



**MANUFACTURING
CORPORATION**

TEMPERATURE INSTRUMENTATION FOR RESEARCH AND INDUSTRY

Thank You,
for selecting Marlin to furnish your temperature instrumentation
requirements.

We at Marlin recognize the importance of Customer Satisfaction to our
success. Our knowledgeable and experienced staff of sales engineers, backed
by an organization dedicated to temperature instrumentation, is available to
assist you in your applications. Marlin will provide products and services
which conform to requirements as stated in our quality policy.

MARLIN QUALITY POLICY

- QUALITY IS CONFORMANCE TO REQUIREMENTS
- NONCONFORMANCES ARE UNACCEPTABLE
- EVERY PROCESS MUST CONTINUOUSLY IMPROVE

Marlin's goal is to be a consistent, high quality and on-time producer of
temperature instrumentation for research and industrial applications. We
measure our success through total quality management that is integrated into
our processes.

Sincerely,

The People of Marlin Manufacturing Corporation



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MANUFACTURING CORPORATION P.O. BOX 118000 CLEVELAND, OHIO 44111-8000 FAX: (216) 941-6207 (216) 941-6200

The Hot Zone:

Where sensors are strategically placed so that process temperatures are meaningfully measured.

Thermocouples generate a small voltage signal that is relative to temperature. The hot junction is where the two thermo-elements are joined for tip sensitive measurements.

RTDs (Resistance Temperature Devices) present an increasing resistance with increasing temperature at its wire wound bulb for end sensitive measurements.

The Extension Region:

Where the signal is transported, without shorts or interference, from the sensor to the instrument that interprets it.

Thermocouples use the same compensating alloy type for connectors, wire, panels, and cable.

Overall color codes are standardized for common thermocouple types (i.e. K - yellow, J - black, etc.) Internally the "Red" color code is negative throughout the thermocouple circuit.

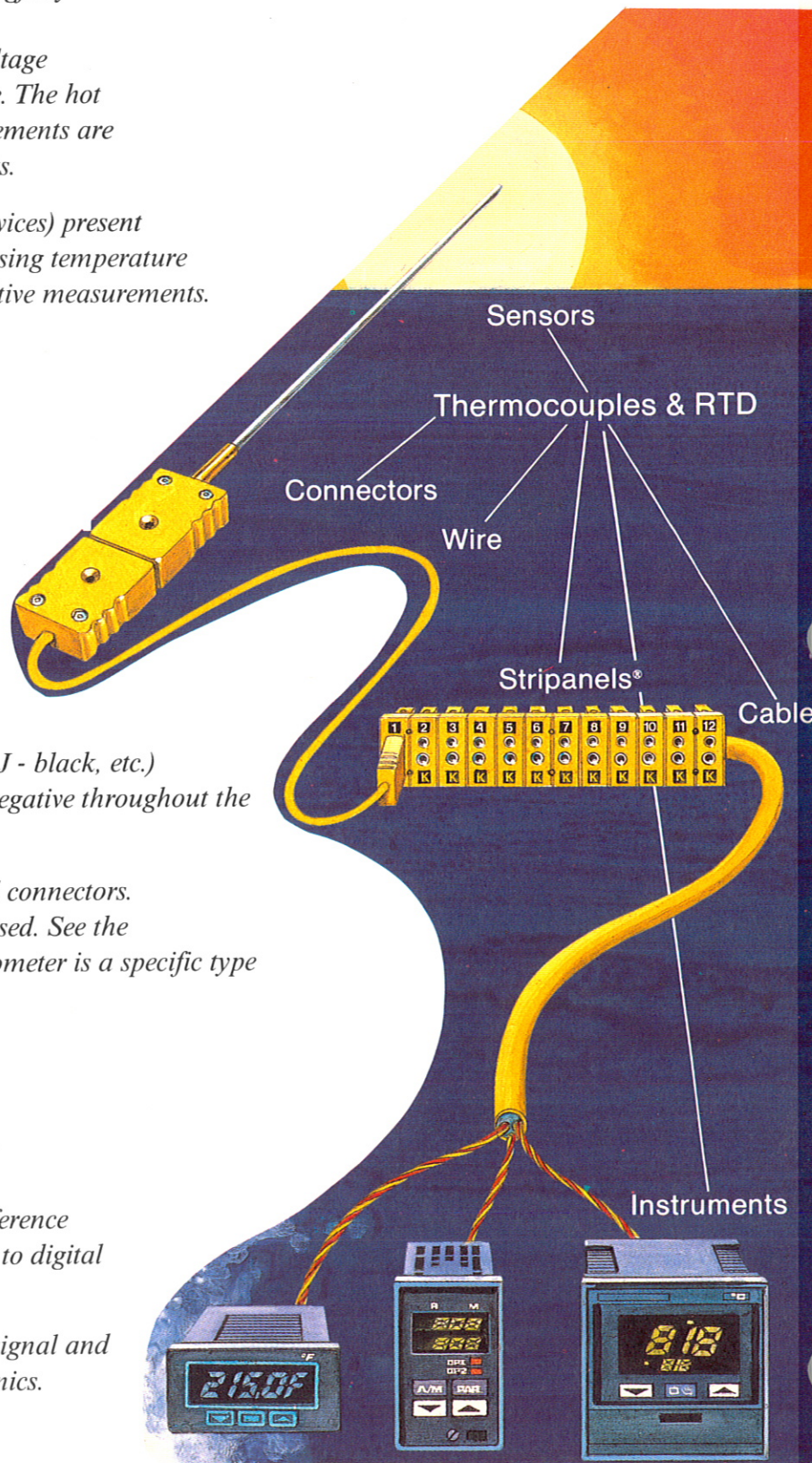
RTDs use copper hook-up wire and connectors. Color codes depend on the circuit used. See the PRT (Platinum Resistance Thermometer is a specific type of RTD) section for details.

The Instrument:

Where the signal is interpreted and used for indicating, controlling, and/or recording the process temperatures.

Thermocouple instruments have reference junction compensation and analog to digital conversion electronics.

RTD instruments provide the loop signal and analog to digital conversion electronics.



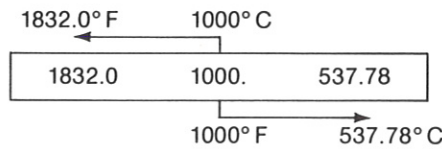
NIST Traceable Calibration Services: Thermocouples, Thermocouple Wire PRT's Calibrators Optical Pyrometers	METROLOGY SERVICE
Temperature Instrumentation Fabrications produced to your plans and specifications.	CUSTOM FABRICATION
Platinum Resistance Thermometers: Stock PRT's Custom PRT's	PT. RESISTANCE THERMOMETERS
Metal Sheathed, MgO Insulated T/C's: Stock Marlox® Custom Marlox® High-Temperature T/C's Random Length Cable	MARLOX® THERMOCOUPLES
Specialty Thermocouples: Profiling, Foil, Surface Plastic Industry Thermocouples: Bayonet, Melt, Nozzle, Washer, Magnetic, Spade	SPECIALTY & PLASTIC INDUSTRY THERMOCOUPLES
Semiconductor Industry: 3-Zone Profile T/C's Non-Ferrous metals: Thermo-Dip® T/C's Assemblies: Platinum T/C's (R, S, B); Base Metal T/C's (J, K)	INDUSTRIAL THERMOCOUPLES
Protecting Tubes: Ceramic, Silicon Carbide, Metal-Ceramic, Laminated, Metal, Cast Iron Thermowells: Threaded, Flanged, Socket Weld	PROTECTING TUBES & THERMOWELLS
Thermocouple Wire: Plastic & Fibrous Insulated Bare Multipair Cable Retractable Cable	THERMOCOUPLE WIRE
Thermocouple Connectors & Strippanels: Miniature Full Size Selector Switches Terminal Heads	CONNECTORS & STRIPANELS®
Hand Held Indicators / Calibrators Panel Mount Indicators Transmitter	INDICATORS CALIBRATORS TRANSMITTER
Temperature Controllers: 1/32 DIN, 1/8 DIN, 1/4 DIN	CONTROLLERS
Stripchart: 100mm; 180mm; Data Recorder Circular: 11"	RECORDERS
Thermocouple Information: Glossary, Tolerance Tables, mV Tables Pt. Resistance Thermometer Tables: "385" Alpha, Bibliography, T/C Systems Concept Units & Conversion Factors	REFERENCE DATA

REFERENCE DATA TEMPERATURE CONVERSION TABLE

$$^{\circ}\text{F} = \frac{9}{5} ^{\circ}\text{C} + 32$$

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

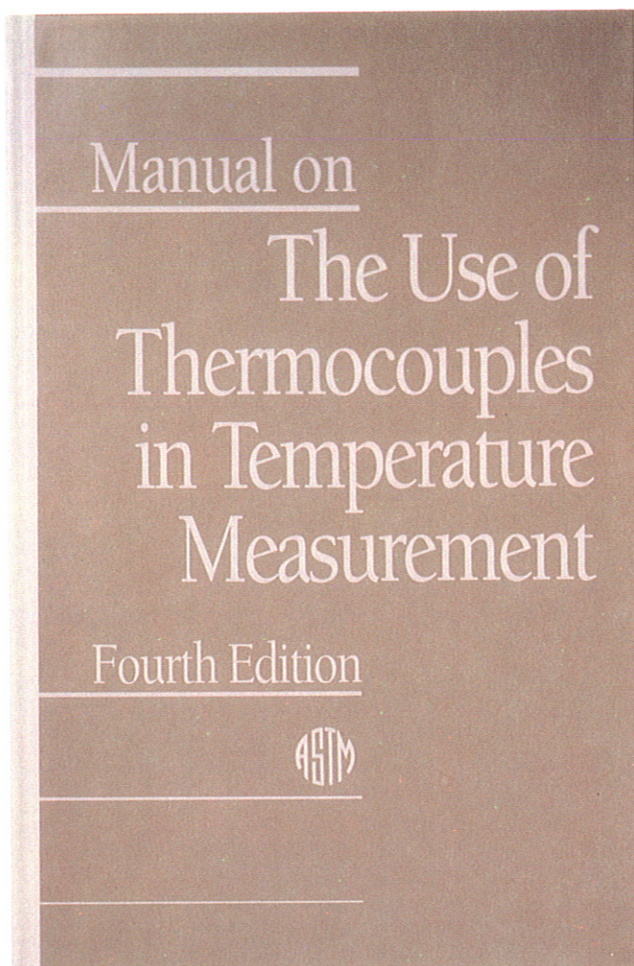
To Convert 1000°F to $^{\circ}\text{C}$
look up 1000 read right



F ← C / F → C			F ← C / F → C			F ← C / F → C			F ← C / F → C			F ← C / F → C		
-458	-272.22		-308	-188.89		-252.4	-158	-105.56	+17.6	-8	-22.22	287.6	142	61.11
-456	-271.11		-306	-187.78		-248.8	-156	-104.44	+21.2	-6	-21.11	291.2	144	62.22
-454	-270.00		-304	-186.67		-245.2	-154	-103.33	+24.8	-4	-20.00	294.8	146	63.33
-452	-268.89		-302	-185.56		-241.6	-152	-102.22	+28.4	-2	-18.89	298.4	148	64.44
-450	-267.78		-300	-184.44		-238.0	-150	-101.11	+32.0	0	-17.78	302.0	150	65.56
-448	-266.67		-298	-183.33		-234.4	-148	-100.00	+35.6	+2	-16.67	305.6	152	66.67
-446	-265.56		-296	-182.22		-230.8	-146	-98.89	+39.2	+4	-15.56	309.2	154	67.78
-444	-264.44		-294	-181.11		-227.2	-144	-97.78	+42.8	+6	-14.44	312.8	156	68.89
-442	-263.33		-292	-180.00		-223.6	-142	-96.67	+46.4	+8	-13.33	316.4	158	70.00
-440	-262.22		-290	-178.89		-220.0	-140	-95.56	+50.0	+10	-12.22	320.0	160	71.11
-438	-261.11		-288	-177.78		-216.4	-138	-94.44	+53.6	+12	-11.11	323.6	162	72.22
-436	-260.00		-286	-176.67		-212.8	-136	-93.33	+57.2	+14	-10.00	327.2	164	73.33
-434	-258.89		-284	-175.56		-209.2	-134	-92.22	+60.8	+16	-8.89	330.8	166	74.44
-432	-257.78		-282	-174.44		-205.6	-132	-91.11	+64.4	+18	-7.78	334.4	168	75.56
-430	-256.67		-280	-173.33		-202.0	-130	-90.00	+68.0	+20	-6.67	338.0	170	76.67
-428	-255.56		-278	-172.22		-198.4	-128	-88.89	+71.6	+22	-5.56	341.6	172	77.78
-426	-254.44		-276	-171.11		-194.8	-126	-87.78	+75.2	+24	-4.44	345.2	174	78.89
-424	-253.33		-274	-170.00		-191.2	-124	-86.67	+78.8	+26	-3.33	348.8	176	80.00
-422	-252.22	-457.6	-272	-168.89		-187.6	-122	-85.56	+82.4	+28	-2.22	352.4	178	81.11
-420	-251.11	-454.0	-270	-167.78		-184.0	-120	-84.44	+86.0	+30	-1.11	356.0	180	82.22
-418	-250.00	-450.4	-268	-166.67		-180.4	-118	-83.33	+89.6	+32	0.00	359.6	182	83.33
-416	-248.89	-446.8	-266	-165.56		-176.8	-116	-82.22	+93.2	+34	+1.11	363.2	184	84.44
-414	-247.78	-443.2	-264	-164.44		-173.2	-114	-81.11	+96.8	+36	+2.22	366.8	186	85.56
-412	-246.67	-439.6	-262	-163.33		-169.6	-112	-80.00	+100.4	+38	+3.33	370.4	188	86.67
-410	-245.56	-436.0	-260	-162.22		-166.0	-110	-78.89	+104.0	+40	+4.44	374.0	190	87.78
-408	-244.44	-432.4	-258	-161.11		-162.4	-108	-77.78	107.6	42	5.56	377.6	192	88.89
-406	-243.33	-428.8	-256	-160.00		-158.8	-106	-76.67	111.2	44	6.67	381.2	194	90.00
-404	-242.22	-425.2	-254	-158.89		-155.2	-104	-75.56	114.8	46	7.78	384.8	196	91.11
-402	-241.11	-421.6	-252	-157.78		-151.6	-102	-74.44	118.4	48	8.89	388.4	198	92.22
-400	-240.00	-418.0	-250	-156.67		-148.0	-100	-73.33	122.0	50	10.00	392.0	200	93.33</

REFERENCE DATA TEMPERATURE CONVERSION TABLE

F ← C / F → C			F ← C / F → C			F ← C / F → C			F ← C / F → C			F ← C / F → C		
557.6	292	144.44	870.8	466	241.11	1832.0	1000	537.78	3398.0	1870	1021.1	4964.0	2740	1504.4
561.2	294	145.56	874.4	468	242.22	1850.0	1010	543.33	3416.0	1880	1026.7	4982.0	2750	1510.0
564.8	296	146.67	878.0	470	243.33	1868.0	1020	548.89	3434.0	1890	1032.2	5000.0	2760	1515.6
568.4	298	147.78	881.6	472	244.44	1886.0	1030	554.44	3452.0	1900	1037.8	5018.0	2770	1521.1
572.0	300	148.89	885.2	474	245.56	1904.0	1040	560.00	3470.0	1910	1043.3	5036.0	2780	1526.7
575.6	302	150.00	888.8	476	246.67	1922.0	1050	565.56	3488.0	1920	1048.9	5054.0	2790	1532.2
579.2	304	151.11	892.4	478	247.78	1940.0	1060	571.11	3506.0	1930	1054.4	5072.0	2800	1537.8
582.8	306	152.22	896.0	480	248.89	1958.0	1070	576.67	3524.0	1940	1060.0	5090.0	2810	1543.3
586.4	308	153.33	899.6	482	250.00	1976.0	1080	582.22	3542.0	1950	1065.6	5108.0	2820	1548.9
590.0	310	154.44	903.2	484	251.11	1994.0	1090	587.78	3560.0	1960	1071.1	5126.0	2830	1554.4
593.6	312	155.56	906.8	486	252.22	2012.0	1100	593.33	3578.0	1970	1076.7	5144.0	2840	1560.0
597.2	314	156.67	910.4	488	253.33	2030.0	1110	598.89	3596.0	1980	1082.2	5162.0	2850	1565.6
600.8	316	157.78	914.0	490	254.44	2048.0	1120	604.44	3614.0	1990	1087.8	5180.0	2860	1571.1
604.4	318	158.89	917.6	492	255.56	2066.0	1130	610.00	3632.0	2000	1093.3	5198.0	2870	1576.7
608.0	320	160.00	921.2	494	256.67	2084.0	1140	615.56	3650.0	2010	1098.9	5216.0	2880	1582.2
611.6	322	161.11	924.8	496	257.78	2102.0	1150	621.11	3668.0	2020	1104.4	5234.0	2890	1587.8
615.2	324	162.22	928.4	498	258.89	2120.0	1160	626.67	3686.0	2030	1110.0	5252.0	2900	1593.3
618.8	326	163.33	932.0	500	260.00	2138.0	1170	632.22	3704.0	2040	1115.6	5270.0	2910	1598.9
622.4	328	164.44	935.6	502	261.11	2156.0	1180	637.78	3722.0	2050	1121.1	5288.0	2920	1604.4
626.0	330	165.56	939.2	504	262.22	2174.0	1190	643.33	3740.0	2060	1126.7	5306.0	2930	1610.0
629.6	332	166.67	942.8	506	263.33	2192.0	1200	648.89	3758.0	2070	1132.2	5324.0	2940	1615.6
633.2	334	167.78	946.4	508	264.44	2210.0	1210	654.44	3776.0	2080	1137.8	5342.0	2950	1621.1
636.8	336	168.89	950.0	510	265.56	2228.0	1220	660.00	3794.0	2090	1143.3	5360.0	2960	1626.7
640.4	338	170.00	953.6	512	266.67	2246.0	1230	665.56	3712.0	2100	1148.9	5378.0	2970	1632.2
644.0	340	171.11	957.2	514	267.78	2264.0	1240	671.11	3830.0	2110	1154.4	5396.0	2980	1637.8
647.6	342	172.22	960.8	516	268.89	2282.0	1250	676.67	3848.0	2120	1160.0	5414.0	2990	1643.3
651.2	344	173.33	964.4	518	270.00	2300.0	1260	682.22	3866.0	2130	1165.6	5432.0	3000	1648.9
654.8	346	174.44	968.0	520	271.11	2318.0	1270	687.78	3884.0	2140	1171.1	5450.0	3010	1654.4
658.4	348	175.56	971.6	522	272.22	2336.0	1280	693.33	3902.0	2150	1176.7	5468.0	3020	1660.0
662.0	350	176.67	975.2	524	273.33	2354.0	1290	698.89	3920.0	2160	1182.2	5486.0	3030	1665.6
665.6	352	177.78	978.8	526	274.44	2372.0	1300	704.44	3938.0	2170	1187.8	5504.0	3040	1671.1
669.2	354	178.89	982.4	528	275.56	2390.0	1310	710.00	3956.0	2180	1193.3	5522.0	3050	1676.7
672.8	356	180.00	986.0	530	276.67	2408.0	1320	715.56	3974.0	2190	1198.9	5540.0	3060	1682.2
676.4	358	181.11	989.6	532	277.78	2426.0	1330	721.11	3992.0	2200	1204.4	5558.0	3070	1687.8
680.0	360	182.22	993.2	534	278.89	2444.0	1340	726.67	4010.0	2210	1210.0	5576.0	3080	1693.3
683.6	362	183.33	996.8	536	280.00	2462.0	1350	732.22	4028.0	2220	1215.6	5594.0	3090	1698.9
687.2	364	184.44	1000.4	538	281.11	2480.0	1360	737.78	4046.0	2230	1221.1	5612.0	3100	1704.4
690.8	366	185.56	1004.0	540	282.22	2498.0	1370	743.33	4064.0	2240	1226.7	5630.0	3110	1710.0
694.4	368	186.67	1007.6	542	283.33	2516.0	1380	748.89	4082.0	2250	1232.2	5648.0	3120	1715.6
698.0	370	187.78	1011.2	544	284.44	2534.0	1390	754.44	4100.0	2260	1237.8	5666.0	3130	1721.1
701.6	372	188.89	1014.8	546	285.56	2552.0	1400	760.00	4118.0	2270	1243.3	5684.0	3140	1726.7
705.2	374	190.00	1018.4	548	286.67	2570.0	1410	765.56	4136.0	2280	1248.9	5702.0	3150	1732.2
708.8	376	191.11	1022.0	550	287.78	2588.0	1420	771.11	4154.0	2290	1254.4	5720.0	3160	1737.8
712.4	378	192.22	1025.6	552	288.89	2606.0	1430	776.67	4172.0	2300	1260.0	5738.0	3170	1743.3
716.0	380	193.33	1029.2	554	290.00	2624.0	1440	782.22	4190.0	2310	1265.6	5756.0	3180	1748.9
719.6	382	194.44	1032.8	556	291.11	2642.0	1450	787.78	4208.0	2320	1271.1	5774.0	3190	1754.4
723.2	384	195.56	1036.4	558	292.22	2660.0	1460	793.33	4226.0	2330	1276.7	5792.0	3200	1760.0
726.8	386	196.67	1040.0	560	293.33	2678.0	1470	798.89	4244.0	2340	1282.2	5810.0	3210	1765.6
730.4	388	197.78	1043.6	562	294.44	2696.0	1480	804.44	4262.0	2350	1287.8	5828.0	3220	1771.1
734.0	390	198.89	1047.2	564	295.56	2714.0	1490	810.00	4280.0	2360	1293.3	5846.0	3230	1776.7
737.6	392	200.00	1050.8	566	296.67	2732.0	1500	815.56	4298.0	2370	1298.9	5864.0	3240	1782.2
741.2	394	201.11	1054.4	568	297.78	2750.0	1510	821.11	4316.0	2380	1304.4	5882.0	3250	1787.8
744.8	396	202.22	1058.0	570	298.89	2768.0	1520	826.67	4334.0	2390	1310.0	5900.0	3260	1793.3
748.4	398	203.33	1061.6	572	300.00	2786.0	1530	832.22	4352.0	2400	1315.6	5918.0	3270	1798.9
752.0	400	204.44	1065.2	574	301.11	2804.0	1540	837.78	4370.0	2410	1321.1	5936.0	3280	1804.4
755.6	402	205.56	1068.8	576	302.22	2822.0	1550	843.33	4388.0	2420	1326.7	5954.0	3290	1810.0
759.2	404	206.67	1072.4	578	303.33	2840.0	1560	848.89	4406.0	2430	1332.2	5972.0	3300	1815.6
762.8	406	207.78	1076.0	580	304.44	2858.0	1570	854.44	4424.0	2440	1337.8	5990.0	3310	1821.1
766.4	408	208.89	1079.6	582	305.56	2876.0	1580	860.00	4442.0	2450	1343.3	6008.0	3320	1826.7
770.0	410	210.00	1083.2	584	306.67	2894.0	1590	865.56	4460.0	2460	1348.9	6026.0	3330	1832.2
773.6	412	211.11	1086.8	586	307.78	2912.0	1600	871.11	4478.0	2470	1354.4	6044.0	3340	1837.8
777.2	414	212.22	1090.4	588	308.89	2930.0	1610	876.67	4496.0	2480	1360.0	6062.0	3350	1843.3
780.8	416	213.33	1094.0	590	310.00	2948.0	1620	882.22	4514.0	2490	1365.6	6080.0	3360	1848.9
784.4	418	214.44	1097.6	592	311.11	2966.0	1630	887.78	4532.0	2500	1371.1	6098.0	3370	1854.4
788.0	420	215.56	1101.2	594	312.22	2984.0	1640	893.33	4550.0	2510	1376.7	6116.0	3380	1860.0
791.6	422	216.67	1104.8	596	313.33	3002.0	1650	898.89	4568.0	2520	1382.2	6134.0	3390	1865.6
795.2	424	217.78	1108.4	598	314.44	3020.0	1660	904.44	4586.0	2530	1387.8	6152.0	3400	1871.1
798.8	426	218.89	1112.0	600	315.56	3038.0	1670	910.00	4604.0	2540	1393.3	6170.0	3410	1876.7
802.4	428	220.00	1115.6	602	316.67	3056.0	1680	915.56	4622.0	2550	1398.9	6188.0	3420	1882.2
806.0	430	221.11	1119.2	604	317.78	3074.0	1690	921.11	4640.0	2560	1404.4	6206.0	3430	1887.8
809.6	432	222.22	1122.8	606	318.89	3092.0	1700	926.67	4658.0	2570	1410.0	6224.0	3440	1893.3
813.2	434	223.33	1126.4	608	320.00	3110.0	1710	932.22	4676.0	2580	1415.6	6242.0	3450	1898.9
816.8	436	224.44	1130.0	610	321.11	3128.0	1720	937.78	4694.0	2590	1421.1	6260.0	3460	1904.4
820.4	438	225.56	1133.6	612	322.22	3146.0	1730	943.33	4712.0	2600	1426.7	6278.0	3470	1910.0
824.0	440	226.67	1137.2	614	323.33	3164.0	1740	948.89	4730.0	2610	1432.2	6296.0	3480	1915.6
827.6	442	227.78	1140.8	616	324.44	3182.0	1750	954.44	4748.0	2620	1437.8	6314.0	3490	1921.1
831.2	444	228.89	1144.4	618	325.56	3200.0	1760	960.00	4766.0	2630	1443.3	6332.0	3500	1926.7
834.8	446	230.00	1148.0	620	326.6									



MANUAL ON THE USE OF THERMOCOUPLES IN TEMPERATURE MEASUREMENT

ASTM Manual Series: MNL-12, \$49.00

Edited by R.M. Park of Marlin Manufacturing Corp., and co-authored by experienced experts from a cross-section of American industry, this newly-revised Fourth Edition of a widely used and highly-regarded 311-page hard cover reference volume on thermocouple thermometry has been completely revised in accordance with latest ITS-90 requirements.

All text in this new edition has been completely reviewed and brought up to date. Whole chapters were completely rewritten, where necessary. The latest ITS-90 tables of EMF vs. Temperature, extracted from NIST Monograph 175 are included in a new easy to read format. Polynomial coefficients for the functions to generate the tables together with inverse polynomial functions, useful for determining temperature from a measured thermocouple emf, are presented. The calibration chapter was completely revised to reflect ITS-90 requirements. Manual 12 is the definitive reference work for the practical user of thermocouples.