a area where an explosive atmosphere is continuously present, present for long periods or frequently present and must ensure a very high level of protection.(Zone 0 and Zone 20)

Category 2: Equipment of this category is intended for use in a area where an explosive atmosphere is likely to occur and must ensure a very high level of protection. (Zone 1 and Zone 21)

Category 3: Equipment of this category is intended for use in a area where an explosive atmosphere is unlikely to occur and must ensure a normal level of protection. (Zone 2 and Zone 22)

Here also most common protection methods used by Thermo Electric are Eexd and Eexi.

The following marking is required:

Name and address of manufacturer.

Type and/or serial number.

Year of fabrication.

CE marking.

Identification number of the notified body.

Epsilon X mark and the equipment group and category.

For equipment of group II the letter G and/or D.

Certificate number of the notified body.

The marking required by the applicable standard. (Eexd IIC T4 etc.)

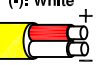
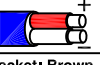
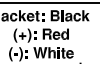
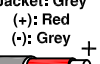


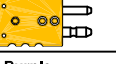
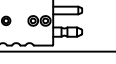
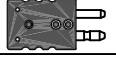
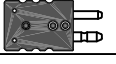
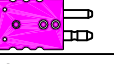
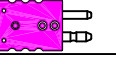
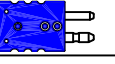
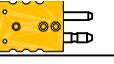
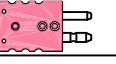
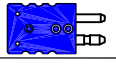
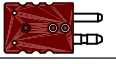
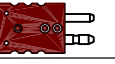
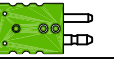
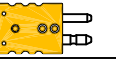
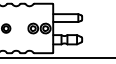
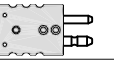
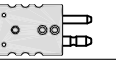
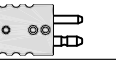
SECTION TECH

CLASSIFIED HAZARDOUS AREAS

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TECHNICAL REFERENCE

TYPE (Letter)	Conductor Material	POLARITY	U.S.A. 	FRANCE 	U.K. 	GERMANY 	JAPAN 	IEC 
J	Iron	+	Jacket: Black (+): White (-): Red	Jacket: Black (+): Yellow (-): Black	Jacket: Black (+): Yellow (-): Blue	Jacket: Blue (+): Red (-): Blue	Jacket: Yellow (+): Red (-): White	Jacket: Black (+): Black (-): White
	Constantan	-						
K	Chromel	+	Jacket: Yellow (+): Yellow (-): Red	Jacket: Yellow (+): Yellow (-): Purple	Jacket: Red (+): Brown (-): Blue	Jacket: Green (+): Red (-): Green	Jacket: Blue (+): Red (-): White	Jacket: Green (+): Green (-): White
	Alumel	-						
T	Copper	+	Jacket: Blue (+): Blue (-): Red	Jacket: Blue (+): Yellow (-): Blue	Jacket: Blue (+): White (-): Blue	Jacket: Brown (+): Red (-): Brown	Jacket: Brown (+): Red (-): White	Jacket: Brown (+): Brown (-): White
	Constantan	-						
E	Chromel	+	Jacket: Purple (+): Purple (-): Red	Jacket: Red (+): Yellow (-): Brown	Jacket: Brown (+): Brown (-): Blue	Jacket: Black (+): Red (-): Black	Jacket: Purple (+): Red (-): White	Jacket: Purple (+): Purple (-): White
	Constantan	-						
N	Nicrosil	+	Jacket: Orange (+): Orange (-): Red	Not Established	Jacket: Orange (+): Orange (-): Blue	Not Established	Not Established	Jacket: Pink (+): Pink (-): White
	NISIL	-						
R	Platinum 13% Rhodium	+	Jacket: Green (+): Black (-): Red	Jacket: Green (+): Yellow (-): Green	Jacket: Green (+): White (-): Blue	Jacket: White (+): Red (-): White	Jacket: Black (+): Red (-): White	Jacket: Orange (+): Orange (-): White
	Platinum	-						
S	Platinum 10% Rhodium	+	Jacket: Green (+): Black (-): Red	Jacket: Green (+): Yellow (-): Green	Jacket: Green (+): White (-): Blue	Jacket: White (+): Red (-): White	Jacket: Black (+): Red (-): White	Jacket: Orange (+): Orange (-): White
	Platinum	-						
B	Platinum 30% Rhodium	+	Jacket: Grey (+): Grey (-): Red	Not Established	Not Established	Jacket: Grey (+): Red (-): Grey	Jacket: Grey (+): Red (-): Grey	Not Established
	Platinum 6% Rhodium	-						

THERMOCOUPLE CONNECTOR COLOR CODE				THERMOCOUPLE CONNECTOR COLOR CODE			
TYPE	ANSI	IEC	DIN	TYPE	ANSI	IEC	DIN
K	Yellow 	Green 	Green 	R	Green 	Orange 	White 
J	Black 	Black 	N/A	E	Purple 	Purple 	N/A
L	N/A	N/A	Blue 	N	Orange 	Pink 	N/A
T	Blue 	Brown 	Brown 	S	Green 	Orange 	White 
				B	Grey 	Grey 	Grey 

- (1) ISA color codes shown is for thermocouple extension grade wire. Thermocouple grade wire has a brown jacket in all calibrations.
- (2) Compensating extension wire and connector pins (copper/alloy II) used with both R and S thermocouples.
- (3) Compensating extension wire and connector pins (copper/copper) used with B thermocouples. Connector body is usually supplied white.



SECTION TECH

THERMOCOUPLE COLOR CODES

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TECHNICAL REFERENCE

FRACTION/DECIMAL/METRIC

Fractions	Decimal	mm	Fractions	Decimal	mm
1/64"	0.016	0.397	33/64"	0.516	13.096
1/32"	0.031	0.794	17/32"	0.531	13.493
3/64"	0.047	1.191	35/64"	0.547	13.890
1/16"	0.063	1.588	9/16"	0.563	14.287
5/64"	0.078	1.984	37/64"	0.578	14.684
3/32"	0.094	2.381	19/32"	0.594	15.081
7/64"	0.109	2.778	39/64"	0.609	15.478
1/8"	0.125	3.175	5/8"	0.625	15.874
9/64"	0.141	3.572	41/64"	0.641	16.271
5/32"	0.156	3.969	21/32"	0.656	16.668
11/64"	0.172	4.366	43/64"	0.672	17.065
3/16"	0.188	4.763	11/16"	0.688	17.462
13/64"	0.203	5.159	45/64"	0.703	17.859
7/32"	0.219	5.556	23/32"	0.719	18.256
15/64"	0.234	5.953	47/64"	0.734	18.653
1/4"	0.250	6.350	3/4"	0.750	19.049
17/64"	0.266	6.747	49/64"	0.766	19.446
9/32"	0.281	7.144	25/32"	0.781	19.843
19/64"	0.297	7.541	51/64"	0.797	20.240
5/16"	0.313	7.938	13/16"	0.813	20.637
21/64"	0.328	8.334	53/64"	0.828	21.034
11/32"	0.344	8.731	27/32"	0.844	21.431
23/64"	0.359	9.128	55/64"	0.859	21.828
3/8"	0.375	9.525	7/8"	0.875	22.224
25/64"	0.391	9.922	57/64"	0.891	22.621
13/32"	0.406	10.319	29/32"	0.906	23.018
7/64"	0.422	10.716	59/64"	0.922	23.415
7/16"	0.438	11.113	15/16"	0.938	23.812
29/64"	0.453	11.509	61/64"	0.953	24.209
15/32"	0.469	11.906	31/32"	0.969	24.606
31/64"	0.484	12.303	63/64"	0.984	25.003
1/2"	0.500	12.700	1"	1.000	25.399

WIRE SIZES AWG & SWG

Gauge No	AWG		SWG	
	Decimal	mm	Decimal	mm
8	0.129	3.264	0.160	3.264
9	0.116	2.957	0.144	3.658
10	0.102	2.588	0.128	3.251
11	0.091	2.304	0.116	2.946
12	0.081	2.052	0.104	2.642
13	0.072	1.829	0.092	2.337
14	0.064	1.628	0.080	2.032
15	0.057	1.450	0.072	1.829
16	0.051	1.290	0.064	1.626
17	0.045	1.151	0.056	1.422
18	0.040	1.024	0.048	1.219
19	0.036	0.912	0.040	1.016
20	0.032	0.813	0.036	0.914
21	0.029	0.724	0.032	0.813
22	0.025	0.643	0.028	0.711
23	0.023	0.574	0.024	0.610
24	0.020	0.511	0.022	0.559
25	0.018	0.455	0.020	0.508
26	0.016	0.404	0.018	0.457
27	0.014	0.361	0.016	0.417
28	0.013	0.320	0.015	0.376
29	0.011	0.287	0.014	0.345
30	0.010	0.254	0.012	0.315
31	0.009	0.226	0.012	0.295
32	0.008	0.201	0.011	0.274
33	0.007	0.180	0.010	0.254
34	0.006	0.160	0.009	0.234
35	0.006	0.142	0.008	0.213
36	0.005	0.127	0.008	0.193
37	0.005	0.114	0.007	0.173
38	0.004	0.102	0.006	0.152
39	0.004	0.089	0.005	0.132

PRESSURE PSI/KPa/BAR

PSI	KPa	BAR	PSI	KPa	BAR	PSI	KPa	BAR
10	68.95	0.69	475	3275.03	32.75	1300	8963.24	89.64
20	137.90	1.38	500	3447.40	34.48	1400	9652.72	96.53
30	206.84	2.07	525	3619.77	36.20	1500	10342.20	103.43
40	275.79	2.76	550	3792.14	37.92	1600	11031.68	110.32
50	344.74	3.45	575	3964.51	39.65	1700	11721.16	117.22
60	413.69	4.14	600	4136.88	41.37	1800	12410.64	124.11
70	482.64	4.83	625	4309.25	43.09	1900	13100.12	131.01
80	551.58	5.52	650	4481.62	44.82	2000	13789.60	137.90
90	620.53	6.21	675	4653.99	46.54	2500	17237.00	172.38
100	689.48	6.90	700	4826.36	48.27	3000	20684.40	206.85
125	861.85	8.62	725	4998.73	49.99	3500	24131.80	241.33
150	1034.22	10.34	750	5171.10	51.71	4000	27579.20	275.80
175	1206.59	12.07	775	5343.47	53.44	4500	31026.60	310.28
200	1378.96	13.79	800	5515.84	55.16	5000	34474.00	344.75
225	1551.33	15.51	825	5688.21	56.88	5500	37921.40	379.23
250	1723.70	17.24	825	5860.58	58.61	6000	41368.80	413.70
275	1896.07	18.96	875	6032.95	60.33	6500	44816.20	448.18
300	2068.44	20.69	900	6205.32	62.06	7000	48263.60	482.65
325	2240.81	22.41	925	6377.69	63.78	7500	51711.00	517.13
350	2413.18	24.13	950	6550.06	65.50	8000	55158.40	551.60
375	2585.55	25.86	975	6722.43	67.23	8500	58605.80	586.08
400	2757.92	27.58	1000	6894.80	68.95	9000	62053.20	620.55
425	2930.29	29.30	1100	7584.28	75.85	9500	65500.60	655.03
450	3102.66	31.03	1200	8273.76	82.74	10000	68948.00	689.50



SECTION TECH

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