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*The maintenance
man has got to
be cunning,*

*To keep the entire
assembly line
humming,*

*A jack-of-all-trades
and master of all,*

*When something's not
running, he's the
first one they call.*

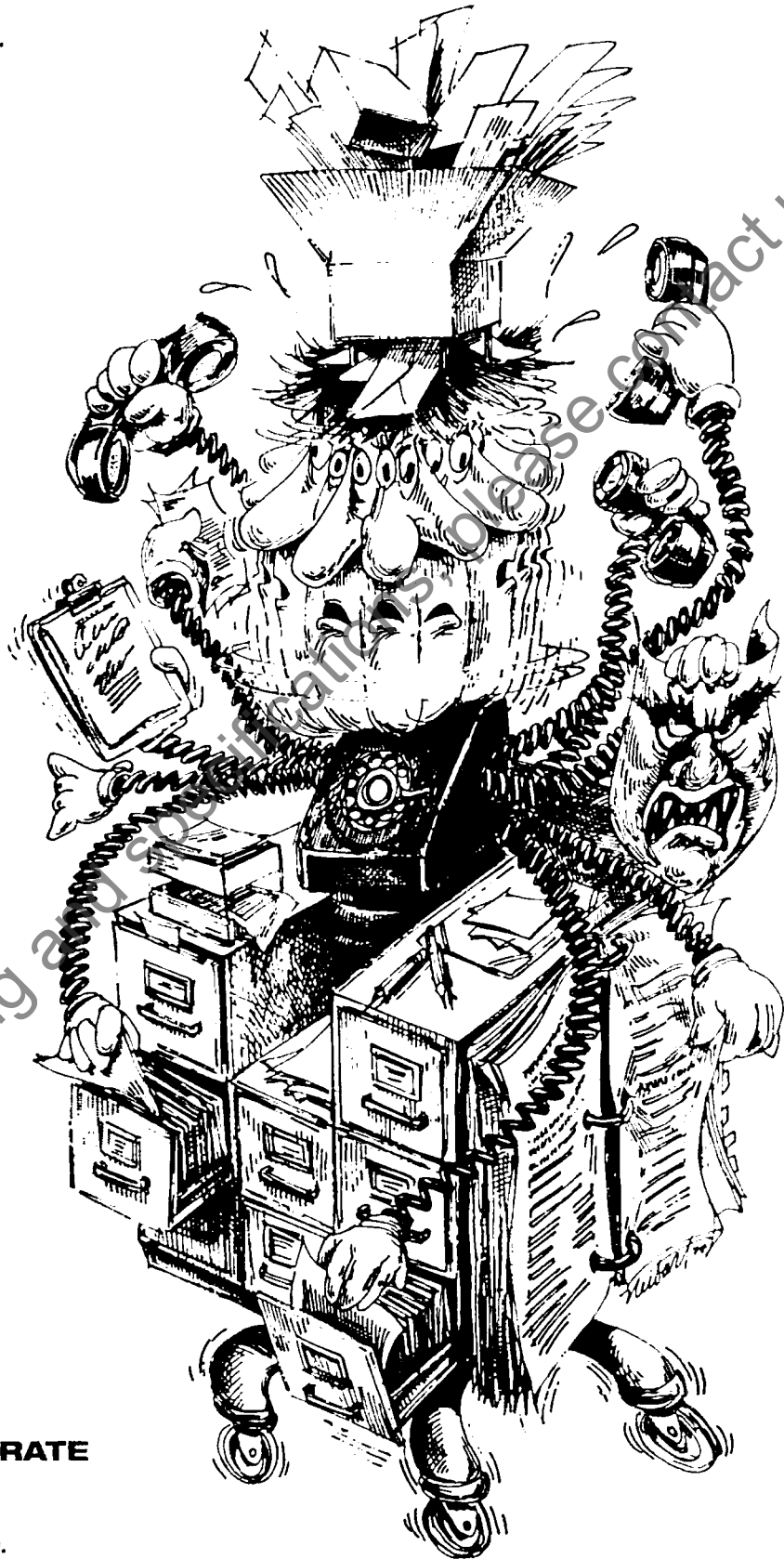


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The Purchasing Agent...

*Pity the man who
buys the goods,
That keeps the plant
on-line,
What the factory
needed by eight
o'clock,
They didn't request
'til nine.*



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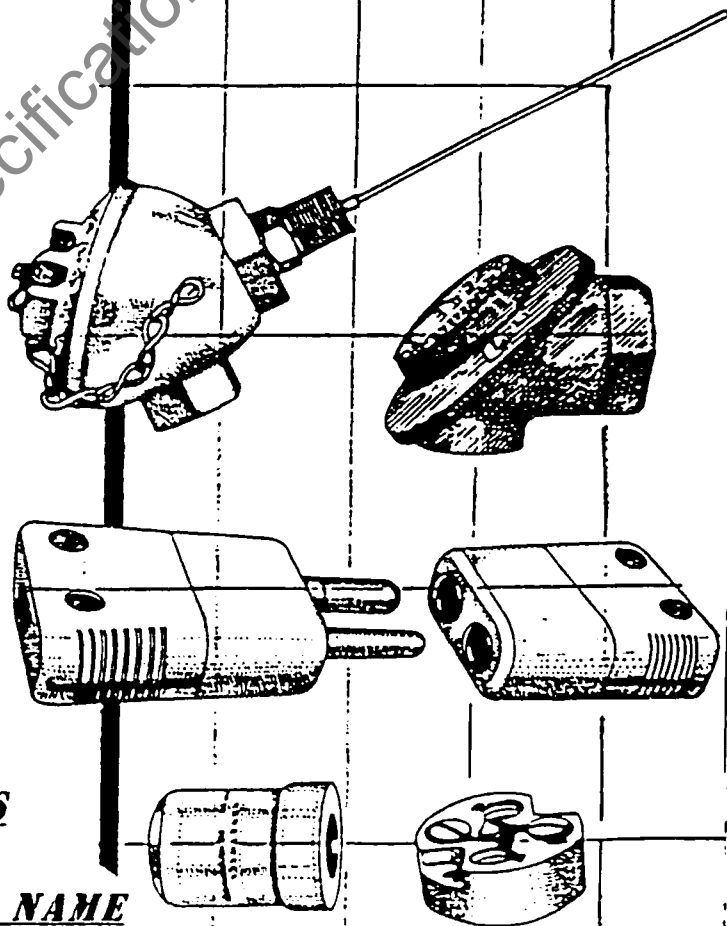
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TECHNICAL OVERVIEW OF THE THERMOCOUPLE

• BASIC THERMOCOUPLE OPERATION:

- Of all the primary measuring sensors, the thermocouple is perhaps the easiest to visualize. A thermocouple consists essentially of a pair of dissimilar conductors welded or fused together at one end to form the 'hot' or measuring junction with the free ends available for connection to the 'cold' or reference junction.
- A temperature difference between the measuring and reference junctions must exist for this device to function as a thermocouple. When this occurs, small electromotive forces (emf's) are generated. These emf's originate at the "hot" junction as well as wherever there is a temperature gradient between parts of the same wire.



• BASIC THERMOCOUPLE CHARACTERISTICS:

Consistent temperature/emf relationship:

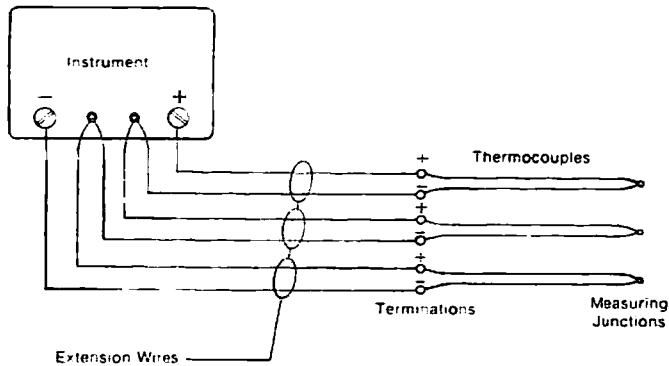
- The direction of the Thompson emf of the two wires must be such as to be additive of the circuit.
- The Thompson emf should vary directly with the temperature.
- The Peltier emf at the measuring junction must develop a potential having the same direction with the temperature.
- The Peltier emf should vary directly with the temperature of both the measuring and reference junctions.
- Effective temperature range of use.
- Good resistance to thermoelectric and mechanical changes due to:
 1. Evaporation
 2. Diffusion
 3. Oxidation
 4. Corrosion
 5. Contamination
- Desirable Chemical Behavior
- High Intensity of Thermoelectric Power
- Low Cost

(ALL EMF TABLES ARE SHOWN ON THE FOLLOWING PAGES).

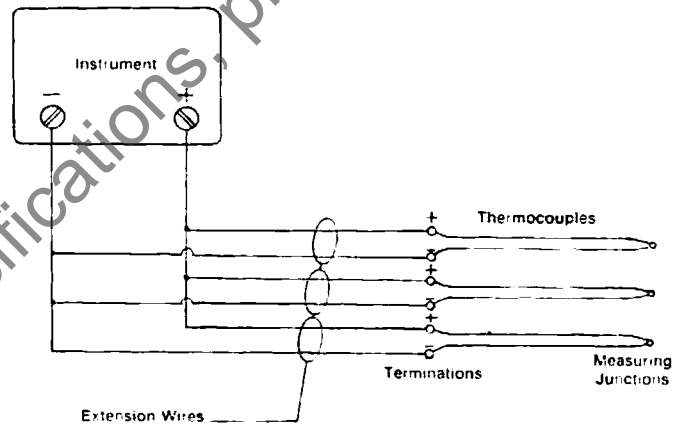
THERMOCOUPLES

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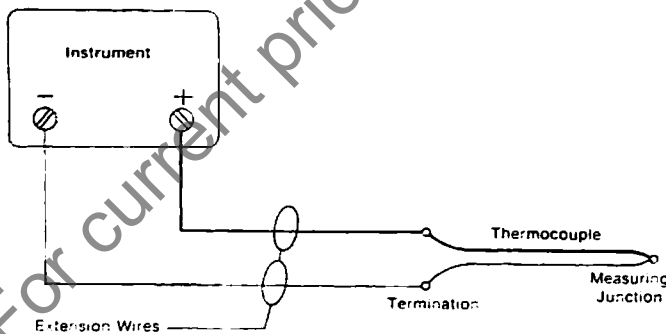
- **TYPICAL THERMOCOUPLE WIRING CIRCUITS:**



THERMOCOUPLES SHOWN ARE CONNECTED IN A "SERIES CIRCUIT."



THERMOCOUPLES SHOWN ARE CONNECTED IN "PARALLEL CIRCUITS".



THERMOCOUPLE UTILIZING EXTENSION WIRES.

RECOMMENDED TEMPERATURE LIMITS FOR THERMOCOUPLES					
Thermocouple Type	8 Gauge °F (°C)	14 Gauge °F (°C)	20 Gauge °F (°C)	24 Gauge °F (°C)	28 Gauge °F (°C)
T	-	700° (371.1)°	500° (260.0)°	400° (204.4)°	400° (204.4)°
J	1400° (760)°	1100° (593.3)°	900° (482.2)°	700° (371.1)°	700° (371.1)°
E	1600° (871)°	1200° (648.9)°	1000° (537.8)°	800° (426.7)°	800° (426.7)°
K	2300° (1260)°	2000° (1093.3)°	1800° (982.2)°	1600° (871.1)°	1600° (871.1)°
B	-	-	-	3100° (1705)°	-
R	-	-	-	2700° (1482)°	-
S	-	-	-	2700° (1482)°	-
Tungsten 5% Rhenium	-	-	-	4200° (2330)°	-
Tungsten 26% Rhenium	-	-	-	-	-
Tungsten-Tungsten 26% Rhenium	-	-	-	4200° (2330)°	-

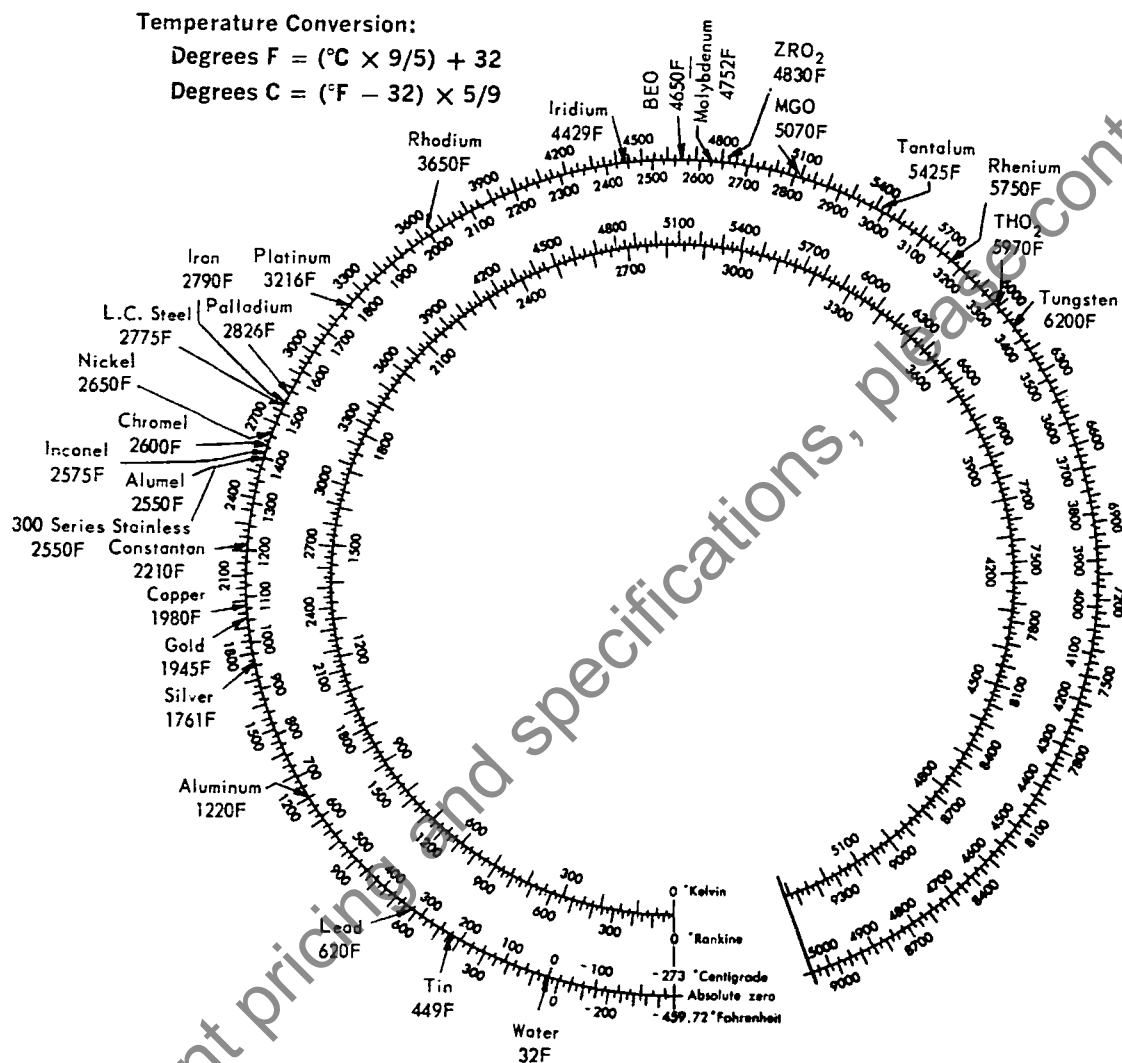
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1

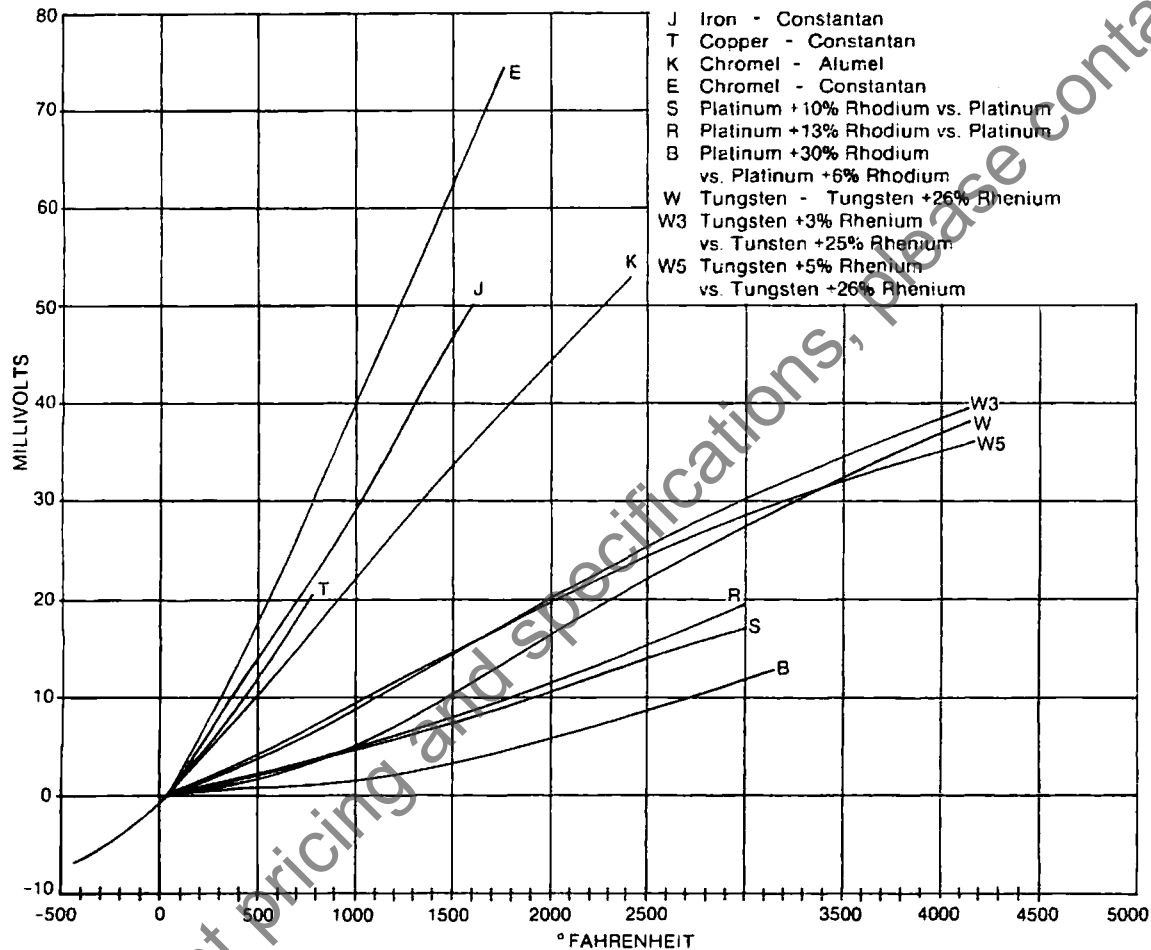
INSTRUMENT FOREMAN AND CHIEF ENGINEER'S TEMPERATURE CONVERSION CHART

SHOWS MELTING POINTS OF COMMONLY USED THERMOCOUPLE ELEMENTS.



THERMOCOUPLE TEMPERATURE/EMF CHART:

Temperature is in °F.
EMF is in Millivolts.
Reference Junction: 32°F.



THERMOCOUPLES

1

INSTRUMENT FOREMAN'S GUIDE TO THERMOCOUPLE TEMPERATURE AND EMF TABLES

TEMPERATURES STATED IN DEGREES °F/EMF STATED IN MILLIVOLTS
REFERENCE JUNCTION: 32°F (0°C)

°F	J	K	E	T	S PT/ PT10%	R PT/ PT13%	P30	W W3/ W25	W5 W5/ W26
32	-	-	-	-	-	-	-	-	-
40	0.224	0.176	0.262	0.173	0.024	0.024	-0.001	0.006	0.059
50	0.507	0.397	0.591	0.391	0.055	0.054	-0.002	0.015	0.135
60	0.791	0.619	0.924	0.611	0.087	0.086	-0.002		
70	1.076	0.843	1.259	0.834	0.119	0.118	-0.003		
80	1.363	1.068	1.597	1.060	0.152	0.150	-0.002		
90	1.652	1.294	1.937	1.288	0.186	0.184	-0.002		
100	1.942	1.520	2.281	1.518	0.221	0.218	-0.001	0.079	0.522
110	2.233	1.748	2.627	1.752	0.256	0.253	0.000		
120	2.526	1.977	2.977	1.988	0.291	0.289	0.002		
130	2.820	2.206	3.329	2.226	0.328	0.326	0.004		
140	3.115	2.436	3.683	2.467	0.365	0.363	0.006		
150	3.411	2.666	4.041	2.711	0.402	0.400	0.009	0.174	0.927
160	3.708	2.896	4.401	2.958	0.440	0.439	0.012		
170	4.006	3.127	4.764	3.206	0.478	0.478	0.015		
180	4.305	3.358	5.130	3.458	0.517	0.517	0.019		
190	4.605	3.589	5.498	3.711	0.557	0.557	0.023		
200	4.906	3.819	5.869	3.967	0.597	0.598	0.027	0.299	1.348
210	5.207	4.049	6.242	4.225	0.637	0.639	0.032		
220	5.509	4.279	6.618	4.486	0.678	0.681	0.037		
230	5.812	4.508	6.996	4.749	0.719	0.723	0.043		
240	6.116	4.737	7.377	5.014	0.761	0.766	0.049		
250	6.420	4.964	7.760	5.281	0.803	0.809	0.055	0.453	1.783
260	6.724	5.192	8.145	5.550	0.846	0.852	0.061		
270	7.029	5.418	8.532	5.821	0.889	0.897	0.068		
280	7.335	5.643	8.922	6.094	0.932	0.941	0.075		
290	7.641	5.868	9.314	6.369	0.976	0.986	0.083		
300	7.947	6.092	9.708	6.647	1.020	1.032	0.090	0.634	2.232
310	8.253	6.316	10.103	6.926	1.064	1.077	0.099		
320	8.560	6.539	10.501	7.207	1.109	1.124	0.107		
330	8.867	6.761	10.901	7.490	1.154	1.170	0.116		
340	9.175	6.984	11.302	7.775	1.199	1.217	0.125		
350	9.483	7.205	11.706	8.062	1.245	1.265	0.135	0.842	2.693
360	9.790	7.427	12.111	8.350	1.291	1.313	0.144		
370	10.098	7.649	12.518	8.641	1.337	1.361	0.155		
380	10.407	7.870	12.926	8.933	1.384	1.409	0.165		
390	10.715	8.092	13.336	9.227	1.431	1.458	0.176		
400	11.023	8.314	13.748	9.523	1.478	1.508	0.187	1.075	3.165
410	11.332	8.537	14.161	9.820	1.525	1.557	0.199		
420	11.640	8.759	14.576	10.120	1.573	1.607	0.210		
430	11.949	8.983	14.992	10.420	1.620	1.657	0.223		
440	12.257	9.206	15.410	10.723	1.669	1.708	0.235		
450	12.566	9.430	15.829	11.027	1.717	1.758	0.248	1.333	3.648
460	12.874	9.655	16.249	11.333	1.765	1.810	0.261		

TEMPERATURE / EMF TABLES (CONTINUED).

°F	J	K	E	T	S PT/ PT10%	R PT/ PT13%	P30	W W3/ W25	W5 W5/ W26
470	13.183	9.880	16.670	11.640	1.814	1.861	0.275		
480	13.491	10.106	17.093	11.949	1.863	1.913	0.288		
490	13.800	10.333	17.517	12.260	1.912	1.964	0.303		
500	14.108	10.560	17.942	12.572	1.962	2.017	0.317	1.613	4.140
510	14.416	10.787	18.368	12.885	2.011	2.069	0.332		
520	14.724	11.015	18.795	13.200	2.061	2.122	0.347		
530	15.032	11.243	19.223	13.516	2.111	2.175	0.362		
540	15.340	11.472	19.653	13.834	2.161	2.228	0.378		
550	15.648	11.702	20.083	14.153	2.211	2.282	0.394	1.915	4.641
560	15.956	11.931	20.514	14.474	2.262	2.335	0.410		
570	16.264	12.161	20.947	14.795	2.313	2.389	0.427		
580	16.571	12.392	21.380	15.118	2.366	2.443	0.444		
590	16.879	12.623	21.814	15.443	2.414	2.498	0.462		
600	17.186	12.854	22.248	15.769	2.465	2.552	0.479	2.238	5.149
610	17.493	13.085	22.684	16.096	2.517	2.607	0.497		
620	17.800	13.317	23.120	16.424	2.568	2.662	0.515		
630	18.107	13.549	23.558	16.753	2.620	2.718	0.534		
640	18.414	13.781	23.996	17.084	2.672	2.773	0.553		
650	18.721	14.013	24.434	17.416	2.723	2.829	0.572	2.581	5.664
660	19.027	14.246	24.873	17.750	2.775	2.885	0.592		
670	19.334	14.479	25.313	18.084	2.828	2.941	0.612		
680	19.640	14.712	25.754	18.420	2.880	2.997	0.632		
690	19.947	14.945	26.195	18.757	2.932	3.053	0.652		
700	20.253	15.178	26.637	19.095	2.985	3.110	0.673	2.943	6.184
710	20.559	15.412	27.079	19.434	3.037	3.167	0.694		
720	20.866	15.646	27.522	19.774	3.090	3.224	0.716		
730	21.172	15.880	27.966	20.116	3.143	3.281	0.737		
740	21.478	16.114	28.409	20.458	3.196	3.338	0.759		
750	21.785	16.349	28.854	20.801	3.249	3.396	0.782	3.323	6.710
760	22.091	16.583	29.299		3.302	3.453	0.804		
770	22.397	16.818	29.744		3.356	3.511	0.827		
780	22.704	17.053	30.190		3.409	3.569	0.851		
790	23.010	17.288	30.636		3.463	3.627	0.874		
800	23.317	17.523	31.082		3.516	3.686	0.898	3.720	7.240
810	23.624	17.759	31.529		3.570	3.744	0.922		
820	23.931	17.994	31.976		3.624	3.803	0.947		
830	24.238	18.230	32.423		3.678	3.862	0.972		
840	24.546	18.466	32.871		3.732	3.921	0.997		
850	24.853	18.702	33.319		3.786	3.980	1.022	4.133	7.774
860	25.161	18.938	33.767		3.840	4.039	1.048		
870	25.469	19.174	34.215		3.895	4.099	1.074		
880	25.778	19.410	34.664		3.949	4.158	1.100		
890	26.087	19.646	35.113		4.004	4.218	1.127		
900	26.396	19.883	35.562		4.058	4.278	1.153	4.562	8.310
910	26.705	20.120	36.011		4.113	4.338	1.181		
920	27.016	20.356	36.460		4.168	4.398	1.208		
930	27.326	20.593	36.909		4.223	4.458	1.236		
940	27.637	20.830	37.358		4.278	4.519	1.264	4.915	8.741

THERMOCOUPLES

1

TEMPERATURE / EMF TABLES (CONTINUED).

°F	J	K	E	S PT/ PT10%	R PT/ PT13%	B PT6/ PT30	W W/ W26	W5 W5/ W26
950	27.949	21.066	37.808	4.333	4.580	1.292	5.005	8.849
960	28.261	21.303	38.257	4.388	4.640	1.321		
970	28.573	21.540	38.707	4.443	4.701	1.350		
980	28.887	21.777	39.157	4.498	4.762	1.379		
990	29.201	22.014	39.606	4.554	4.824	1.409		
1,000	29.515	22.251	40.056	4.609	4.885	1.438	5.461	9.390
1,010	29.831	22.488	40.505	4.665	4.947	1.468		
1,020	30.147	22.725	40.955	4.721	5.008	1.499		
1,030	30.464	22.961	41.404	4.776	5.070	1.529		
1,040	30.782	23.198	41.853	4.832	5.132	1.560		
1,050	31.100	23.435	42.303	4.888	5.194	1.591	5.930	9.932
1,060	31.420	23.672	42.752	4.944	5.256	1.623		
1,070	31.740	23.908	42.201	5.000	5.319	1.655		
1,080	32.061	24.145	43.650	5.057	5.381	1.687		
1,090	32.384	24.382	44.098	5.113	5.444	1.719		
1,100	32.707	24.618	44.547	5.169	5.507	1.752	6.412	10.475
1,110	33.031	24.854	44.995	5.226	5.570	1.785		
1,120	33.356	25.091	45.443	5.283	5.633	1.818		
1,130	33.683	25.327	45.891	5.339	5.696	1.851		
1,140	34.010	25.563	46.339	5.396	5.759	1.885		
1,150	34.339	25.799	46.786	5.453	5.823	1.919	6.904	11.019
1,160	34.668	26.034	47.234	5.510	5.886	1.953		
1,170	34.999	26.270	47.681	5.567	5.950	1.988		
1,180	35.331	26.505	48.127	5.625	6.014	2.022		
1,190	35.664	26.740	48.574	5.682	6.078	2.058		
1,200	35.999	26.975	49.020	5.740	6.143	2.093	7.407	11.561
1,210	36.334	27.210	49.466	5.797	6.207	2.128		
1,220	36.671	27.445	49.911	5.855	6.272	2.164		
1,230	37.009	27.679	50.357	5.913	6.336	2.201		
1,240	37.348	27.914	50.802	5.971	6.401	2.237		
1,250	37.688	28.148	51.246	6.029	6.466	2.274	7.920	12.104
1,260	38.030	28.382	51.691	6.087	6.532	2.311		
1,270	38.372	28.615	52.135	6.146	6.597	2.348		
1,280	38.716	28.849	52.578	6.204	6.662	2.385		
1,290	39.061	29.082	53.022	6.263	6.728	2.423		
1,300	39.407	29.315	53.465	6.321	6.794	2.461	8.441	12.645
1,310	39.754	29.547	53.907	6.380	6.860	2.499		
1,320	40.103	29.780	54.349	6.439	6.926	2.538		
1,330	40.452	30.012	54.791	6.498	6.992	2.576		
1,340	40.802	30.244	55.233	6.557	7.059	2.615		
1,350	41.154	30.475	55.674	6.616	7.125	2.655	8.971	13.185
1,360	41.506	30.706	56.115	6.675	7.192	2.694		
1,370	41.859	30.937	56.555	6.734	7.259	2.734		
1,380	42.212	31.168	56.995	6.794	7.326	2.774		
1,390	42.567	31.399	57.434	6.853	7.393	2.814		
1,400	42.922	31.629	57.873	6.913	7.460	2.855	9.509	13.723
1,410	43.278	31.859	58.312	6.972	7.527	2.896		

TEMPERATURE / EMF TABLES (CONTINUED).

F	J	K	E	S PT/ PT10%	R PT/ PT13%	B PT6/ PT30	W W/ W26	W5 W5/ W26
1.420	43 635	32.088	58.750	7.032	7.595	2.937		
1.430	43.992	32.317	59.188	7.092	7.663	2.978		
1.440	44.350	32.546	59.626	7.152	7.731	3.019		
1.450	44.709	32.775	60.063	7.212	7.799	3.061	10.054	14.259
1.460	45.067	33.003	60.499	7.272	7.867	3.103		
1.470	45.426	33.231	60.935	7.333	7.9.5	3.146		
1.480	45.785	33.459	61.371	7.393	8.004	3.188		
1.490	46.144	33.686	61.806	7.454	8.072	3.231		
1.500	46.503	33.913	62.240	7.514	8.141	3.274	10.606	14.792
1.510	46.861	34.140	62.675	7.575	8.210	3.317		
1.520	47.219	34.366	63.108	7.636	8.279	3.361		
1.530	47.577	34.593	63.542	7.697	8.348	3.404		
1.540	47.934	34.818	63.974	7.758	8.417	3.448		
1.550	48.290	35.044	64.406	7.819	8.487	3.492	11.163	15.323
1.560	48.645	35.269	64.838	7.880	8.556	3.537		
1.570	49.000	35.494	65.269	7.942	8.626	3.581		
1.580	49.354	35.718	65.700	8.003	8.696	3.626		
1.590	49.707	35.942	66.130	8.065	8.766	3.672		
1.600	50.059	36.166	66.559	8.126	8.836	3.717	11.725	15.851
1.610	50.441	36.390	66.988	8.188	8.907	3.762		
1.620	50.761	36.613	67.416	8.250	8.977	3.808		
1.630	51.110	36.836	67.844	8.312	9.048	3.854		
1.640	51.458	37.058	68.271	8.374	9.118	3.901		
1.650	51.805	37.280	68.698	8.436	9.189	3.947	12.293	16.376
1.660	52.151	37.502	69.124	8.498	9.260	3.994		
1.670	52.496	37.724	69.549	8.560	9.331	4.041		
1.680	52.840	37.945	69.974	8.623	9.403	4.088		
1.690	53.183	38.166	70.398	8.685	9.474	4.136		
1.700	53.525	38.387	70.821	8.748	9.546	4.183	12.864	16.898
1.710	53.865	38.607	71.244	8.811	9.617	4.231		
1.720	54.205	38.827	71.667	8.874	9.689	4.279		
1.730	54.544	39.046	72.088	8.937	9.761	4.327		
1.740	54.881	39.266	72.509	9.000	9.833	4.376		
1.750	55.218	39.485	72.930	9.063	9.906	4.425	13.439	17.416
1.760	55.553	39.703	73.350	9.126	9.978	4.474		
1.770	55.888	39.922	73.769	9.190	10.050	4.523		
1.780	56.221	40.140	74.188	9.253	10.123	4.572		
1.790	56.554	40.358	74.606	9.317	10.196	4.622		
1.800	56.886	40.575	75.024	9.380	10.269	4.672	14.018	17.930
1.810	57.217	40.792	75.441	9.444	10.342	4.722		
1.820	57.547	41.009	75.858	9.508	10.415	4.772		
1.830	57.876	41.225	76.274	9.572	10.488	4.823		
1.840	58.205	41.442		9.636	10.562	4.873		
1.850	58.533	41.657		9.700	10.636	4.924	14.598	18.440
1.860	58.860	41.873		9.764	10.709	4.975		
1.870	59.187	42.088		9.829	10.783	5.027		
1.880	59.513	42.303		9.893	10.857	5.078		
1.890	59.838	42.518		9.958	10.931	5.130	15.065	18.846

THERMOCOUPLES

TEMPERATURE / EMF TABLES (CONTINUED)

F	J	K	S PT/ PT10%	R PT/ PT13%	B PT6/ PT30	W W/ W26	W5 W5/ W26	F	S PT/ PT10%	R PT/ PT13%	B PT6/ PT30	W W/ W26	W5 W5/ W26
1.900	60.163	42.732	10.023	11.006	5.182	15.182	18.947	2.510	14.085	15.705	8.690		
1.910	60.488	42.946	10.087	11.080	5.234			2.520	14.152	15.784	8.752		
1.920	60.812	43.159	10.152	11.155	5.286			2.530	14.220	15.862	8.814		
1.930	61.135	43.373	10.217	11.229	5.339			2.540	14.287	15.941	8.877		
1.940	61.459	43.585	10.282	11.304	5.391			2.550	14.354	16.019	8.939	22.770	25.13
1.950	61.781	43.798	10.348	11.379	5.444	15.766	19.449	2.560	14.422	16.097	9.002		
1.960	62.104	44.010	10.413	11.454	5.497			2.570	14.489	16.176	9.065		
1.970	62.426	44.222	10.478	11.529	5.551			2.580	14.556	16.254	9.128		
1.980	62.748	44.434	10.544	11.605	5.604			2.590	14.624	16.333	9.191		
1.990	63.070	44.645	10.609	11.680	5.658			2.600	14.691	16.411	9.254	23.341	25.574
2.000	63.392	44.856	10.675	11.756	5.712	16.353	19.947	2.610	14.758	16.490	9.317		
2.010	63.713	45.066	10.740	11.831	5.766			2.620	14.826	16.568	9.380		
2.020	64.034	45.276	10.806	11.907	5.820			2.630	14.893	16.646	9.443		
2.030	64.355	45.486	10.872	11.983	5.875			2.640	14.960	16.725	9.507		
2.040	64.676	45.695	10.938	12.059	5.930			2.650	15.027	16.803	9.570	23.909	26.013
2.050	64.997	45.904	11.004	12.135	5.984	16.939	20.441	2.660	15.094	16.882	9.634		
2.060	65.318	46.113	11.070	12.211	6.039			2.670	15.161	16.960	9.697		
2.070	65.638	46.321	11.136	12.287	6.095			2.680	15.228	17.038	9.761		
2.080	65.959	46.529	11.202	12.363	6.150			2.690	15.295	17.116	9.825		
2.090	66.279	46.737	11.268	12.440	6.206			2.700	15.362	17.195	9.889	24.474	26.447
2.100	66.600	46.944	11.335	12.516	6.262	17.527	20.930	2.710	15.429	17.273	9.953		
2.110	66.920	47.150	11.401	12.593	6.318			2.720	15.496	17.351	10.017		
2.120	67.240	47.356	11.467	12.669	6.374			2.730	15.563	17.429	10.081		
2.130	67.559	47.562	11.534	12.746	6.430			2.740	15.630	17.507	10.145		
2.140	67.879	47.767	11.600	12.823	6.487			2.750	15.697	17.585	10.210	25.034	26.676
2.150	68.198	47.972	11.667	12.900	6.543	18.114	21.415	2.760	15.763	17.663	10.274		
2.160	68.517	48.177	11.734	12.977	6.600			2.770	15.830	17.741	10.338		
2.170	68.836	48.381	11.800	13.054	6.657			2.780	15.897	17.819	10.403		
2.180	69.155	48.584	11.867	13.131	6.714			2.790	15.963	17.897	10.467		
2.190	69.472	48.787	11.934	13.208	6.772			2.800	16.030	17.975	10.532	25.591	27.301
2.200		48.990	12.001	13.286	6.829	18.701	21.896	2.810	16.096	18.053	10.596		
2.210		49.192	12.067	13.363	6.887			2.820	16.163	18.130	10.661		
2.220		49.394	12.134	13.440	6.945			2.830	16.229	18.208	10.726		
2.230		49.595	12.201	13.518	7.000			2.840	16.295	18.286	10.790		
2.240		49.796	12.268	13.595	7.061			2.850	16.362	18.363	10.855	26.143	27.721
2.250		49.996	12.335	13.673	7.120	19.288	22.372	2.860	16.428	18.441	10.920		
2.260		50.196	12.402	13.751	7.178			2.870	16.494	18.518	10.985		
2.270		50.395	12.469	13.828	7.237			2.880	16.560	18.595	11.050		
2.280		50.594	12.536	13.906	7.296			2.890	16.626	18.673	11.115		
2.290		50.792	12.604	13.984	7.355			2.900	16.692	18.750	11.179	26.690	28.137
2.300		50.990	12.671	14.062	7.414	19.973	22.843	2.910	16.758	18.827	11.244		
2.310		51.187	12.738	14.140	7.473			2.920	16.824	18.904	11.309		
2.320		51.384	12.805	14.218	7.533			2.930	16.890	18.981	11.374		
2.330		51.580	12.872	14.296	7.592			2.940	16.955	19.058	11.439		
2.340		51.776	12.940	14.374	7.652			2.950	17.021	19.135	11.504	27.232	28.547
2.350		51.971	13.007	14.452	7.712	20.496	23.31	2.960	17.086	19.211	11.569		
2.360		52.165	13.074	14.530	7.772			2.970	17.152	19.288	11.634		
2.370		52.360	13.142	14.608	7.833			2.980	17.217	19.365	11.699		
2.380		52.553	13.209	14.686	7.893			2.990	17.282	19.441	11.764		
2.390		52.747	13.276	14.765	7.953			3.000	17.347	19.518	11.829	27.769	28.953
2.400		52.939	13.344	14.843	8.014	21.038	23.772						
2.410		53.132	13.411	14.921	8.075								
2.420		53.324	13.478	15.000	8.136								
2.430		53.515	13.546	15.078	8.197								
2.440		53.706	13.613	15.156	8.258								
2.450		53.897	13.681	15.235	8.319	21.618	24.229						
2.460		54.087	13.748	15.313	8.381								
2.470		54.277	13.815	15.391	8.442								
2.480		54.466	13.883	15.470	8.504								
2.490		54.656	13.950	15.548	8.566								
2.500		54.845	14.018	15.627	8.628	22.195	24.682						

TECH TIP:

FOR CONVERSION TO 75°F (24°C) REFERENCE JUNCTION,
SUBTRACT THE MILLIVOLT VALUES BELOW:

CALIBRATION
J
K
T
E
S

MILLIVOLT VALUE
1.220
0.955
0.947
1.427
0.136

CALIBRATION
R
B
W
W3
W5

MILLIVOLT VALUE
0.134
0.003
0.065
0.240
0.323

• COMPLETE CLASSIFICATIONS OF THERMOCOUPLE MATERIALS:

• NOBLE METALS:

- The choice of platinum as a material was based on its thermoelectric properties, excellent mechanical and chemical properties, low electrical resistivity, reproducibility and homogeneity when properly heat treated.

The only practical companion alloys for platinum in the noble metal field are Iridium and Rhodium.

Since Iridium has a tendency to become brittle at elevated temperatures, and tends to evaporate from the alloy at these temperatures, the established noble metal thermocouples have been Platinum vs. Rhodium in composition.

- Platinum +10% Rhodium vs. Platinum, identified as Type S, is the most important thermocouple now in use.
- Platinum comes in 2 grades:
 1. Standard: 99.99% Purity.
 2. Premium: 99.999% Purity.
- Platinum +13% Rhodium vs. Platinum is called "Type R" and it generates a higher millivoltage than "Type S".
- Platinum +30% Rhodium vs. Platinum +6% Rhodium is called "Type B" and is almost always used in processes which exceed 2700°F.
- The advantages of using noble metal thermocouples are:
 - High level of accuracy.
 - Interchangeability of sensors.
 - Long-term stability.
- The disadvantages are:
 - High cost.
 - Adverse affects to other elements such as sulfur, iron, etc.

• BASE METALS:

- The most popular and widely used in the industry.
- There are 4 widely-used types of base-metals:
 1. Iron Constantan-Type J
 - Low in cost
 - Adapts well to both oxidizing & reducing atmospheres.
 2. Copper Constantan Type
 - Most widely used
 - Accurately measures temps from -300°F to 700°F.
 3. Chromel Alumel - Type K
 - Not as accurate as Type T in sub-zero temps.
 - Widely used range of -320°F to 2300°F.
 4. Chromel Constantan - Type E
 - Excellent for narrow instrument spans
 - Excellent for averaging & Differential temp. measurements.

• REFRACTORY METALS:

- 3 Types of refractory metals:
 1. Tungsten vs. Tungsten + 26% Rhenium, Type W.
 2. Tungsten +3% Rhenium vs. Tungsten +25% Rhenium, Type W3.
 3. Tungsten +5% Rhenium vs. Tungsten +26% Rhenium, Type W5.
 - Temp. ranges up to as high as 4200°F.

THERMOCOUPLES vs. R.T.D.'S

- Of all the primary measuring sensors, the thermocouple is perhaps the easiest to visualize. A thermocouple consists essentially of a pair of dissimilar conductors welded or fused together at one end to form the 'hot' or measuring junction with the free ends available for connection to the 'cold' or reference junction.
A temperature difference between the measuring and reference junctions must exist for this device to function as a thermocouple. When this occurs, small electromotive forces (emf's) are generated. These emf's originate at the "hot" junction as well as wherever there is a temperature gradient between parts of the same wire.

Thermocouple Advantages:

- Higher temperature range available. Thermocouples are designed to measure temperatures to 4200°F (2316°C), compared to a maximum temperature limit of only 1166°F (630°C) for RTD's.
- Point temperature measurements.
- Thermocouples are generally more rugged than RTD's.
- Thermocouples are lower in cost and provide the necessary accuracy for most temperature measurements from Cryogenic to extremely high temperatures.
- Faster speed of response. They can be made of very fine wire providing a measuring junction of small mass. This causes quick reactions to temperature changes.


- The basic concept underlying the measurement of temperature by RTD's is that the electrical resistance of certain metals varies proportionally with temperature. This proportional variation is precise and repeatable, therefore allowing the consistent measurement of temperature through electrical resistance detection.
Platinum is the material most often used in RTD's due to its superiority regarding temperature limit, linearity, stability and reproducibility.

The RTD sensor consists of a winding or coil of wire, usually Platinum, that is connected to an indicating instrument. The electrical resistance in the RTD is measured by an indicating instrument which converts the reading to temperature.

RTD Advantages:

- Higher accuracy:
Much higher signal level generated.
Self-heating is minimal, thus the sensor temperature more accurately reflects the temperature of the process being measured.
- Better long term stability:
Stability tests after one year indicate drift to be only .18°F (.1°C) at 32°F (0°C).
Sometimes used as temperature standards against which other types of sensors are calibrated.
- Precise interchangeability:
Sensors can be interchanged without calibration.
- Total system cost is less expensive.
Signal strength eliminates the need for high-gain amplifiers.
- Better suited for narrow instrument spans.
- Reference junction compensation unnecessary.
- Area sensing:
Ability to measure temperature over a surface or within a volume since RTD's tend to average out differences in temperature over an area.

ARE YOUR THERMOCOUPLES OR R.T.D.'S IN NEED OF
CALIBRATION OR CERTIFICATION? LOOK NO FURTHER.....



Certification of Test for Compliance or Calibration

TO: _____ Date: _____

Certificate No. _____

Customer Order No. _____ S.O. No. _____ Customer Drawing No. _____

This is to certify that the material furnished on the above order number has been thermoelectrically calibrated with the following result:

Type of Calibration _____ Reference Junction _____

Number	Check Temperature F° <input type="checkbox"/> C° <input type="checkbox"/>	CORRECTION	
		F° <input type="checkbox"/> ADD	C° <input type="checkbox"/> SUBTRACT

The corrections given above apply only to the thermocouple checked. Where coils of wire are calibrated it is expected that any thermocouple made from these coils of wire will not require a greater correction than the samples checked.


This data applies to the material as shipped. No guarantee can be made as to consistency of calibration because of inhomogeneity resulting from application condition.

We hereby certify that to the best of our knowledge and belief the above values are true and are in accordance with all of the required specifications.

CERTIFICATE OF COMPLIANCE

It is hereby certified that the materials specified above comply to the best of our knowledge and belief with the latest drawings or specifications pertaining to the goods, which the customer has approved or furnished to us, and that physical and/or calibration test reports, as the same may be called for on said drawings or specifications are on file.

Inspected by _____ BENCH TECHNICIAN/FOREMAN



1-800-356-8000

THERMOCOUPLES

1

HOW TO BUILD-YOUR-OWN THERMOCOUPLE

GENERAL PURPOSE THERMOCOUPLE ASSEMBLY:

(METAL SHEATHED / MINERAL INSULATED CAPP-O-PAK's)

STEP 1: SELECT ELEMENT TYPE:

- A. TYPE J
- B. TYPE K
- C. TYPE T
- D. TYPE E
- E. DUPLEX (2 PAIRS OF WIRES)

STEP 2: SELECT SHEATH MATERIAL:

- A. 310 STAINLESS STEEL
- B. 316 STAINLESS STEEL
- C. 446 STAINLESS STEEL
- D. INCONEL (ALLOY 601)

STEP 3: SELECT SHEATH DIAMETER:

- A. 1/16" (1.6mm)
- B. 1/8" (3.2mm)
- C. 3/16" (4.8mm)
- D. 1/4" (6.4mm)
- E. 3/8" (9.5mm)

STEP 4: SELECT HOT-LEG JUNCTION:

(THE END OF THE PROBE THAT GOES INTO THE ACTUAL PROCESS)

- A. INTEGRAL / GROUNDED - *MOST COMMON CHOICE*
- B. EXPOSED (SHEATH END IS LEFT OPEN)
- C. REMOTE / UNGROUNDED (EMBEDDED IN INSULATION)

STEP 5: SELECT LENGTH OF ELEMENT:

SPECIFY LENGTH OF PROBE IN INCHES

STEP 6: SELECT COLD-END TERMINATION:

(THE END OF THE PROBE THAT GETS WIRED TO THE CONTROLLER OR RECORDER)

- A. GENERAL PURPOSE HEAD
- B. SCREW COVER HEAD
- C. MINI-ALUMINUM HEAD

CONTINUED ON NEXT PAGE:

HOW TO BUILD-YOUR-OWN THERMOCOUPLE (Continued)

- D. MINI-TERMINAL BLOCK
- E. QUICK-CONNECT PLUG
- F. QUICK-CONNECT JACK
- G. INSULATED WIRE EXTENSION
- H. INSULATED WIRE EXTENSION W/ ARMOR TUBING
- I. INSULATED WIRE EXTENSION W/ ARMOR TUBING & JUNCTION BOX CONNECTOR.
- J. EXPLOSION-PROOF HEAD
- K. PLASTIC HEAD (POLYPROPYLENE)
- L. FULL SIZE ALUMINUM HEAD
- M. NO TERMINATION - ELEMENT ONLY
- N. HEX, 1/2" X 1/2"

STEP 7: OPTIONAL MOUNTING COMPRESSION FITTINGS:

- A. BRASS NON-READJUSTABLE FITTING - 1/8"
- B. 303 ST. STEEL RE-ADJUSTABLE PACKING GLAND
- C. 316 ST. STEEL NON-READJUSTABLE FITTING - 1/8"

STEP 8: OPTIONAL EXTENSION WIRE TERMINATIONS:

- A. WIRES BARED AT 1/2" (NO END TERMINALS)
- B. TERMINALS (SPADE LUG TYPE)
- C. QUICK-CONNECT JACK
- D. QUICK-CONNECT PLUG

STEP 9: THERMOCOUPLE WIRE EXTENSION: SEE THERMOCOUPLE WIRE SELECTIONS

**IF YOU CAN DRAW IT, DESCRIBE IT, or EXPLAIN IT.....
.....THEN WE CAN MAKE IT !
TALK TO ONE OF OUR ENGINEERS TODAY - (800) 356-8000**

THERMOCOUPLES

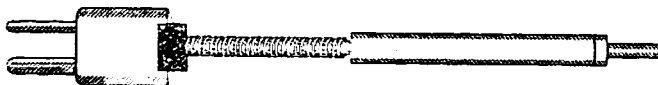
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CAPP-O-PAK THERMOCOUPLE ASSEMBLIES & ELEMENTS: METAL-SHEATHED / MINERAL-INSULATED



MANUFACTURED TO O.E.M.
SPECIFICATIONS TO FIT:

- HONEYWELL® (MEGOPAK) ®
- GORDON®
- OMEGA®
- LEEDS & NORTHRUP®
- TUDOR (TTI) ®
- THERMO ELECTRIC®
- PYROMATION®

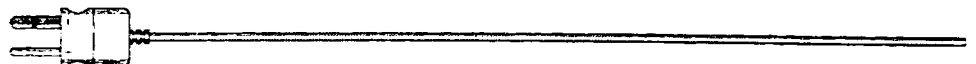


ASSEMBLY WITH ARMOR-CABLE & EXTENSION

CAPP-O-PAK WITH SCREW-COVER HEAD

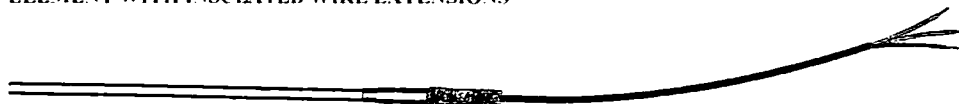


CAPP-O-PAK WITH GENERAL-PURPOSE HEAD



ASSEMBLY WITH QUICK-CONNECT PLUG

ELEMENT WITH INSULATED WIRE EXTENSIONS



THERMOCOUPLES

CAPP-O-PAK THERMOCOUPLE ASSEMBLIES & ELEMENTS (CONTINUED):

1

CAPP-O-PAK OVERVIEW & SPECIFICATIONS

Type	Conductor & Characteristics		Temperature Range deg F	Limits of Error		Application Notes
	Positive	Negative		Standard	Special	
J	Iron	Constantan	30 to 1400°F	$\pm 2^{\circ}\text{C}(4^{\circ}\text{F})$ or $\pm 0.75\%$	$\pm 1^{\circ}\text{C}(2^{\circ}\text{F})$ or $\pm 0.4\%$	Reducing atmosphere recommended. Iron oxidizes rapidly at elevated temperatures.
K	Chromel	Alumel	30 to 2300°F	$\pm 2^{\circ}\text{C}(4^{\circ}\text{F})$ or $\pm 0.75\%$	$\pm 1^{\circ}\text{C}(2^{\circ}\text{F})$ or $\pm 0.4\%$	Oxidizing atmosphere recommended. Vented protection tube suggested in reducing atmosphere.
T	Copper	Constantan	30 to 700°F	$\pm 1^{\circ}\text{C}(1.8^{\circ}\text{F})$ or $\pm 1.5\%$ $\pm 1^{\circ}\text{C}(1.8^{\circ}\text{F})$ or $\pm 0.75\%$	$\pm 0.5^{\circ}\text{C}(0.9^{\circ}\text{F})$ or $\pm 0.4\%$	Can be used in oxidizing or reducing atmospheres. Rust and corrosion resistant. Fine for sub-zero temperatures.
E	Chromel	Constantan	30 to 1700°F	$\pm 1.7^{\circ}\text{C}(3^{\circ}\text{F})$ or $\pm 0.5\%$	$\pm 1^{\circ}\text{C}(1.8^{\circ}\text{F})$ or $\pm 0.4\%$	Oxidizing atmosphere recommended. Highest emf output of thermocouples commonly used.

OPERATING TEMPERATURES AND SHEATH DIMENSIONS:

WIRE GAUGE	O.D. OF SHEATH	NOMINAL TUBE WALL THICKNESS
14	3/8"	0.025" 0.25mm
18	1/4"	0.035" 0.80mm
20	3/16"	0.025" 0.63mm
23	1/8"	0.018" 0.45mm
29	1/16"	0.010" 0.25mm

MAXIMUM TEMPERATURE RECOMMENDATIONS:	
MAX. TEMP. °F	IMMERSION LENGTHS/ AND SHEATH O.D.'S:
1900°	1 To 5ft. / 1/16", 1/8", 3/16"
2100°	1 To 5ft. / 1/4", 3/8"
1700°	6 To 10ft. / 1/16", 1/8", 3/16"
2100°	6 To 10ft. / 1/4", 3/8"
1700°	11 To 20ft. / 1/16", 1/8", 3/16"
1800°	11 To 20ft. / 1/4", 3/8"

COMPLETE ORDERING INFORMATION ON NEXT PAGE(S).

THERMOCOUPLES

1

CAPP-O-PAK THERMOCOUPLE ASSEMBLIES & ELEMENTS (CONTINUED):

COMPLETE ORDERING INFORMATION ORDERING IS EASY AND ONLY 2-STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE CHOICES BELOW & ON NEXT PAGE.

(TABLE 1):

TYPE ELEMENT	SHEATH DIAMETERS AND MATERIALS					
	STOCK NO.	1/16" (1.6mm)	STOCK NO.	1/8" (3.2mm)	STOCK NO.	3/16" (4.8mm)
J	278723	316 ST. STEEL	278730	316 ST. STEEL	278741	316ST. STEEL
J	-	446 ST. STEEL	-	446 ST. STEEL	-	446 ST. STEEL
J	278724	INCONEL	278731	INCONEL	278736	INCONEL
K	278725	316 ST. STEEL	278732	316 ST. STEEL	278737	316 ST. STEEL
K	-	446 ST. STEEL	-	446 ST. STEEL	-	446 ST. STEEL
K	278726	INCONEL	278733	INCONEL	278738	INCONEL
E	-	316 ST. STEEL	-	316 ST. STEEL	278739	316 ST. STEEL
T	278727	316 ST. STEEL	278734	316 ST. STEEL	-	316 ST. STEEL

(TABLE 1
CONTINUED):

TYPE ELEMENT	SHEATH DIAMETERS AND MATERIALS			
	STOCK NO.	1/4" (6.4mm)	STOCK NO.	3/8" (9.5mm)
J	278751	316 ST. STEEL	278761	316 ST. STEEL
J	278743	446 ST. STEEL	278753	446 ST. STEEL
J	278744	INCONEL	278755	INCONEL
K	278745	316 ST. STEEL	278756	316 ST. STEEL
K	278746	446 ST. STEEL	278758	446 ST. STEEL
K	278747	INCONEL	278759	INCONEL
E	278749	316 ST. STEEL	-	316 ST. STEEL
T	-	316 ST. STEEL	-	316 ST. STEEL

SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - SELECT MEASURING JUNCTION:

- E: EXPOSED (SHEATH IS OPEN & WIRES ARE EXPOSED). NO CHARGE.
 G: GROUNDED (THE JUNCTION IS WELDED TO THE TIP OF SHEATH). NO CHARGE.
 R: REMOTE (JUNCTION IS INSULATED FROM THE SHEATH). \$13.00

CHOICE 2 - SPECIFY ELEMENT LENGTH:

CAPP-O-PAK ELEMENT ORDERING:
\$1.60 PER INCH (ALL SIZES)

SEE FOLLOWING PAGES TO COMPLETE YOUR ASSEMBLY

CAPPOPAK ASSEMBLY CHOICES & OPTIONS:

CHOICE 3 - SELECT TERMINATION:

QP:



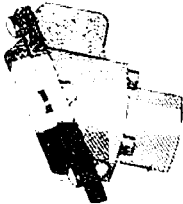
QUICK - CONNECT PLUG. ADD \$65.00 TO ASSEMBLY.

QJ:



QUICK - CONNECT JACK. ADD \$65.00 TO ASSEMBLY.

GP50:



GENERAL PURPOSE HEAD 1/2" NPT CONDUIT AND MOUNTING BUSHING. ADD \$95.00 TO ASSEMBLY.

TB:



MINI TERMINAL BLOCK.
* FOR OPTIONAL 1/4" MOUNTING BUSHING, SPECIFY OPTION TBM INSTEAD OF TB. ADD \$56.00 TO ASSEMBLY.

SC50:

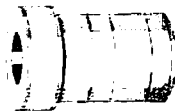


SC50: SCREW-COVER HEAD 1/2" NPT CONDUIT AND 1/2" MOUNTING BUSHING. ADD \$107.00 TO ASSEMBLY.

SC75:

SC75: SCREW-COVER HEAD 3/4" NPT CONDUIT AND 1/2" MOUNTING BUSHING. ADD \$107.00 TO ASSEMBLY.

MH:



MINI ALUMINUM HEAD.
* FOR OPTIONAL 1/4" MOUNTING BUSHING, SPECIFY OPTION MHB INSTEAD OF MH. ADD \$72.00 TO ASSEMBLY.

IW:

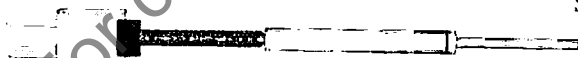


INSULATED WIRE EXTENSION. ADD \$63.00 TO ASSEMBLY.

IWA:

INSULATED WIRE EXTENSION WITH ARMOR. ADD \$63.00 TO ASSEMBLY.

IWAP:



INSULATED WIRE EXT. W/ARMOR & JUNCTION BOX CONN. ADD \$75.00 TO ASSEMBLY.

SW:

STRIPPED WIRE, ELEMENT ONLY. ADD \$35.00 TO ASSEMBLY.

THERMOCOUPLES

1

OPTIONAL ASSEMBLY CHOICES:

OPTION 1 - COMPRESSION FITTINGS:

	BASED ON SHEATH DIAMETERS			
	1/16"	1/8"	3/16"	1/4"
SS: 316 STAINLESS STEEL / NOT READJUSTABLE. MOUNTING THREADS ARE: 1/8", 1/4" AND ARE USED ON SHEATH SIZES: 3/16", 1/4".	\$34.00	\$19.00	\$19.00	\$19.00
				\$34.00

B: BRASS / NOT READJUSTABLE.

MOUNTING THREADS ARE: 1/8" AND ARE
USED ON SHEATH SIZES: 1/16", 1/8".

\$11.00 \$11.00 \$11.00 \$11.00

\$11.00 \$11.00 \$11.00 \$12.00

303SS: 303 STAINLESS STEEL / READJUSTABLE.
MOUNTING THREADS ARE: 1/2" AND IS
USED ON SHEATH SIZES: 3/8".

\$16.00 \$17.00 \$17.00 \$35.00

\$16.00 \$17.00 \$17.00 \$56.00

TO ORDER COMPRESSION FITTINGS INDIVIDUALLY, SEE PAGE 136.

OPTION 2 - TERMINATIONS FOR WIRE EXTENSIONS:

SL:

SPADE-LUG TERMINALS. \$5.00

QP:

QUICK - CONNECT PLUG. \$15.00

QJ:

QUICK - CONNECT JACK. \$18.00

B:

NO TERMINATIONS - WIRES BARED 1/2". NO CHARGE.

SPECIFY LENGTH OF EXTENSION WIRE.
(MIN. LENGTH IS 12").

OPTION 3 - INSULATED WIRE EXTENSIONS:

SELECT FROM WIRE CHOICES ON PAGES 131 AND 132.

• **EXAMPLE ASSEMBLY #1:**

STOCK NO.: 278723-R-24"-SC50. **PRICE: \$158.40**

THIS EXAMPLE STOCK NO. SPECIFIES 1/16"O.D., 316S.S. SHEATH ELEMENT, TYPE J (278723) - WITH A REMOTE JUNCTION (R) - ELEMENT IS 24 INCHES IN LENGTH (24) - SCREW COVER HEAD WITH 1/2" NPT CONDUIT AND 1/2" MOUNTING BUSHING (SC50).

• **EXAMPLE ASSEMBLY #2:**

STOCK NO.: 278733-G-48-IW-SS-QJ12-278571. **PRICE: \$176.80**

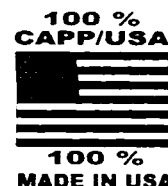
THIS EXAMPLE STOCK NO. SPECIFIES 1/8"O.D., INCONEL SHEATH ELEMENT, TYPE K (278733) - WITH A GROUNDED JUNCTION (G) - ELEMENT IS 48 INCHES IN LENGTH (48) - WITH 12" INSULATED WIRE EXTENSION (IW) - AND 316S.S. COMPRESSION FITTING (SS) - AND QUICK CONNECT JACK (QJ) ON EXTENSION WIRE (278571).

THERMOCOUPLES

1

CAPP-O-PAK DUPLEX THERMOCOUPLE ASSEMBLIES

CAPP-O-PAK DUPLEX THERMOCOUPLES
ARE THE SAME AS REGULAR CAPP-O-PAKS
EXCEPT THEY HAVE 2 ELEMENTS IN THE SHEATH.



ORDERING INFORMATION:

- 1: SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2: SELECT AN OPTION FROM THE CHOICES BELOW.

TYPE ELEMENT	SHEATH DIAMETERS AND MATERIALS									
	STOCK NO.	1/16 "	STOCK NO.	1/8 "	STOCK NO.	3/16 "	STOCK NO.	1/4 "	STOCK NO.	3/8 "
J	279419	316S.S.	279420	316S.S.	279421	316S.S.	279422	316S.S.		316S.S.
K	-	316S.S.	-	316S.S.	279423	316S.S.	279424	316S.S.	279425	316S.S.
K	279426	INCONEL	279427	INCONEL	279428	INCONEL	279431	INCONEL	-	INCONEL
T	-	316S.S.	279432	316S.S.	279433	316S.S.	-	316S.S.	-	316S.S.
T	-	INCONEL	279434	INCONEL	279435	INCONEL	279436	INCONEL	-	INCONEL

SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - SELECT MEASURING JUNCTION:

- E:** EXPOSED, NO CHARGE
G: GROUNDED, NO CHARGE
R: REMOTE, ADD \$25.00 TO ASSEMBLY.

CHOICE 2 - SELECT TERMINATION:

- QP:** QUICK-CONNECT PLUG, ADD \$79.00 TO ASSEMBLY.
QJ: QUICK-CONNECT JACK, ADD \$79.00 TO ASSEMBLY.
SCD: SCREW-COVER HEAD / DUPLEX-TYPE, ADD \$180.00 TO ASSEMBLY
PH: POLYPROPYLENE HEAD, ADD \$190.00 TO ASSEMBLY.
EH: EXPLOSION-PROOF HEAD, ADD \$221.00 TO ASSEMBLY.
SW: STRIPPED WIRE (ELEMENT ONLY), ADD \$70.00 TO ASSEMBLY.
EW*: EXTENSION WIRE WITH A SPRING CONNECTION
* WITH CHOICE "EW" YOU MUST ALSO SELECT
A CHOICE FROM OPTIONS 2 & 3. ADD \$165.00 TO ASSEMBLY.
AL: ALUMINUM HEAD, ADD \$177.00 TO ASSEMBLY.

CHOICE 3 - SPECIFY ELEMENT LENGTH: \$2.25 PER INCH (ALL SIZES)

HONEYWELL - PARTLOW - AMPROBE - CHESSELL - DICKSON - RUSTRAK
ALL OF THE NATIONAL BRANDS OF RECORDERS & CONTROLLERS
FEATURED IN THIS CATALOG - CAPP/USA GIVES YOU FREEDOM
OF CHOICE & FLEXIBILITY

CAPP-O-PAK DUPLEX THERMOCOUPLE ASSEMBLIES (CONTINUED):

OPTIONAL ASSEMBLY CHOICES:

OPTION 1 -- COMPRESSION FITTINGS:

		BASED ON SHEATH DIAMETERS				
		1/16"	1/8"	3/16"	1/4"	3/8"
SS:	316 Stainless Steel/Not Readjustable. Mounting Threads Are: 1/8", 1/4" and Are used on sheath sizes: 3/16", 1/4".	\$34.00	\$19.00	\$19.00	\$19.00	\$19.00
B:	Brass/Not Readjustable. Mounting Threads Are: 1/8" and Are Used on sheath sizes: 1/16", 1/8".	\$12.00	\$12.00	\$12.00	\$12.00	\$12.00
303SS:	303 Stainless Steel/Readjustable. Mounting Threads Are: 1/2" and Is used on sheath sizes: 3/8".	\$17.00	\$17.00	\$17.00	\$35.00	\$57.00

TO ORDER COMPRESSION FITTINGS INDIVIDUALLY, SEE PAGE 136.

OPTION 2 - TERMINATIONS FOR WIRE EXTENSIONS:

SL: SPADE-LUG TERMINALS. \$11.00
QP: QUICK-CONNECT PLUG. \$35.00
QJ: QUICK-CONNECT JACK. \$39.00
B: NO TERMINATIONS -- WIRES BARED 1/2" NO CHARGE

SPECIFY LENGTH OF EXTENSION WIRE. (MIN. LENGTH IS 12")

OPTION 3 - INSULATED WIRE EXTENSIONS:

SELECT FROM WIRE CHOICES ON PAGES 131 AND 132.

EXAMPLE DUPLEX ASSEMBLY:

STOCK NO.: 279419-G-SCD-48" PRICE: \$288.00

THIS EXAMPLE STOCK NO. SPECIFIES 1/16" O.D., 316S.S. SHEATH
 ELEMENT, TYPE J (279419) -- WITH GROUNDED JUNCTION (G) --
 SCREW-COVER/DUPLEX TYPE HEAD (SCD) -- ELEMENT LENGTH
 IS 48" (48"), WITH NO OPTIONS.

THERMOCOUPLES

1

CAPP-O-PAK MINI-JIMMY THERMOCOUPLE ASSEMBLIES

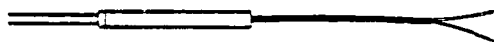
JUST LIKE REGULAR CAPP-O-PAK'S AND DUPLEX CAPP-O-PAK'S, THESE MINI-JIMMY CAPP-O-PAK'S ARE VERY SIMILAR BUT ARE MUCH SMALLER IN SIZE THUS GIVING YOU THE CONVENIENCE OF PUTTING THEM IN APPLICATIONS WHERE SPACE IS LIMITED.



MINI-JIMMY ASSEMBLY



MINI-JIMMY ASSEMBLY



MINI-JIMMY ASSEMBLY

MINI-JIMMY ORDERING INFORMATION:

TYPE ELEMENT	SHEATH DIAMETERS AND MATERIALS					
	STOCK NO.	6" PRICE	.010"	STOCK NO.	6" PRICE	.032"
J	319570	\$60.00	304S S	279442	\$39.00	304S S
J	319572	\$60.00	INCONEL	319580	\$39.00	INCONEL
K	279445	\$60.00	304S S	279447	\$39.00	304S S
K	319577	\$60.00	316S S	319581	\$39.00	316S S
T	319578	\$60.00	304S S	319585	\$39.00	304S S
ELEMENT	STOCK NO.	6" PRICE	.020"	STOCK NO.	6" PRICE	.040"
J	279441	\$39.00	304S S	279443	\$39.00	304S S
J	319583	\$39.00	INCONEL	279444	\$39.00	INCONEL
K	279446	\$39.00	304S S	279448	\$39.00	304S S
K	279449	\$39.00	316S S	279450	\$39.00	316S S
T	279451	\$39.00	304S S	279452	\$39.00	304S S

ALL PRICES ABOVE ARE FOR INITIAL 6"
FOR EACH ADD'L. 6" LENGTH, ADD \$4.00 FOR .010" DIAMETERS
AND \$1.97 FOR ALL OTHER DIAMETERS.

(OPTION CHOICES CONTINUED NEXT PAGE)

CAPP/USA ALSO OFFERS SHEATH DIAMETERS OF 0.62" -- JUST ASK US.

THERMOCOUPLES

1

SELECT AN OPTION FROM EACH CHOICE:

CHOICE 1 - SELECT MEASURING JUNCTION:

E: EXPOSED. (NO CHARGE)
G: GROUNDED. (NO CHARGE)
R: REMOTE / INSULATED, \$25.00
FOR .010" DIAMETERS
\$5.00 FOR ALL OTHER DIAMETERS.

CHOICE 2 - SELECT TERMINATION:

QP: QUICK-CONNECT PLUG, \$6.00
QJ: QUICK-CONNECT JACK, \$6.00
MP: MINI-JIMMY PLUG. (NO CHARGE)
MJ: MINI-JIMMY JACK. (NO CHARGE)

EXAMPLE STOCK NO.:

279449-R-QJ.

EXAMPLE PRICE:

\$50.00

THERMOCOUPLES

1

HOW TO BUILD-YOUR-OWN THERMOCOUPLE ELEMENTS

THERMOCOUPLE ELEMENTS

STEP 1: SELECT ELEMENT TYPE:

- | | |
|-----------|--|
| A. TYPE J | E. TYPE T |
| B. TYPE K | F. TYPE R (PLATINUM-PLATINUM, 13% RHODIUM) |
| C. TYPE E | G. TYPE S (PLATINUM-PLATINUM, 13% RHODIUM) |
| D. TYPE T | H. TYPE B |

STEP 2: SELECT WIRE SIZE / GAUGE:

- A. 8 GAUGE
- B. 14 GAUGE
- C. 20 GAUGE
- D. .020" diameter (FOR TYPES R & S)
- E. .022" diameter (FOR TYPES R & S)
- F. .026" diameter (FOR TYPES R & S)

STEP 3: SELECT AN INSULATOR TYPE:

- A. BEAD
- B. DOUBLE-BORE
- C. FULL-LENGTH
- D. FOUR-HOLE
- E. NONE (BARE ELEMENT)

STEP 4: SPECIFY ELEMENT LENGTH:

SPECIFY LENGTH OF ELEMENT IN INCHES

STEP 5: OPTIONS:

- A. TERMINAL BLOCK FOR ELEMENT
- B. DUPLEX ELEMENTS

IF YOU CAN DRAW IT, DESCRIBE IT, or EXPLAIN IT.....

.....THEN WE CAN MAKE IT !

TALK TO ONE OF OUR ENGINEERS TODAY - (800) 356-8000

**DID YOU KNOW ? THAT YOU CAN CALL CAPP/USA WITH ANY
THERMOCOUPLE COMPANY'S PART No. AND WE'LL GLADLY MAKE IT FOR YOU**

THERMOCOUPLES

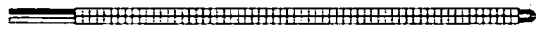
CAPP/USA GENERAL PURPOSE THERMOCOUPLES ELEMENTS: (STRAIGHT - TYPE)



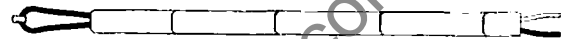
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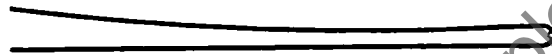
CERAMIC INSULATED ELEMENTS



BEADED INSULATED ELEMENTS



DOUBLE-BORE INSULATED ELEMENTS



BARE ELEMENTS

ORDERING IS EASY AND ONLY 2 - STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE 2 CHOICES ON THE NEXT PAGE.
3. MATCH-UP YOUR STOCK NO., INSULATOR TYPE, & LENGTH FOR PRICING.

TYPE	WIRE SIZE / GAUGE	STOCK NO.	TYPE OF INSULATOR
J	8 GAUGE	277571	AVAILABLE WITH
J	14 GAUGE	277572	BEAD OR DOUBLE-
J	20 GAUGE	277573	BORE INSULATORS.
K	8 GAUGE	277574	AVAILABLE WITH
K	14 GAUGE	277575	BEAD OR DOUBLE-
K	20 GAUGE	277577	BORE INSULATORS.
E	8 GAUGE	277585	AVAILABLE WITH
E	14 GAUGE	277586	BEAD OR DOUBLE-
E	20 GAUGE	277587	BORE INSULATORS.
T	20 GAUGE	277578	AVAILABLE WITH
			BEAD OR DOUBLE-
			BORE INSULATORS
R PLATINUM-PLATINUM .020" DIA.		277580	FULL LENGTH.
R 13% RHODIUM. .022" DIA.		277581	
S PLATINUM-PLATINUM .020" DIA.		277582	FULL LENGTH.
S 10% RHODIUM. .022" DIA.		277583	

THERMOCOUPLES

1

ORDERING INFORMATION (CONTINUED).

TYPE	WIRE SIZE / GAUGE	STOCK NO.	TYPE OF INSULATOR
J-DUPLEX	14 GAUGE	278970	FOUR-HOLE.
J-DUPLEX	20 GAUGE	278974	
K-DUPLEX	14 GAUGE	278976	FOUR-HOLE.
K-DUPLEX	20 GAUGE	278979	
T-DUPLEX	20 GAUGE	278981	FOUR-HOLE.
E-DUPLEX	14 GAUGE	278984	FOUR-HOLE.
E-DUPLEX	20 GAUGE	278990	

SELECT AN OPTION FROM THE 3 CHOICES BELOW

CHOICE 1 - SELECT AN INSULATOR TYPE:

B**: BEAD-TYPE

DB*: DOUBLE-BORE TYPE

FL*: FULL-LENGTH TYPE

FH: FOUR-HOLE TYPE

BW: BARE WIRE

FS: FIBER SLEEVE

CHOICE 2 - SPECIFY ELEMENT LENGTH:

* OVERALL LENGTH MINUS 0.90" EQUALS SPECIFIED LENGTH.

** OVERALL LENGTH MINUS 0.40" EQUALS SPECIFIED LENGTH, AND MINUS 0.90" FOR TYPES R AND S.

NOTE:

TERMINAL BLOCKS FOR THESE ELEMENTS ARE OPTIONAL. JUST TELL US WHETHER THE TERMINAL BLOCK IS FOR:

1. A GENERAL PURPOSE HEAD; \$17.00
2. A SCREW-COVER HEAD; OR \$17.00
3. A DUPLEX ELEMENT WITH SCREW-COVER HEAD. \$34.00

THERMOCOUPLES

ORDERING INFORMATION (CONTINUED).

1

CHOICE 3 - MATCH-UP YOUR STOCK NO. BELOW WITH YOUR CHOICE OF INSULATOR & LENGTH:

INSULATOR TYPE	ELEMENT STOCK NO.	INITIAL 12" LENGTH	ADDITIONAL 6" LENGTHS
<u>(B) BEAD TYPE:</u>	277585	\$ 50.00	\$ 8.00
	277571	\$ 50.00	\$ 8.00
	277572	\$ 52.00	\$ 11.00
	277586	\$ 52.00	\$ 11.00
	277573	\$ 59.00	\$ 11.00
	277587	\$ 59.00	\$ 11.00
	277578	\$ 59.00	\$ 11.00
	277574	\$ 49.00	\$ 9.00
	277575	\$ 53.00	\$ 12.00
	277577	\$ 59.00	\$ 13.00
<u>(DB) DOUBLE- BORE TYPE:</u>	277585	\$ 24.00	\$ 6.00
	277571	\$ 24.00	\$ 6.00
	277572	\$ 24.00	\$ 6.00
	277586	\$ 24.00	\$ 6.00
	277573	\$ 24.00	\$ 6.00
	277587	\$ 24.00	\$ 6.00
	277588	\$ 24.00	\$ 6.00
	277574	\$ 24.00	\$ 6.00
	277575	\$ 24.00	\$ 6.00
	277577	\$ 24.00	\$ 6.00
<u>(FL) FULL-LENGTH TYPE:</u>	277580	\$394.00	\$147.00
	277581	\$394.00	\$147.00
	277582	\$429.00	\$169.00
	277583	\$429.00	\$169.00
<u>(FH) FOUR-HOLE TYPE:</u>	278970	\$ 49.00	\$ 10.00
	278984	\$ 49.00	\$ 10.00
	278974	\$ 49.00	\$ 10.00
	278981	\$ 49.00	\$ 10.00
	278990	\$ 49.00	\$ 10.00
	278976	\$ 50.00	\$ 11.00
	278979	\$ 50.00	\$ 11.00
<u>(BW) BARE WIRE:</u>	277585	\$ 21.00	\$ 5.00
	277571	\$ 21.00	\$ 5.00
	277572	\$ 21.00	\$ 5.00
	277586	\$ 21.00	\$ 5.00
	277573	\$ 21.00	\$ 5.00
	277587	\$ 21.00	\$ 5.00

THERMOCOUPLES

1

CHOICE 3 - (CONTINUED):

INSULATOR TYPE	ELEMENT STOCK NO.	INITIAL 12" LENGTH	ADDITIONAL 6" LENGTHS
<u>(BW) BARE WIRE:</u>	277578	\$ 21.00	\$ 5.00
	277574	\$ 22.00	\$ 6.00
	277575	\$ 22.00	\$ 6.00
	277577	\$ 22.00	\$ 6.00
	277580	\$329.00	\$129.00
	277581	\$329.00	\$129.00
	277582	\$405.00	\$161.00
	277583	\$405.00	\$161.00
<u>(FS) FIBER SLEEVE:</u>	277585	\$ 39.00	\$ 7.00
	277571	\$ 39.00	\$ 7.00
	277572	\$ 39.00	\$ 7.00
	277586	\$ 39.00	\$ 7.00
	277573	\$ 39.00	\$ 7.00
	277587	\$ 39.00	\$ 7.00
	277578	\$ 39.00	\$ 7.00
	277574	\$ 48.00	\$ 8.00
	277575	\$ 48.00	\$ 8.00
	277577	\$ 48.00	\$ 8.00
	278970	\$ 43.00	\$ 9.00
	278974	\$ 43.00	\$ 9.00
	278981	\$ 43.00	\$ 9.00
	278990	\$ 43.00	\$ 9.00
	278976	\$ 49.00	\$ 10.00
	278979	\$ 49.00	\$ 10.00

EXAMPLE STOCK NO.: 277574-B-24"

EXAMPLE PRICE: \$98.00

SEE NEXT PAGE FOR COMPLETE SELECTION OF
SPARE INSULATORS FOR THESE ELEMENTS.
STOCK-UP NOW.

CAPP/USA PROVIDES THE PROPER PROTECTION FOR ALL OF YOUR
THERMOCOUPLES.....

SEE OUR HUGE SELECTION OF METAL & CERAMIC PROTECTION TUBES
STARTING ON PAGE 64

**COMPLETE SELECTION OF
SPARE CERAMIC INSULATORS****OVAL INSULATOR / DOUBLE-BORE:**

TO FIT HONEYWELL MODEL	STOCK NO.	PRICE	HOLE DIAMETER	FITS WIRE GAUGE SIZE	LENGTH
30042348-4	278284	\$65.00 FOR 100	.028"	24	1/2"
30042348-1	278285	\$44.00 FOR 100	.028"	24	1"
30042348-2	278287	\$46.00 FOR 100	.028"	24	2"
30042348-3	278286	\$35.00 FOR 100	.028"	24	3"
30042347-5	278283	\$29.00 FOR 100	.042"	20	1/4"
30042347-5	278282	\$68.00 FOR 100	.042"	20	1/2"
30042347-1	278279	\$109.00 FOR 100	.042"	20	1"
30042347-2	278280	\$118.00 FOR 100	.042"	20	2"
30042347-3	278281	\$84.00 FOR 100	.042"	20	3"
30042346-2	278272	\$28.00 FOR 100	.080"	14	1/4"
30042346-4	278274	\$29.00 FOR 100	.080"	14	1/2"
30042346-1	278275	\$35.00 FOR 100	.080"	14	1"
30042346-5	278276	\$37.00 FOR 100	.080"	14	2"
30042346-3	230208	\$49.00 FOR 100	.080"	14	3"
30042345-2	278266	\$34.00 FOR 100	.156"	8	1/4"
30042345-4	278269	\$29.00 FOR 100	.156"	8	3/4"
30042345-1	278270	\$35.00 FOR 100	.156"	8	1"
30042345-5	278271	\$36.00 FOR 100	.156"	8	2"
30042345-3	4143	\$39.00 FOR 100	.156"	8	3"
30041578-1	278265	\$48.00 FOR 100	.193	7	1"
30041578-3	278267	\$19.00 FOR 100	.193	7	3"

THERMOCOUPLES

CYLINDRICAL INSULATOR / SINGLE-BORE:

TO FIT	MODEL	STOCK	NO.	PRICE	INSIDE HOLE DIAMETER (I.D.)	OUTSIDE HOLE DIAMETER (O.D.)	WIRE GAUGE	LENGTH
3004677-2	3004677-2	278264		\$62.00/100	.036"	.090"	20	2"
3004675	3004675	278263		\$63.00/100	.080"	.140"	14	1"
3004680-3	3004680-3	278262		\$96.00/100	.156"	.250"	8	3"
3004685	3004685	278261		\$109.00/100	.188"	.375"	7	1"

CYLINDRICAL INSULATOR / FOUR-HOLE:

TO FIT	MODEL	STOCK	NO.	PRICE	OUTSIDE DIAM. OF INSULATOR (O.D.)	HOLE DIAMETER	WIRE GAUGE	LENGTH
30730224-1	30730224-1	278289		\$2.49/100	.187"	.046"	20	1"
30730224-2	30730224-2	278290		\$4.80/100	.187"	.046"	20	2"
30730224-3	30730224-3	278291		\$7.29/100	.187"	.046"	20	3"
30350258	30350258	278288		\$28.00/100	.300"	.078"	14	1"

BEAD-TYPE INSULATOR:

TO FIT	MODEL	STOCK	NO.	PRICE	INSIDE HOLE DIAMETER (I.D.)	OUTSIDE DIAMETER (O.D.)	WIRE GAUGE
30040882-5	30040882-5	278295		\$4.00/100	.056"	.110"	20
30040882-4	30040882-4	278294		\$5.00/100	.068"	.170"	14
30040882-2	30040882-2	278293		\$5.00/100	.152"	.260"	8
30040882-6	30040882-6	278292		\$3.00/100	.180"	.400"	7

METALLIC-OXIDE INSULATORS:

TO FIT	HONEYWELL MODEL	STOCK	NO.	PRICE	OUTSIDE DIAMETER	DIAMETER OF HOLE	LENGTH	MAX. OPERATING TEMP.
30702206	30702206	279042		\$34.00/EACH	.151"	.041"	6"	1850°F.

NOBODY MAKES IT EASIER THAN CAPP/USA TO SELECT & ORDER
RECORDERS & CONTROLLERS BY USING OUR UNIQUE "BUILD-YOUR-OWN"
OPTION TABLES

HOW TO BUILD-YOUR-OWN THERMOCOUPLE

BAYONET Thermocouples for the PLASTICS Industry:

ADJUSTABLE-DEPTH (VARIDDEPTH) IMMERSION THERMOCOUPLES:

STEP 1: SELECT THERMOCOUPLE TYPE:

- A. TYPE J - 20 or 24 GAUGE STRANDED, SOLID, or W/ S.S. OVERBRAID
- B. TYPE K - 20 or 24 GAUGE STRANDED, SOLID, or W/ S.S. OVERBRAID
- C. TYPE T - 20 or 24 GAUGE STRANDED, SOLID, or W/ S.S. OVERBRAID
- D. TYPE E - 20 or 24 GAUGE STRANDED, SOLID, or W/ S.S. OVERBRAID

STEP 2: SELECT ELEMENT STYLE:

- A. STRAIGHT SINGLE ELEMENT
- B. STRAIGHT DUAL (DUPLEX) ELEMENT

STEP 3: SELECT JUNCTION TYPE:

- A. GROUNDED (CLOSED-END) MOST POPULAR
- B. UNGROUNDED (CLOSED-END)

STEP 4: SELECT COLD-END TERMINATION:

*(THE END OF THE PROBE THAT GETS WIRED
TO THE RECORDER OR CONTROLLER)*

- A. SPLIT LEADS (STRIPPED OR W/ SPADE LUGS)
- B. QUICK-DISCONNECT PLUG (SPECIFY SOLID OR HOLLOW PIN)
- C. QUICK-DISCONNECT JACK (SPECIFY SOLID OR HOLLOW PIN)
- D. QUICK-DISCONNECT PLUG W/ MATING JACK

STEP 5: SPECIFY ELEMENT LENGTH:

SPECIFY LENGTH IN INCHES

IF YOU CAN DRAW IT, DESCRIBE IT, or EXPLAIN IT.....

.....THEN WE CAN MAKE IT !

TALK TO ONE OF OUR ENGINEERS TODAY - (800) 356-8000

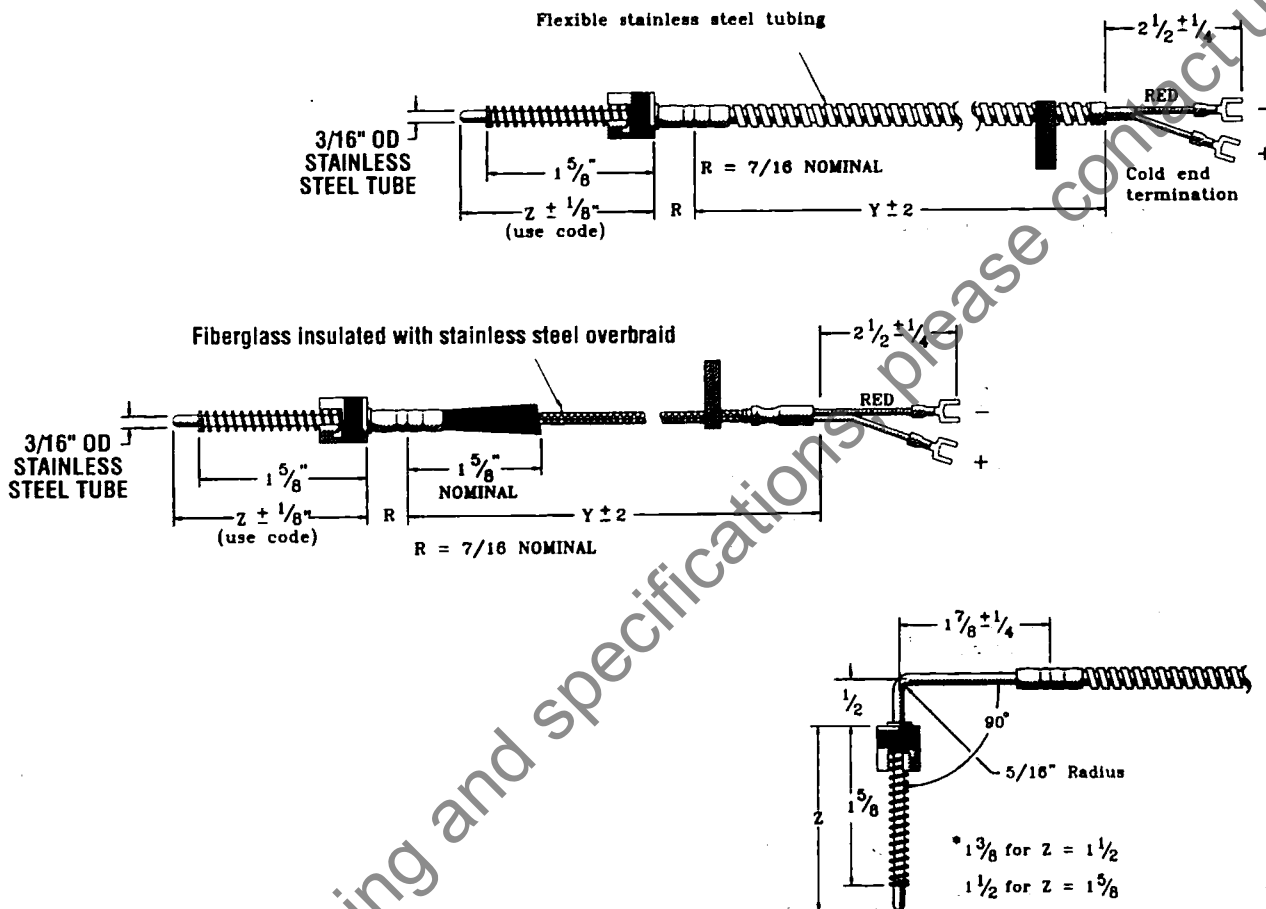
THERMOCOUPLES

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CAPP/USA BAYONET THERMOCOUPLES (FIXED-IMMERSION STYLE)

Directly replaces Barber Colman styles in fit, form, & function. Replaces Barber Colman bayonet series P011 and P071 styles.

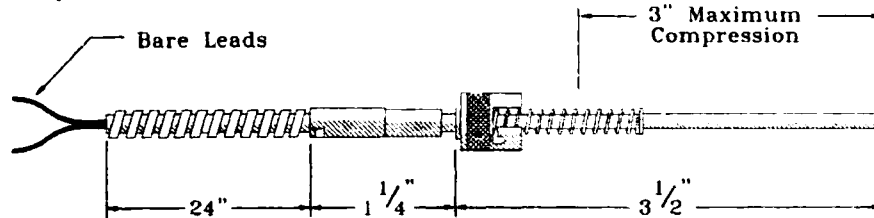


Stock No.	Description	Price
312660	Fiberglass with flexible tubing, Type J, 20 gage, single element, straight, 3/16" OD probe, closed-end, grounded, 2 1/2" split leads with spade lugs, 36" length ("Y" dimension), 6" "Z" dimension.	\$17.80
312665	Fiberglass with flexible tubing, Type J, 20 gage, single element, straight, 3/16" OD probe, closed-end, grounded, quick-disconnect plug, 36" length ("Y" dimension), 6" "Z" dimension.	\$25.50
312668	Fiberglass with flexible tubing, Type J, 20 gage, single element, straight, 3/16" OD probe, closed-end, grounded, quick-disconnect jack, 36" length ("Y" dimension), 6" "Z" dimension.	\$24.00
312678	Fiberglass with stainless steel overbraiding, Type J, 20 gage, straight single element, 3/16" OD probe, closed-end, grounded, with no flexible tubing, 2 1/2" split leads with spade lugs, 36" length ("Y" dimension), 6" "Z" dimension.	\$17.30
312682	Fiberglass with stainless steel overbraiding, Type J, 20 gage, straight single element, 3/16" OD probe, closed-end, grounded, with no flexible tubing, quick-disconnect plug, 36" length ("Y" dimension), 6" "Z" dimension.	\$25.10
312684	Fiberglass with stainless steel overbraiding, Type J, 20 gage, straight single element, 3/16" OD probe, closed-end, grounded, with no flexible tubing, quick-disconnect jack, 36" length ("Y" dimension), 6" "Z" dimension.	\$22.80
312685	Fiberglass with stainless steel overbraiding, Type J, 20 gage, straight single element, 3/16" OD probe, closed-end, grounded, with no flexible tubing, quick-disconnect jack, 36" length ("Y" dimension), 6" "Z" dimension.	\$15.05
312720	Fiberglass insulation only, Type J, 20 gage, straight single element, 3/16" OD probe, closed-end, grounded, quick-disconnect plug, 36" length ("Y" dimension), 6" "Z" dimension.	\$24.35
312723	Fiberglass insulation only, Type J, 20 gage, straight single element, 3/16" OD probe, closed-end, grounded, quick-disconnect jack, 36" length ("Y" dimension), 6" "Z" dimension.	\$22.00

CAPP/USA bayonet thermocouples come in over 100 different styles & specifications. If you don't see the style above for your needs, just call us and we'll make it for you!

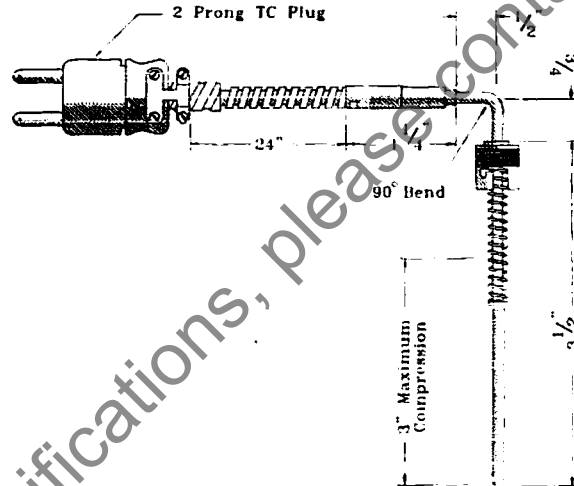


CAPP/USA BAYONET THERMOCOUPLES



Specifications:

- Type J, ungrounded
- 316SS material
- $\frac{3}{16}$ " OD diameter
- 3 1/2" Immersion length
- Leads are high-temp. fiberglass with stainless steel flexible overbraid
- 100% made in the U.S.A.



Stock No.	Thermocouple Bend	Termination	Price
312728	45°	Bare end	\$43.70
312729	90°	Bare end	\$43.70
312730	None	Bare end	\$43.70
312731	45°	2 prong T/C connector	\$49.50
312732	90°	2 prong T/C connector	\$49.50
312733	None	2 prong T/C connector	\$49.50
312736	45°	1/2" conduit connector	\$46.00
312737	90°	1/2" conduit connector	\$46.00
312738	None	1/2" conduit connector	\$46.00

All Dimensions in Inches

**MANY TYPES OF THERMOCOUPLE & EXTENSION WIRE
TO CHOOSE FROM STARTING ON PAGE 130**

THERMOCOUPLES

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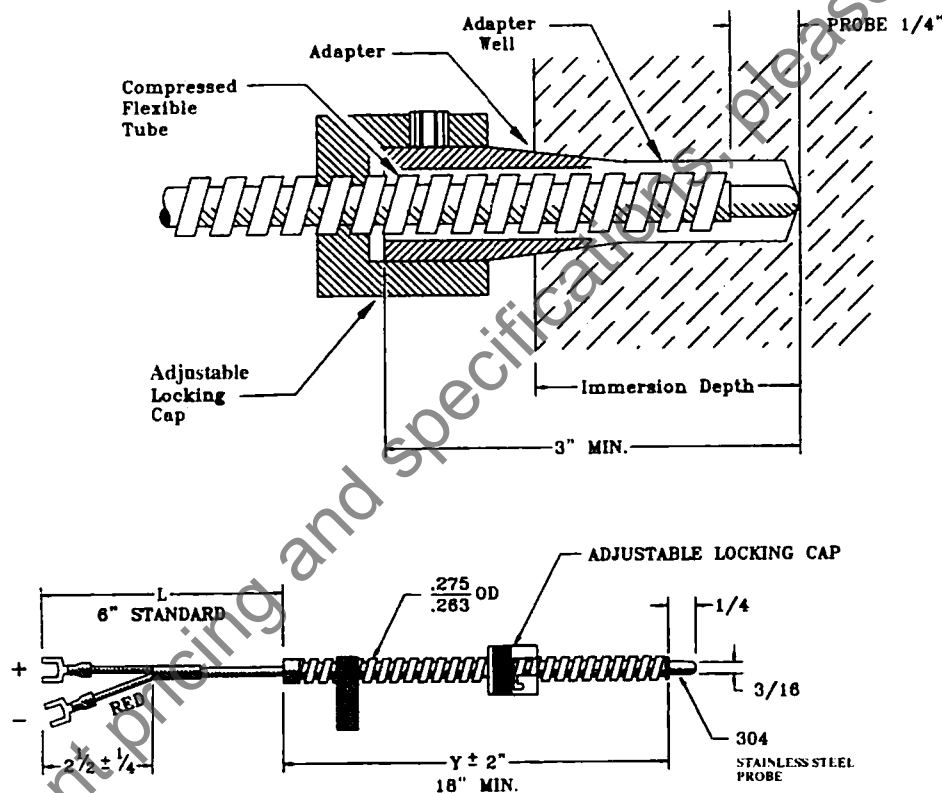
CAPP/USA

ADJUSTABLE DEPTH IMMERSION THERMOCOUPLES:

COMPARE TO BARBER COLMAN VARIDEPTH® SERIES

SPECIFICATIONS:

- Compression of spring holds locking cap.
- Adjustable to many immersion depths.
- Locking cap is adjustable.
- 100% made in the U.S.A.
- Replaces Barber Colman Varidepth Series in fit, form, & function.
- Very easy to install.



ADJUSTABLE DEPTH IMMERSION THERMOCOUPLES

All Dimensions in Inches

CONTINUED ON THE NEXT PAGE

THERMOCOUPLES

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CAPP/USA

ADJUSTABLE DEPTH IMMERSION THERMOCOUPLES:

COMPARE TO BARBER COLMAN VARIDEPTH® SERIES

ORDERING IS EASY AND ONLY 5 STEPS:
SELECT AN OPTION FROM THE FOLLOWING CHOICES:

CHOICE 1 - THERMOCOUPLE TYPE:

Wire Type	Description	Single Element		Duplex Element	
		Initial 36"	Addl. 6" Lengths	Initial 36"	Addl. 6" Lengths
CAPP-P01	Type J, 20 Gauge - solid	\$15.40	\$0.65	\$30.80	\$1.30
CAPP-P02	Type J, 24 Gauge - solid	\$15.20	\$0.60	\$30.40	\$1.20
CAPP-P05	Type K, 20 Gauge - solid	\$16.05	\$0.70	\$32.10	\$1.40
CAPP-P06	Type T, 20 Gauge - solid	\$16.05	\$0.70	\$32.10	\$1.40
CAPP-P11	Type J, 20 Gauge - stranded w/stainless steel overbraid	\$17.50	\$0.95	\$35.00	\$1.90
CAPP-P12	Type J, 20 Gauge - stranded	\$16.35	\$0.75	\$32.70	\$1.50
CAPP-P13	Type J, 24 Gauge - solid with stainless steel overbraid	\$16.70	\$0.90	\$33.40	\$1.80
CAPP-P14	Type T, 24 Gauge - solid	\$16.00	\$0.70	\$32.00	\$1.40
CAPP-P15	Type J, 24 Gauge - stranded with stainless steel overbraid	\$17.20	\$0.90	\$34.40	\$1.80
CAPP-P17	Type E, 20 Gauge - solid	\$16.70	\$0.80	\$33.40	\$1.60
CAPP-P18	Type E, 24 Gauge - solid	\$15.70	\$0.65	\$31.40	\$1.30
CAPP-P19	Type K, 24 Gauge - solid	\$15.55	\$0.65	\$31.10	\$1.30
CAPP-P20	Type K, 20 Gauge - stranded	\$17.45	\$0.95	\$34.90	\$2.00
CAPP-P25	Type J, 20 Gauge - solid Teflon insulated -400°F Max	\$15.70	\$0.70	\$31.40	\$1.40
CAPP-P26	Type J, 24 Gauge - stranded	\$15.40	\$0.65	\$31.40	\$1.30
CAPP-P60	Type J, 20 Gauge - solid special limits	\$15.70	\$0.70	\$31.70	\$1.40
CAPP-P61	Type J, 24 Gauge - solid special limits	\$15.70	\$0.70	\$31.70	\$1.40
CAPP-P62	Type K, 20 Gauge - solid special limits	\$16.20	\$0.75	\$32.40	\$1.50
CAPP-P63	Type K, 24 Gauge - solid special limits	\$16.00	\$0.70	\$32.00	\$1.40
CAPP-P64	Type T, 20 Gauge - solid special limits	\$16.00	\$0.70	\$32.00	\$1.40

CHOICE 2 - ELEMENTS:

- 1: STRAIGHT, SINGLE ELEMENT
2: STRAIGHT, DUAL (DUPLEX) ELEMENT (BOTH PRICED IN CHOICE 1)
(AVAILABLE IN 24 GAUGE ONLY)

CHOICE 3 - JUNCTION TYPE:

- 33: CLOSED END, GROUNDED: NO CHARGE
35: CLOSED END, UNGROUNDED: \$3.00/SINGLE ELEMENT.
\$6.00/DUPLEX ELEMENT.

CONTINUED ON THE NEXT PAGE

THERMOCOUPLES

1

CAPP/USA ADJUSTABLE DEPTH IMMERSION THERMOCOUPLES: (CONTINUED)

ORDERING CHOICES: (CONTINUED)

CHOICE 4 - COLD-END TERMINATIONS:

- 0: 2 1/2" split leads, ends stripped: No Charge for Single or Duplex.
- 1: 2 1/2" split leads with spade lugs: No Charge for Single or Duplex.
- 2: 2 1/2" split leads with spade lugs, and 1/2" NPS box connector with locknut: \$1.30 for Single & Duplex.
- 3: Solid pin quick disconnect plug(s): \$8.80 for Single/\$17.60 for Duplex.
- 4: Solid pin quick disconnect plug(s) with mating jack(s): \$14.30 for Single/\$28.60 for Duplex
- 7: Quick disconnect jack(s): \$6.80 for Single/\$13.60 for Duplex.
- C: Hollow pin quick disconnect plug(s).
Type J only.: \$6.80 for Single/\$13.60 for Duplex.
- D: Hollow pin quick disconnect plug(s) with mating jack(s). Type J only: \$12.30 for Single/\$24.60 for Duplex.

CHOICE 5 - LENGTH:

(SPECIFY "Y" DIMENSION LENGTH IN INCHES)

EXAMPLE STOCK NO.: CAPP-P02-1-33-7-24".

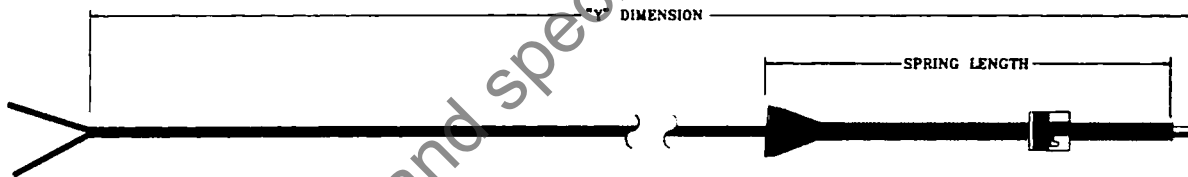
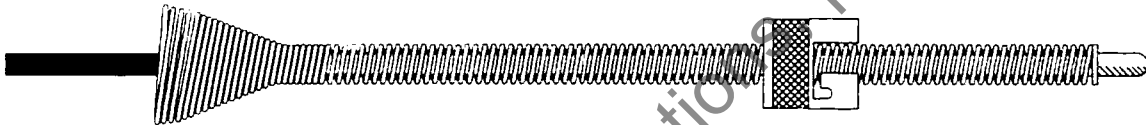
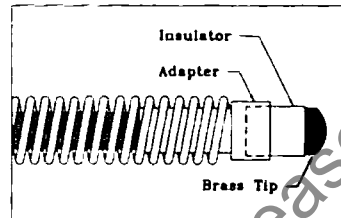
EXAMPLE PRICE: \$22.00

→ "Y" LENGTH

CAPP/USA - ADJUSTABLE IMMERSION THERMOCOUPLE - SPRING STYLE: REPLACES BARBER COLMAN SERIES P07, P08, P11, P13, P15 & P24

SPECIFICATIONS:

- Compression of Spring Holds Locking Cap.
- Max. Temp. of Probe: 800°F.
- Adjustable to Many Immersion Lengths.
- Locking Cap Adjusts over 6" or 12" Spring.
- 100% Made in the U.S.A.
- Replaces Barber Colman Varidepth in Fit, Form, & Function.
- Very Easy to Install.



IMMERSION THERMOCOUPLE - SPRING STYLE

ORDERING IS EASY AND ONLY 6 STEPS: SELECT AN OPTION FROM THE FOLLOWING CHOICES:

CHOICE 1 - THERMOCOUPLE TYPE:

	Type	Fiberglass-Fiberglass Insulation
	(gage)	unless stated otherwise
CAPP-P07:	J (20) with stainless steel overbraid:	
CAPP-P08:	K (20) with stainless steel overbraid:	
CAPP-P11:	J (20) stranded, with SS overbraid:	
CAPP-P13:	J (24) solid with stainless steel overbraid:	
CAPP-P15:	J (24) stranded, with SS overbraid:	
CAPP-P24:	K (24) solid with stainless steel overbraid:	

Single Element		Duplex Element	
Initial 36"	Addl. 6" Lengths	Initial 36"	Addl. 6" Lengths
\$11.00	\$.50	\$22.00	\$1.00
\$11.50	\$.60	\$22.50	\$1.20
\$11.30	\$.55	\$22.30	\$1.10
\$10.50	\$.50	\$21.00	\$1.00
\$11.00	\$.50	\$22.00	\$1.00
\$11.25	\$.55	\$22.50	\$1.10

THERMOCOUPLES

1

CAPP/USA - ADJUSTABLE IMMERSION THERMOCOUPLE - SPRING STYLE: (CONTINUED)

ORDERING CHOICES: (CONTINUED)

CHOICE 2 - NUMBER OF ELEMENTS:

- 1: SINGLE ELEMENT
2: DUAL ELEMENT (24 GAGE ONLY) (BOTH PRICED IN CHOICE 1)
(DUAL ELEMENTS HAVE COMMON JUNCTIONS).

CHOICE 3 - JUNCTION TYPE:

- 31: 3/16" O.D. probe, closed end, grounded, without flexible tubing: No Charge
34: 3/16" O.D. probe, closed end, ungrounded, without flexible tubing: \$3.00
61: Brass tip, grounded: \$10.00

CHOICE 4 - COLD-END TERMINATIONS:

- 0: 2 1/2" split leads, ends stripped: No Charge for Single or Duplex.
1: 2 1/2" split leads with spade lugs: No Charge for Single or Duplex.
2: 2 1/2" split leads with spade lugs, and 1/2" NPS box connector with locknut: \$1.30 for Single/\$1.30 for Duplex.
3: Solid pin quick disconnect plug(s): \$8.80 for Single/\$17.60 for Duplex.
4: Solid pin quick disconnect plug(s) with mating jack(s): \$14.30 for Single/\$28.60 for Duplex.
7: Quick disconnect jack(s): \$6.80 for Single/\$13.60 for Duplex.
C: Hollow pin quick disconnect plug(s). Type J only.: \$6.80 for Single/\$13.60 for Duplex.
D: Hollow pin quick disconnect plug(s) with mating jack(s). Type J only.: \$12.30 for Single/\$24.60 for Duplex.

CHOICE 5 - SPRING AND LOCKCAP:

- A: 6" spring, standard lockcap: No Charge.
B: 12" spring, standard lockcap: .40¢
C: 6" spring, 12mm metric lockcap: \$2.00
D: 12" spring, 12mm metric lockcap: \$2.40
E: 6" spring, 1mm metric lockcap: \$2.00
F: 12" spring, 15mm metric lockcap: \$2.40

CHOICE 6 - LENGTH OF "Y" DIMENSION: (MINIMUM IS 18")

"Y" DIMENSION PICTURED ON PREVIOUS PAGE - SPECIFY LENGTH IN INCHES

EXAMPLE STOCK NO.: CAPP-P08-1-61-2-B-46".

EXAMPLE PRICE: \$24.40

→ "Y" LENGTH

THERMOCOUPLES

HOW TO BUILD-YOUR-OWN THERMOCOUPLE

1

THERMOCOUPLES FOR THE PLASTICS INDUSTRY:

NOZZLE TYPE (NOZZLE-MELT) THERMOCOUPLES:

STEP 1: SELECT THERMOCOUPLE TYPE:

- A. TYPE J SOLID
- B. TYPE J STRANDED
- C. TYPE J SOLID W/ STAINLESS STEEL OVERBRAID
- D. TYPE J STRANDED W/ STAINLESS STEEL OVERBRAID

STEP 2: SELECT ANGLE OF ELEMENT: (IMMERSION STYLE ONLY)

- A. STRAIGHT SINGLE ELEMENT
- B. 90 DEGREE ANGLE
- C. 45 DEGREE ANGLE

STEP 3: SELECT JUNCTION STYLE: (IMMERSION STYLE ONLY)

- A. 1/8" O.D. GROUNDED (CLOSED END)
- B. 1/8" O.D. GROUNDED, W/ "Y" DIMENSION IN FLEXIBLE ARMOR

STEP 4: SELECT COLD-END TERMINATION: ***(THE END OF THE PROBE THAT GETS WIRED TO THE CONTROLLER OR RECORDER)***

- A. SPLIT LEADS (STRIPPED OR W/ SPADE LUGS)
- B. QUICK-DISCONNECT PLUG (SPECIFY SOLID OR HOLLOW PIN)
- C. QUICK-DISCONNECT JACK (SPECIFY SOLID OR HOLLOW PIN)
- D. QUICK-DISCONNECT PLUG W/ MATING JACK

STEP 5: SPECIFY LENGTH OF PROBE: ***(SPECIFY LENGTH IN INCHES)***

- A. SPECIFY "X", "Y", and "T" DIMENSIONS ***(IMMERSION STYLE ONLY) SEE NOZZLE-MELT CATALOG SECTION FOR COMPLETED DIMENSIONAL DETAILS.***

***IF YOU CAN DRAW IT, DESCRIBE IT, or EXPLAIN IT.....
.....THEN WE CAN MAKE IT !***

TALK TO ONE OF OUR ENGINEERS TODAY - (800) 356-8000

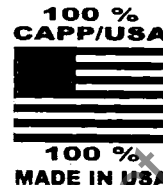
THERMOCOUPLES

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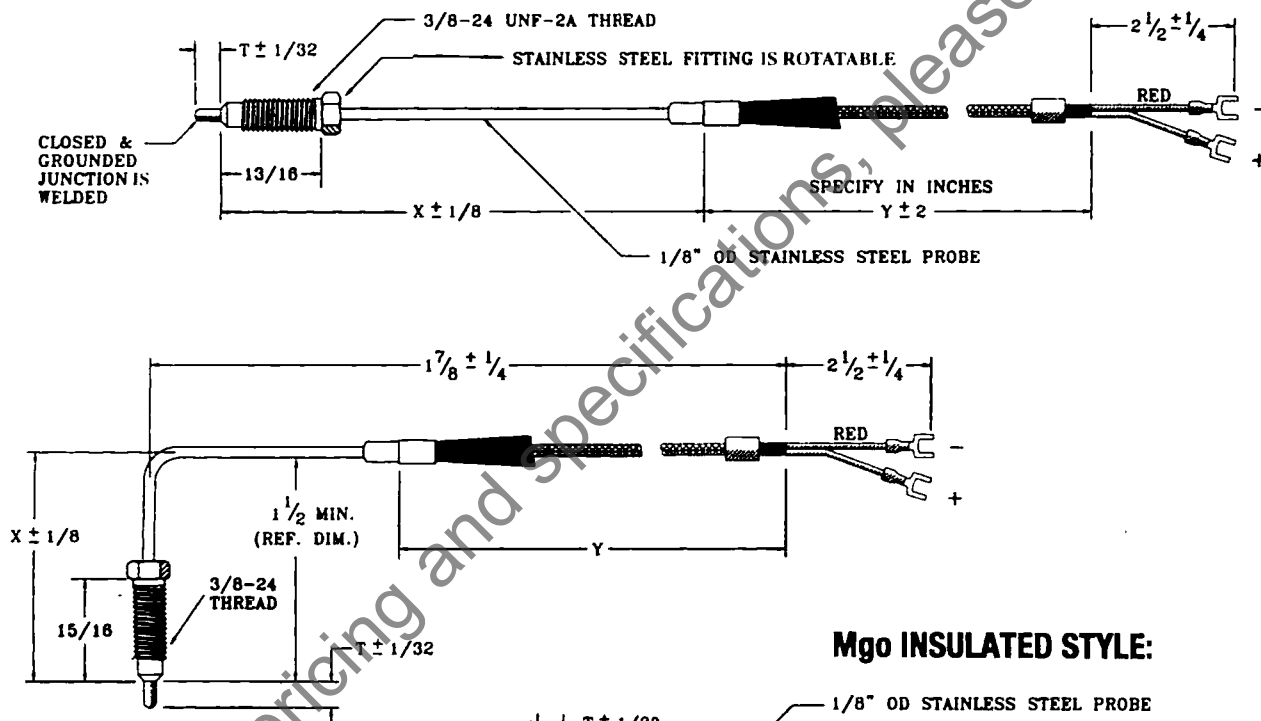
CAPP/USA NOZZLE-MELT® THERMOCOUPLES COMPARE TO BARBER COLMAN'S NOZZLE MELT T/C'S

SPECIFICATIONS:

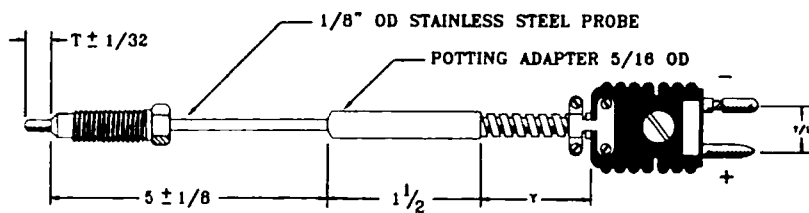
- ELEMENT STYLE: FIBERGLASS INSULATED OR MGO INSULATED
- EASY INSTALLATION WITH NO LEAD TWISTING
- DESIGNED FOR PLASTIC INJECTION MOLDING PROCESSES
- AVAILABLE IN TWO TYPE J STYLES
- AVAILABLE IN SEVERAL TYPES OF TERMINATIONS
- 100% MADE IN THE U.S.A.
- REPLACES BARBER COLMAN STYLES P015 & P016 IN FIT, FORM, & FUNCTION.



FIBERGLASS-INSULATED STYLE:



Mgo INSULATED STYLE:



All Dimensions in Inches

CAPP/USA NOZZLE-MELT THERMOCOUPLES: (CONTINUED)

ORDERING IS EASY AND ONLY 5 STEPS SELECT AN OPTION FROM THE FOLLOWING CHOICES:

CHOICE 1 - THERMOCOUPLE TYPE:

CAPP-P15: TYPE J, FIBERGLASS INSULATED WITH STAINLESS STEEL OVERBRAID.
24 GAGE STRANDED,: INITIAL 36" = \$43.00 / ADD .50¢ FOR EACH
ADDITIONAL 6".

CAPP-P16: TYPE J, MgO INSULATED, WITH TRANSITION TO 20 GAGE STRANDED
FIBERGLASS INSULATED WIRE,: INITIAL 36" = \$50.00 / ADD 35¢ FOR
EACH ADDITIONAL 6".

CHOICE 2 - ANGLE OF ELEMENT:

- 1: STRAIGHT, SINGLE ELEMENT: NO CHARGE
 - 2: 90° ANGLE * \$1.30
 - 3: 45° ANGLE * \$1.30
- * AVAILABLE FOR T/C CODE P15 ABOVE ONLY.

CHOICE 3 - JUNCTION STYLE & "Y" DIMENSION:

- 21: 1/8" O.D., closed end, grounded. CAPP-P15 TC without flexible armor over "Y": NO CHARGE.
- 23: 1/8" O.D., closed end, grounded. CAPP-P15 TC additional covered with flexible armor over "Y": \$2.70 / ADD .40¢ FOR EACH ADDITIONAL 6".
- 41: 1/8" O.D., closed end, grounded. CAPP-P16 TC with flexible armor over "Y": \$2.70 / ADD .40¢ FOR EACH ADDITIONAL 6".
- 42: 1/8" O.D., closed end, ungrounded. CAPP- P16 TC with flexible armor over "Y": \$8.50 / .40¢ FOR EACH ADDITIONAL 6".

CHOICE 4 - COLD END TERMINATIONS:

- 0: 2 1/2" split leads, ends stripped: NO CHARGE
- 1: 2 1/2" split leads with spade lugs: NO CHARGE
- 2: 2 1/2" split leads with spade lugs, and 1/2": \$1.30
- 3: Solid pin quick disconnect plug(s): \$8.80
- 4: Solid pin quick disconnect plug(s) with mating jack(s): \$14.30
- 7: Quick disconnect jack(s): \$6.80
- C: Hollow pin quick disconnect plug(s). Type J only,: \$6.80
- D: Hollow pin quick disconnect plug(s) with mating jack(s). Type J only,: \$12.30

THERMOCOUPLES

1

CAPP/USA NOZZLE-MELT THERMOCOUPLES: (CONTINUED)

CHOICE 5 - "X" DIMENSION:

00 : 5" (ONLY AVAILABLE FOR P16 IN CHOICE 1).

01 : 1 1/2"

02 : 1 3/4"

03 : 2"

04 : 2 1/4"

05 : 2 1/2"

99 : SPECIFY IN INCHES. _____

* (ADD \$3.00 FOR ANY LENGTHS OVER 6")

(NO CHARGE)

CHOICE 6 - "Y" DIMENSION: (NO CHARGE)

SPECIFY "Y" DIMENSION IN INCHES

CHOICE 7 - "T" DIMENSION: (NO CHARGE)

01 : 1/8" (STANDARD)

02 : 3/16"

03 : 1/4"

EXAMPLE STOCK NO.: CAPP-P15-2-21-2-01-36"-01

EXAMPLE PRICE: \$45.60

→ "Y" DIMENSION

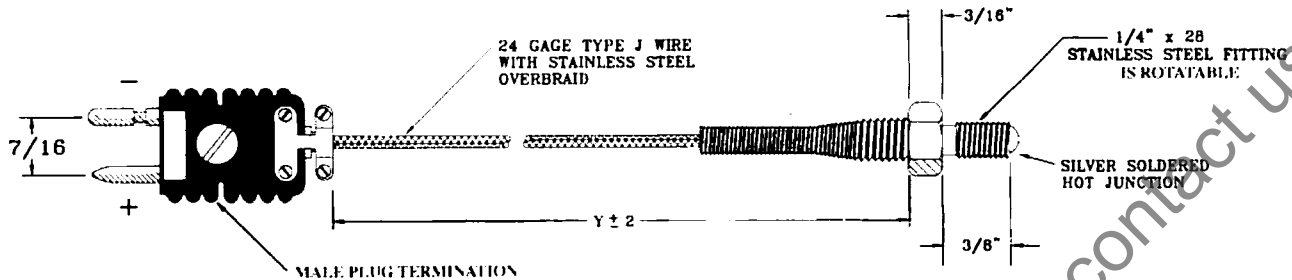
CHOOSE FROM A WIDE SELECTION OF RTD'S.....SPRING-LOADED,
SURFACE, PLATINUM, HERMETICALLY-SEALED, STICK-ON,
STRAP-ON, & EXTENDIBLE - CAPP'S GOT THEM ALL!

THERMOCOUPLES

CAPP/USA NON-IMMERSION NOZZLE THERMOCOUPLES:

1

COMPARE TO BARBER COLMAN'S NOZZLE THERMOCOUPLES!



100% MADE IN THE U.S.A.

NON-IMMERSION NOZZLE THERMOCOUPLE

All Dimensions in Inches



CHOICE 1 - THERMOCOUPLE TYPE:

- CAPP-P021: Type J, 24 gauge, solid
CAPP-P0131: Type J, 24 gauge, solid w/s.s. overbraid
CAPP-P0151: Type J, 24 gauge, stranded w/s.s. overbraid
CAPP-P0261: Type J, 24 gauge, stranded

Initial 36"	Add'l. 6" Length
\$24.50	.20¢
\$26.00	.50¢
\$26.50	.50¢
\$24.70	.25¢

CHOICE 2 - COLD-END TERMINATION:

- 0: 2 1/2" split leads, ends stripped: No Charge
1: 2 1/2" split leads with spade lugs: No Charge
2: 2 1/2" split leads with spade lugs, and 1/2" NPS box connector with locknut: \$1.30
3: Solid pin quick disconnect plug(s): \$8.80
4: Solid pin quick disconnect plug(s) with mating jack(s): \$14.30
7: Quick disconnect jack(s): \$6.80
C: Hollow pin quick disconnect plug(s). Type J only: \$6.80
D: Hollow pin quick disconnect plug(s) with mating jack(s). Type J only: \$12.30

CHOICE 3 - "Y" DIMENSION:

SPECIFY "Y" DIMENSION IN INCHES.

EXAMPLE STOCK NO.: CAPP-P021-0-30".

EXAMPLE PRICE: \$24.50

→ "Y" DIMENSION LENGTH

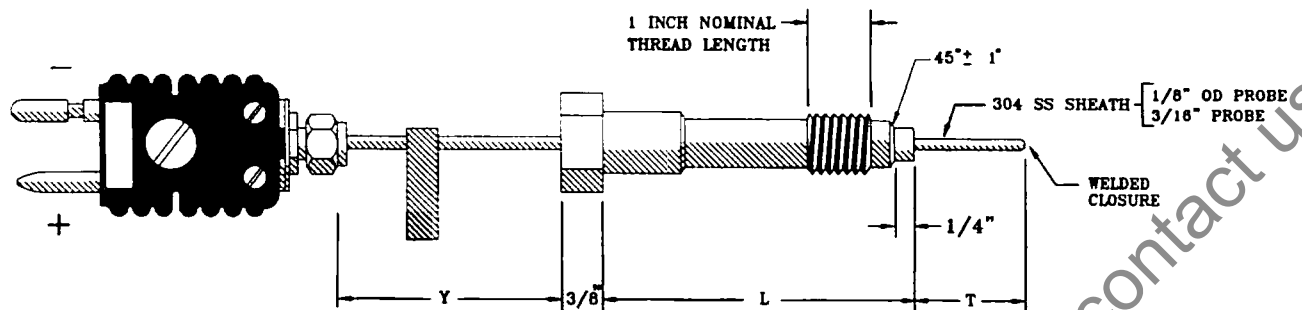
THERMOCOUPLES

1

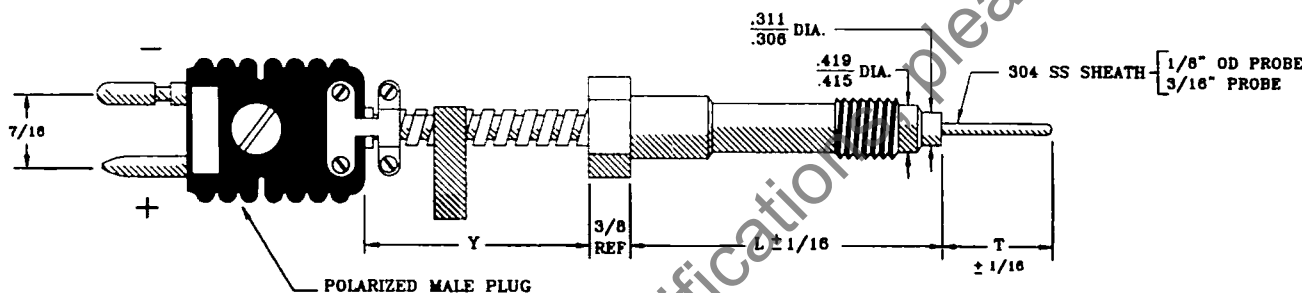


CAPP/USA MELT-BOLT THERMOCOUPLES

Compare to Barber Colman's melt-bolt series P16 and P011 types.



Element with MgO Insulation



Element with Fiberglass Insulation

FIXED PROBE TYPES

All Dimensions in Inches

Stock No.	Description	Price
ORDERING INFORMATION		
312559	Type J, MgO insulation, single element, 1/8" OD protection tube, closed-end, grounded junction, quick-disconnect plug, 3" bolt length ("Y" dimension), 2" "Y" dimension, 1/4" "T" dimension.	\$45.60
312592	Type J, MgO insulation, single element, 1/8" OD protection tube, closed-end, grounded junction, quick-disconnect plug, 4" bolt length ("Y" dimension), 2" "Y" dimension, 1/4" "T" dimension.	\$49.75
312598	Type J, MgO insulation, single element, 1/8" OD protection tube, closed-end, grounded junction, quick-disconnect plug, 6" bolt length ("Y" dimension), 2" "Y" dimension, 1/4" "T" dimension.	\$49.88
312627	Type J, fiberglass insulation, 20 gage solid, single element, 3/16" OD protection tube, closed-end, grounded junction, quick-disconnect plug, 3" bolt length ("Y" dimension), 2" "Y" dimension, 1/4" "T" dimension.	\$43.25
312628	Type J, fiberglass insulation, 20 gage solid, single element, 3/16" OD protection tube, closed-end, grounded junction, quick-disconnect plug, 4" bolt length ("Y" dimension), 2" "Y" dimension, 1/4" "T" dimension.	\$45.00
312631	Type J, fiberglass insulation, 20 gage solid, single element, 3/16" OD protection tube, closed-end, grounded junction, quick-disconnect plug, 6" bolt length ("Y" dimension), 2" "Y" dimension, 1/4" "T" dimension.	\$46.75

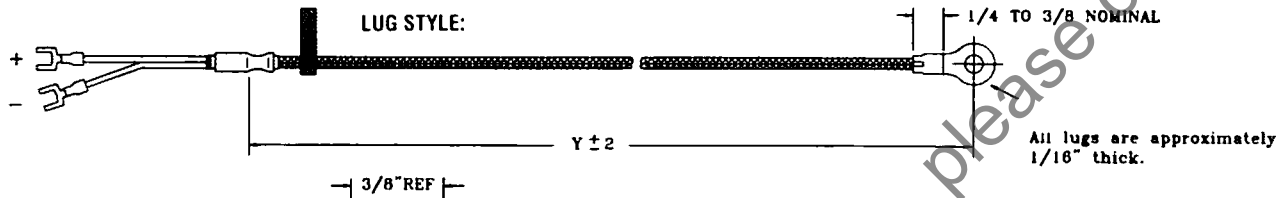
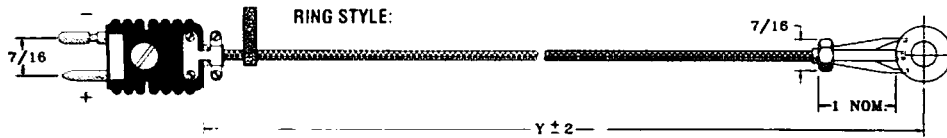
Note: All thermocouples are custom made; if you don't see the specifications above that fit your needs, just call us and we'll make it for you!

CAPP/USA RING & LUG STYLE THERMOCOUPLES

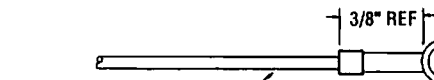
100 %
CAPP/USA



100 %
MADE IN USA



All lugs are approximately
1/16" thick.



Includes additional fiberglass
sleeving over the duplex insulated
wire. Also available in Stranded
and with STAINLESS STEEL
OVERBRAIDING - JUST ASK US!

RING:
3/8" Screw x
3/16" OD ring

All Dimensions in Inches

RING:
#10 Screw x 5/16" OD
STAINLESS STEEL RING.

COMPARE TO BARBER COLMAN'S RING & LUG TYPES

Stock No.	Description	Price
ORDERING INFORMATION		
312539	Type J, 20 gage thermocouple with stainless steel overbraiding, 2 1/2" split leads with spade lugs. 36" length ("Y" dimension), #10 screw x 1/32" OD lug style.	\$9.80
312540	Type J, 20 gage thermocouple with stainless steel overbraiding, 2 1/2" split leads with spade lugs. 36" length ("Y" dimension), 3/16" screw x 3/4" OD lug style.	\$9.80
312542	Type J, 20 gage thermocouple with 2 1/2" split leads with spade lugs. 36" length ("Y" dimension), #10 screw x 5/16" OD ring, 3/32" thickness.	\$15.50
312543	Type J, 20 gage thermocouple with stainless steel overbraiding, 2 1/2" split leads with spade lugs. 36" length ("Y" dimension), 3/16" screw x 13/16" OD ring, 7/32" thickness.	\$16.00

Note: All thermocouples are custom made; if you don't see the specifications above that fit your needs, just call us and we'll make it for you!

LOOKING FOR TECHNICAL SUPPORT ON THERMOCOUPLES OR
RTD'S.....SIMPLY CALL CAPP/USA AT (800) 356-8000.
CAPP/USA's PRODUCT ENGINEERS CAN ANSWER ANY QUESTIONS.

THERMOCOUPLES

1

CAPP/USA PAD STYLE THERMOCOUPLES:

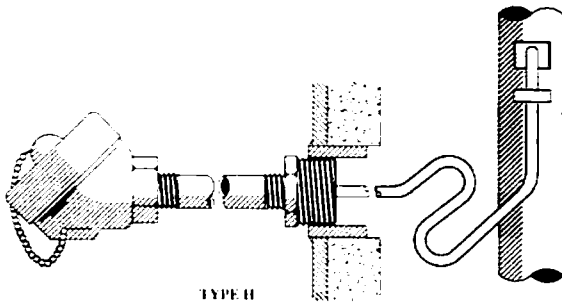
REPLACES BARBER COLMAN SERIES MJ36 & MK36

SPECIFICATIONS:

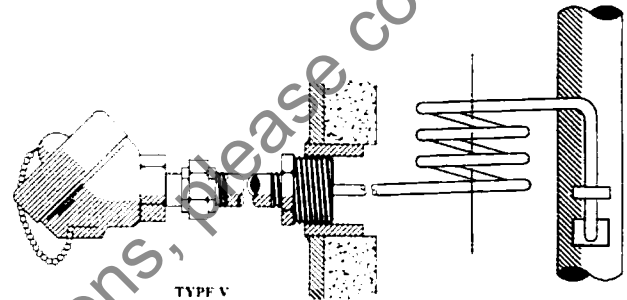
- Insulation: Magnesium-Oxide
- Sheath Dia.: 1/4" O.D. is standard (3/16" O.D. is available.)
- 100% Made in the U.S.A.



- Sheath: 316 Stainless Steel
- Single element
- Head: Cast-Iron (Weatherproof)



TYPE H



TYPE V

Specifications

Magnesium oxide insulation
316 SS sheath
1/4" OD sheath dia. standard (3/16" OD available)
Single element
1" x 1" x 1/8" pad size
Cast iron weatherproof head

ORDERING IS EASY AND ONLY 7 STEPS: SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - THERMOCOUPLE TYPE: (.250" SHEATH DIAMETER)

CAPP-MJ36: TYPE J. 316 S.S.: \$13.20 FOR INITIAL 12"/ADD \$4.25 FOR EACH ADD'L 6"

CAPP-MK36: TYPE K. 316 S.S.: \$15.00 FOR INITIAL 12"/ADD \$4.85 FOR EACH ADD'L 6"

CHOICE 2 - HOT JUNCTION:

- | | |
|----------------|--------------------------|
| 1: GROUNDED: | \$2.00 (FOR INITIAL 12") |
| 2: UNGROUNDED: | \$4.50 (FOR INITIAL 12") |

CHOICE 3 - SPECIFY HOT LENGTH: (PRICE INCLUDED IN CHOICE 1) SPECIFY LENGTH IN INCHES

CONTINUED ON THE NEXT PAGE

THERMOCOUPLES

CAPP/USA PAD STYLE THERMOCOUPLES: (CONTINUED)

1

ORDERING CHOICES: (CONTINUED)

CHOICE 4 - PAD STYLE:

<u>H</u> :	HORIZONTAL:	\$20.00
<u>V</u> :	VERTICAL:	\$20.00

CHOICE 5 - PAD RADIUS:

<u>A</u> :	FLAT RADIUS
<u>B</u> :	0.435" / 1/2" PIPE SIZE
<u>C</u> :	0.515" / 3/4" PIPE SIZE
<u>D</u> :	0.670" / 1" PIPE SIZE
<u>E</u> :	1.205" / 2" PIPE SIZE
<u>F</u> :	1.765" / 3" PIPE SIZE
<u>G</u> :	2.265" / 4" PIPE SIZE

CHOICE 6 - OPTIONS:

<u>O</u> :	NONE	NO CHARGE
<u>A</u> :	1/2" NPT NIPPLE W/COMPRESSION FTG.:	\$20.00
<u>B</u> :	1/2" NPT NIPPLE-UNION-NIPPLE W/COMPRESSION	FTG. \$27.00

CHOICE 7 - TERMINATION:

<u>10</u> :	CAST-IRON WEATHERPROOF:	\$39.00
<u>27</u> :	ALUMINUM WEATHERPROOF:	\$39.00

TO ORDER 304 S.S. WELDING STRAP FOR 1/4" SHEATH,
SPECIFY ... STOCK NO. 279672:

\$1.70

EXAMPLE STOCK NO.: CAPP-MJ36-1-24"-H-A-0-27

EXAMPLE PRICE: \$82.70

THERMOCOUPLES

1

HOW TO BUILD-YOUR-OWN THERMOCOUPLE

STRAIGHT THERMOCOUPLE ASSEMBLY:

STEP 1: SELECT PROTECTION TUBE MATERIAL:

- | | |
|-----------------|--------------------------|
| A. SILLRAMIC | F. NICKEL |
| B. QUARTZ | G. RESISTHEAT (446 S.S.) |
| C. ALUMINA | H. INCONEL (ALLOY 601) |
| D. CARBON STEEL | I. CAST T |
| E. CAST IRON | J. 316 STAINLESS STEEL |

STEP 2: SELECT ELEMENT TYPE:

ALSO SPECIFY YOUR ELEMENT SIZE - 8, 14, OR 20 GAUGE

- | | |
|-----------|---------------------------|
| A. TYPE J | E. TYPE T |
| B. TYPE K | F. TYPE E |
| C. TYPE R | G. DUAL ELEMENTS (DUPLEX) |
| D. TYPE S | |

STEP 3: SELECT O.D. OF TUBE:

(MOST COMMON CHOICES LISTED BELOW, HOWEVER, THERE ARE MANY MORE)

- | | | |
|----------|----------|-----------|
| A. .938" | E. .405" | I. .162" |
| B. .687" | F. .75" | J. .875" |
| C. .5" | G. .540" | K. .125" |
| D. .375" | H. .840" | L. 1.050" |

STEP 4: SPECIFY LENGTH OF TUBE:

SPECIFY LENGTH IN INCHES

STEP 5: SELECT TYPE OF HEAD:

- | |
|---|
| A. GENERAL PURPOSE HEAD (1/2" NPT CONN.) |
| B. SCREW COVER HEAD (1/2" or 3/4" NPT CONN.) |

STEP 6: SELECT MOUNTING ATTACHMENTS:

- | |
|--|
| A. ADJUSTABLE FLANGE |
| B. BUSHING WELDED TO STEEL SLEEVE |
| C. STEEL or S.S. BUSHING (3/8", 1/2", 3/4", 1", 1 1/4", or 1 1/2") |

STEP 7: SELECT WIRE OPTIONS:

- | |
|---|
| A. PREMIUM GRADE THERMOCOUPLE WIRE |
| B. THERMOCOUPLE INSULATED FROM THE TUBE |
| C. VENTED-TUBE |

IF YOU CAN DRAW IT, DESCRIBE IT, or EXPLAIN IT.....

.....THEN WE CAN MAKE IT !

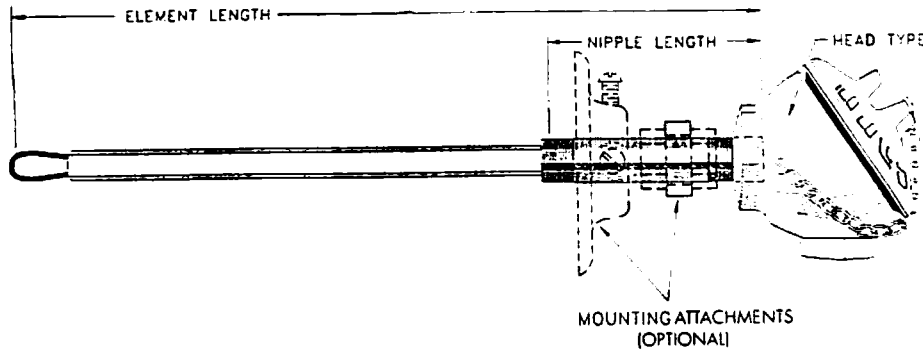
TALK TO ONE OF OUR ENGINEERS TODAY - (800) 356-8000

THERMOCOUPLES

CAPP/USA EXPOSED TIP THERMOCOUPLES:



1



ORDERING IS EASY AND ONLY 2-STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE 4 CHOICES BELOW.

To Fit Honeywell Model	Type Element	Max. Temp. °F	O.D. Of Nipple	Element Length	Matl. Of Nipple	STOCK NO.	PRICE
3A41V	Type J	1500°	.840"	Min. 9"	Carbon	277607	\$3.50 per
5A41V	Type K	2400°	.840"	Max. 120"	Steel	277608	inch

MUST SPECIFY LENGTH

CHOICE 1 - SELECT 1 TYPE OF HEAD:

- GP:** GENERAL PURPOSE WITH A 1/2" NPT CONDUIT CONN. NO CHARGE
SC50: SCREW-COVER WITH A 1/2" NPT CONDUIT CONN. \$16.00
SC75: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. \$16.00

CHOICE 2 - SELECT MOUNTING ATTACHMENTS:

(THIS CHOICE IS OPTIONAL)

- AF:** ADJUSTABLE FLANGE \$12.00
UC: UNION CONNECTOR \$ 9.00
N: NIPPLE \$ 7.00

CHOICE 3 - LENGTH OF NIPPLE:

SELECT NIPPLE LENGTHS OF: 3 1/2", 4", 6", 9", 12", 18", OR 24"
TO ORDER SPARE PIPE-NIPPLES INDIVIDUALLY, SEE PAGE ____.

CHOICE 4 - PREMIUM GRADE WIRE:

- W:** PREMIUM GRADE WIRE. \$15.00

EXAMPLE STOCK NO.: 277607-SC75-N6-W-24"

EXAMPLE PRICE: \$122.00

LENGTH OF NIPPLE.
ELEMENT LENGTH

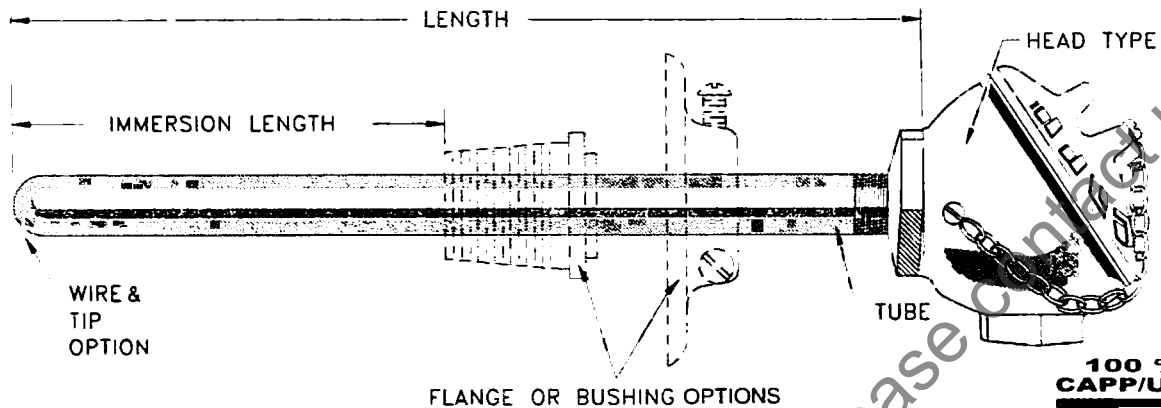
CALL CAPP/USA TODAY FOR A FULL SELECTION OF
CHART PAPER, PENS & INKS FOR ALL O.E.M. RECORDERS

THERMOCOUPLES

1

CAPP/USA

STRAIGHT THERMOCOUPLE ASSEMBLIES WITH FULL-LENGTH METAL PROTECTION TUBES:



ORDERING IS EASY AND ONLY 2-STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE 3 CHOICES ON NEXT PAGE.

To Fit Honeywell Model	Gauge	Type Element	Max. Temp. °F	Tube Material	Tube O.D.	Max. Length Of Tube	STOCK NO.	Initial 12"	For Each Add'l 6"
1D10B	20	Type I	550°	Carbon Steel	.405"	120"	278194	\$79.00	\$8.00
3D10B		Type J	1000°				278195	\$79.00	\$8.00
Y3D10B		Type E	1100°				278196	\$82.00	\$9.00
1D10T		Type I	550°	316 SST	.405"	120"	278197	\$98.00	\$18.00
3D10T		Type J	1200°				278198	\$98.00	\$18.00
Y3D10T		Type E	1100°				278199	\$101.00	\$19.00
3D10S	14	Type J	900°	304 SST	.540"	120"	278200	\$89.00	\$16.00
Y3D10S		Type E	1000°				278201	\$93.00	\$17.00
3B10B		Type J	1000°	Carbon Steel	.540"	120"	278202	\$84.00	\$9.00
Y3B10B		Type E	1000°				278203	\$87.00	\$10.00
5B10P		Type K	1000°				278204	\$84.00	\$10.00
3A10W	8	Type J	1000°	Carbon Steel	.840"	120"	278205	\$89.00	\$8.00
Y3A10W		Type E	1000°				278206	\$93.00	\$9.00
5A10W		Type K	1000°				278207	\$93.00	\$8.00
3A10D		Type J	1500°	Cast Iron	1.62"	48"	278208	\$93.00	\$17.00
Y3A10D		Type E	1500°				278210	\$96.00	\$18.00
5A10D		Type K	1500°				278211	\$96.00	\$19.00
3A10L	8	Type J	1500°	Nickel	.875"	120"	278212	\$207.00	\$52.00
Y3A10L		Type E	1600°				278213	\$208.00	\$54.00
5A10L		Type K	1900°				278214	\$208.00	\$55.00
5A10L A		Type K	1900°	Nickel	1.25"	30"	278215	\$296.00	\$229.00
5B10L A		Type K	1900°				278216	\$267.00	\$70.00
3A10PA		Type J	1400°	Resistat (446 SS)	.840"	120"	278217	\$116.00	\$21.00
Y3A10PA		Type E	1600°				278218	\$119.00	\$22.00

THERMOCOUPLES

CAPP/USA STRAIGHT THERMOCOUPLE ASSEMBLIES WITH FULL-LENGTH METAL PROTECTION TUBES: (CONT.)

1

ORDERING INFORMATION CONTINUED:

To Fit Honeywell Model	Gauge	Type Element	Max. Temp °F	Tube Material	Tube O.D.	Max. Length of Tube	STOCK NO.	Initial 12"	For Each Add'l. 6"
3A10M	8	Type J	1400°	Inconel	.840"	120"	278228	\$159.00	\$45.00
Y3A10M		Type E	1600				278229	\$160.00	\$47.00
5A10M		Type K	2200°				278231	\$161.00	\$49.00
5B10M	14	Type K	2100°	Inconel	.840"	120"	278232	\$153.00	\$48.00
5A10E	8	Type K	2100°	Cast T.	1.050"	120"	278233	\$246.00	\$79.00

**MUST SPECIFY LENGTH - 12" IS MINIMUM LENGTH.
MAX. LENGTH IS SHOWN IN ABOVE TABLE BY STOCK NO.**

SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - SELECT 1 TYPE OF HEAD:

- GP:** GENERAL PURPOSE WITH A 1/2" NPT CONDUIT CONN. NO CHARGE
SCD: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. - NO CHARGE
 FOR DUPLEX ELEMENTS.
SC75: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. \$16.00
SC50: SCREW-COVER WITH A 1/2" NPT CONDUIT CONN. \$16.00

CHOICE 2 - SELECT 1 TYPE OF FLANGE & BUSHING:

- AF:** ADJUSTABLE FLANGE - FITS ALL TUBES. \$12.00
3/8: 3/8" BUSHING = FITS .405" O.D. TUBES. \$25.00
1/2: 1/2" BUSHING = FITS .405" & .540" O.D. TUBES. \$25.00
3/4: 3/4" BUSHING = FITS .405" & .540" O.D. TUBES. \$25.00
3/4SS: 3/4" S.S. BUSHING = FITS .540" O.D. S.S. TUBES. \$29.00
1: 1" BUSHING = FITS .540, .840, .75, .875, 1.0" O.D. TUBES. \$25.00
1 1/4: 1 1/4" BUSHING = FITS .540, .840, .75, .875, 1.0", 1.05", & 1.25" O.D. TUBES. \$25.00
1 1/2: 1 1/2" BUSHING = FITS .540, .840, .75, .875, 1.0", 1.05", & 1.25" O.D. TUBES. \$25.00

CHOICE 3 - SELECT 1 OPTION OF WIRE & TIP:

- W:** PREMIUM GRADE T/C WIRE. \$15.00
IT: T/C INSULATED FROM THE TUBE. \$15.00

PROT. TUBE LENGTH.

EXAMPLE STOCK NO.: 278198-SC50-1/2"-IT-24"

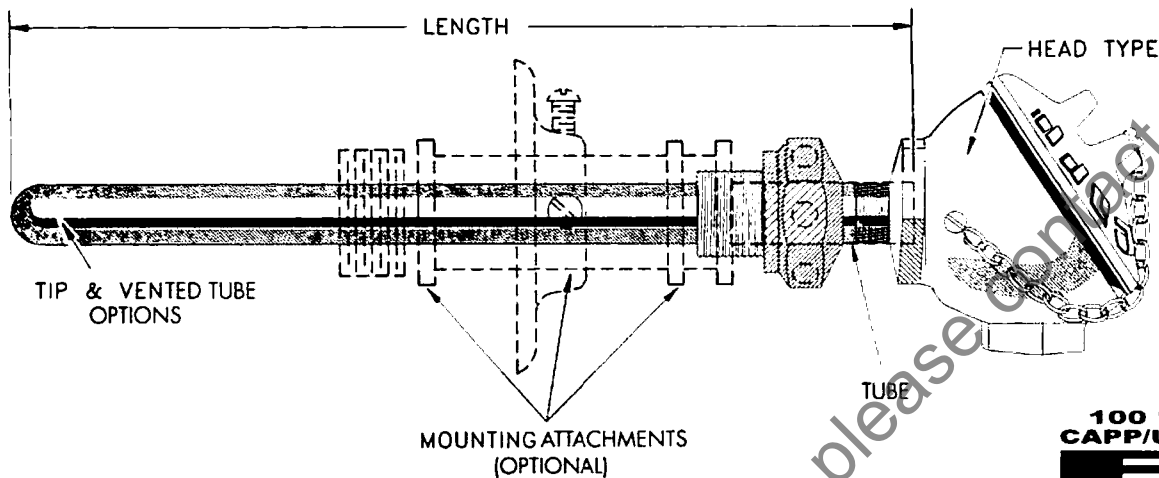
EXAMPLE PRICE: \$190.00

THERMOCOUPLES

1

CAPP/USA

STRAIGHT THERMOCOUPLE ASSEMBLIES WITH FULL-LENGTH CERAMIC PROTECTION TUBES:



ORDERING IS EASY AND ONLY 2-STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE 3 CHOICES ON THE NEXT PAGE.

To Fit Honeywell Model	Type Element	Max. Temp. °F	Tube Material	Tube O.D.	Min. & Max. Length Of Tube	STOCK NO.	Initial 12"	For Each Add'l 6"
3A15R	Type J	1500°	Sillramic	.938"	Min. 12" Max. 48"	278130	\$105.00	\$20.00
5A15R	Type K	2400°	Sillramic	.938"		278132	\$105.00	\$20.00
3B15R	Type J	1200°	Sillramic	.687		278133	\$95.00	\$18.00
5B15R	Type K	2000°	Sillramic	.687		278134	\$95.00	\$18.00
6G15R	Type R	2800°	Sillramic	.687		278138	\$364.00	\$109.00
7G15R	Type S	2800°	Sillramic	.687		278142	\$364.00	\$109.00
6G15N	Type R	2400°	Quartz	.5"		278143	\$375.00	\$109.00
7G15N	Type S	2400°	Quartz	.5"		278144	\$375.00	\$109.00
*SPECIAL	PT 6% Rh PL 30% Rh	3100°	Alumina	.375		278336	*_	*_
*SPECIAL	Rh	3100°	Alumina	.375		278337	*_	*_

MUST SPECIFY LENGTH - (12" IS MINIMUM LENGTH).

EXAMPLE STOCK NO.: 278130-24"

EXAMPLE PRICE: \$145.00

OPTIONS ON FOLLOWING PAGE.

***SPECIAL: MUST CONSULT CAPP/USA FOR PRICING—DUE TO THE EVERYDAY CHANGES OF THE PRICE OF PRECIOUS METALS.**

CAPP/USA
STRAIGHT THERMOCOUPLE ASSEMBLIES WITH
FULL-LENGTH CERAMIC PROTECTION TUBES:
(CONTINUED)

ORDERING INFORMATION CONTINUED:

SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - SELECT 1 TYPE OF HEAD:

- GP:** GENERAL PURPOSE WITH A 1/2" NPT CONDUIT CONN. NO CHARGE
SC50: SCREW-COVER WITH A 1/2" NPT CONDUIT CONN. \$16.00
SC75: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. \$16.00

CHOICE 2 - SELECT MOUNTING ATTACHMENTS:

(THIS CHOICE IS OPTIONAL)

- AF:** ADJUSTABLE FLANGE ON A STEEL SLEEVE. \$29.00
WB: 1 1/4" NPT WELDED BUSHING TO STEEL SLEEVE OVER CERAMIC
TUBE - SPECIFY EITHER 6", 7", 9", OR 12" BELOW THE HEAD. \$10.00

CHOICE 3 - SELECT WIRE OPTIONS:

- W:** PREMIUM-GRADE T/C WIRE. \$15.00
VT: VENTED-TUBE. \$15.00

EXAMPLE STOCK NO.: **278130-SC50-AF-W-24"**.
EXAMPLE PRICE: **\$205.00**

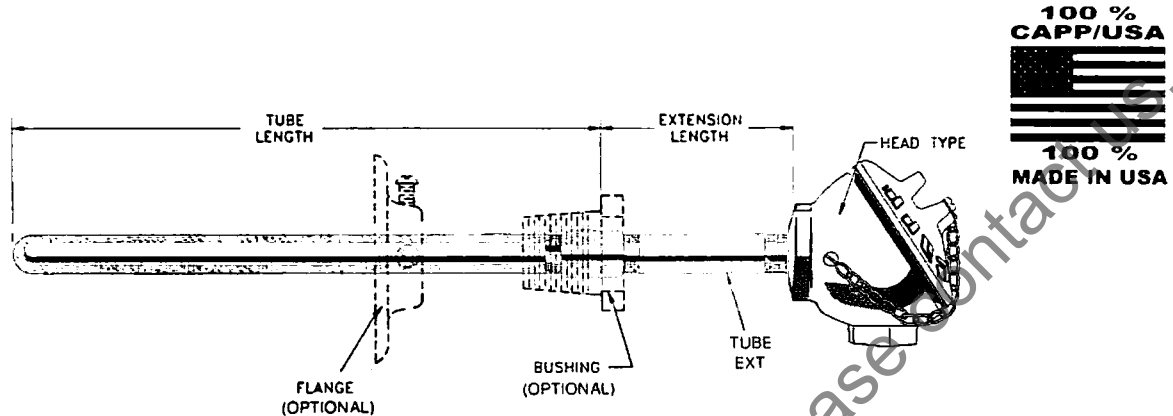
PROT. TUBE LENGTH
↓

THERMOCOUPLES

1

CAPP/USA

STRAIGHT THERMOCOUPLE ASSEMBLIES WITH PIPE-EXTENDED METAL PROTECTION TUBES:



ORDERING IS EASY AND ONLY 2-STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE 3 CHOICES ON THE NEXT PAGE.

To Fit Honeywell Model	Gauge	Type Element	Max. Lengths		O.D. Of Tube	Max. Temp. °F	Tube Material	STOCK NO.	Initial 12"	For Each Add'l 6"
			Prot. Tube	Ext. Tube						
3A30P	8	Type J	30"	48"	1"	1450°	(446SS)	277591	\$228.00	\$29.00
5A30P		Type K				1900°		277592	\$209.00	\$33.00
3B30P	14	Type J	24"		.75"	1200°	(446SS)	277593	\$202.00	\$30.00
5B30P		Type K				1900°		277594	\$204.00	\$30.00
3B30S		Type J	54"		.540"	1200°	304 SS	277595	\$135.00	\$17.00
5B30S		Type K				1900°		277596	\$135.00	\$17.00
3A30M	8	Type J	54"		.840"	1450°	Inconel	277597	\$186.00	\$44.00
5A30M		Type K				2200°		277598	\$192.00	\$49.00
5A30E		Type K	54"		1.050"	2000°	Cast. I	277599	\$311.00	\$89.00
5A30L		Type K	54"		.875"	2000°	Nickel	277600	\$276.00	\$57.00
5A30LA		Type K	30"		1.25"	2000	Nickel	277601	\$431.00	\$287.00
5B30LA	14	Type K	24"		.75"	2000°	Nickel	277602	\$315.00	\$109.00

OPTIONS ON FOLLOWING PAGE

CAPP/USA

STRAIGHT THERMOCOUPLE ASSEMBLIES WITH PIPE-EXTENDED METAL PROTECTION TUBES (CONT.)

ORDERING INFORMATION CONTINUED:
SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - SELECT 1 TYPE OF HEAD:

GP: GENERAL PURPOSE WITH A 1/2" NPT CONDUIT CONN. NO CHARGE

SC50: SCREW-COVER WITH A 1/2" NPT CONDUIT CONN. \$16.00

SC75: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. \$16.00

CHOICE 2 - SELECT MOUNTING ATTACHMENTS:

(THIS CHOICE IS OPTIONAL)

AF: ADJUSTABLE FLANGE ON PROTECTION TUBE \$12.00

AFE: ADJUSTABLE FLANGE ON PIPE-EXTENSION \$12.00

1 1/4: BUSHING WITH 1 1/4" NPT MOUNTING THREAD \$27.00

1 1/2: BUSHING WITH 1 1/2" NPT MOUNTING THREAD \$27.00

CHOICE 3 - LENGTH OF PIPE-EXTENSION:

MUST SPECIFY LENGTH - 6" IS MINIMUM LENGTH. ADD'L. 6" LENGTHS:
(NO CHARGE FOR INITIAL 6" LENGTH.)

TYPES J & K = \$7.00/6"

TYPES R & S = \$130.00/6"

CHOICE 4 - LENGTH OF PROTECTION TUBE:

MINIMUM LENGTH IS 12" & MAX. LENGTH IS SHOWN IN
TABLE BY STOCK NO.

LENGTH OF
PIPE EXT.

PROTECTION
TUBE LENGTH

EXAMPLE STOCK NO.: 277601-GP-AFE-6"-18".

EXAMPLE PRICE: \$730.00

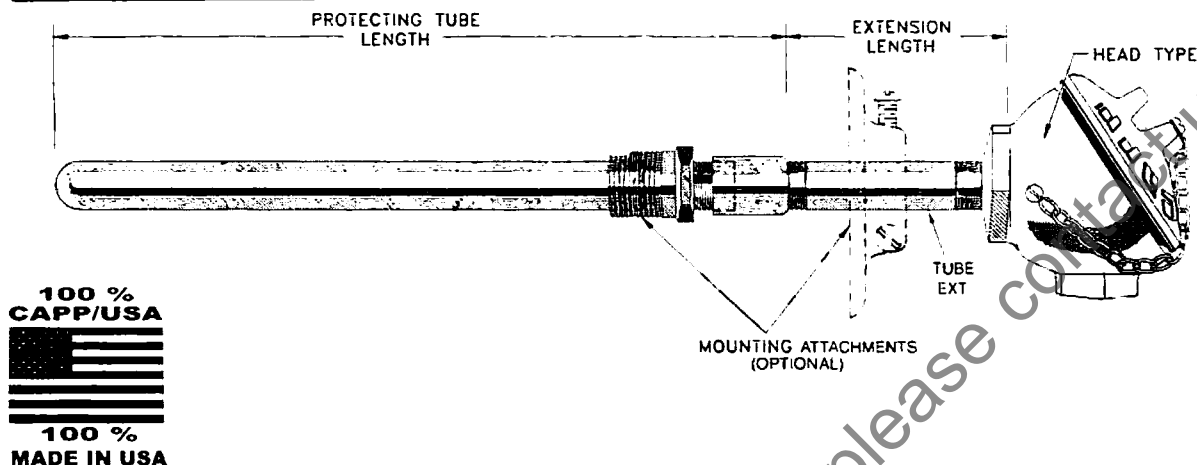
ALL CAPP/USA THERMOCOUPLES & RTD'S ARE MADE IN THE U.S.A.
BY AMERICAN WORKERS - GUARANTEED!

THERMOCOUPLES

1

CAPP/USA

STRAIGHT THERMOCOUPLE ASSEMBLIES WITH PIPE-EXTENDED CERAMIC PROTECTION TUBES:



ORDERING IS EASY AND ONLY 2-STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE 4 CHOICES BELOW AND NEXT PAGE.

TYPE ELEMENT	MAXIMUM LENGTHS			MAX. TEMP. °F	TO FIT HONEYWELL MODEL	STOCK NO.	INITIAL 12"	FOR EACH ADD'L 6"		
	Protection Tube	Ext. Tube	Tube O.D.							
Type J	* 48"	48"	688"	1200°F	3B30R	277603	\$109.00	\$19.00		
Type K				2000°F	5B30R	277604	\$109.00	\$19.00		
Type R	* 42"			2800°F	6G30R	277605	\$513.00	\$129.00		
Type S				2800°F	7G30R	277606	\$513.00	\$129.00		

* NOTE: TUBE & EXTENSION MUST NOT EXCEED 60" FOR TYPES J & K, OR 48" FOR TYPES R & S.

SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - SELECT 1 TYPE OF HEAD:

GP: GENERAL PURPOSE WITH A 1/2" NPT CONDUIT CONN. NO CHARGE
SC50: SCREW-COVER WITH A 1/2" NPT CONDUIT CONN. \$16.00
SC75: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. \$16.00

CHOICE 2 - SELECT MOUNTING ATTACHMENTS: (THIS CHOICE IS OPTIONAL)

AF: ADJUSTABLE FLANGE ON THE PIPE EXTENSION \$12.00
1 1/4: COUPLING WITH 1 1/4" NPT MOUNTING THREAD. \$27.00
1 1/2: COUPLING WITH 1 1/2" NPT MOUNTING THREAD. \$27.00

THERMOCOUPLES

ORDERING INFORMATION (CONTINUED)

1

CHOICE 3 - SPECIFY LENGTH OF PROTECTION TUBE:

MINIMUM LENGTH IS 12" AND MAXIMUM LENGTH IS SHOWN IN
TABLE BY STOCK NO.

CHOICE 4 - SPECIFY LENGTH OF PIPE-EXTENSION:

MINIMUM LENGTH IS 6".

MAXIMUM LENGTH IS 48".

STANDARD

\$6.50 FOR EACH ADD'L 6" (TYPES J & K)

\$117.00 FOR EACH ADD'L 6" (TYPES R & S)

EXAMPLE STOCK NO.: 277604-GP-AF-36"-6".

EXAMPLE PRICE: \$198.00

→ PROTECTION
TUBE LENGTH


→ LENGTH OF
PIPE EXT.

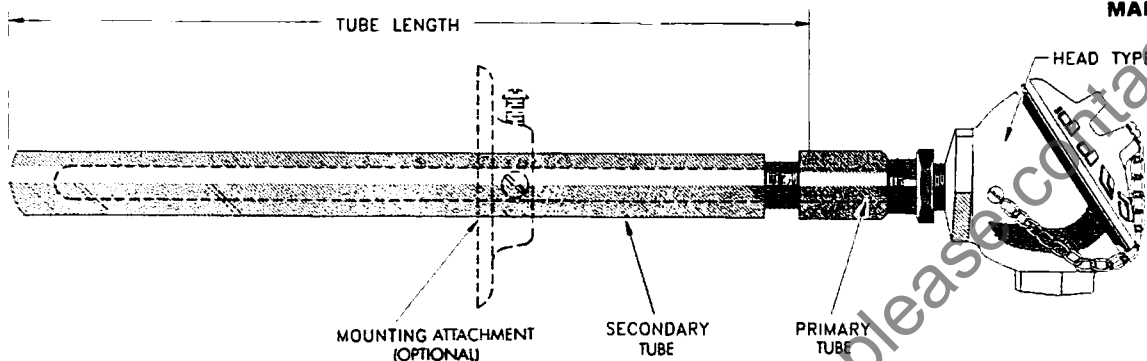
THERMOCOUPLES

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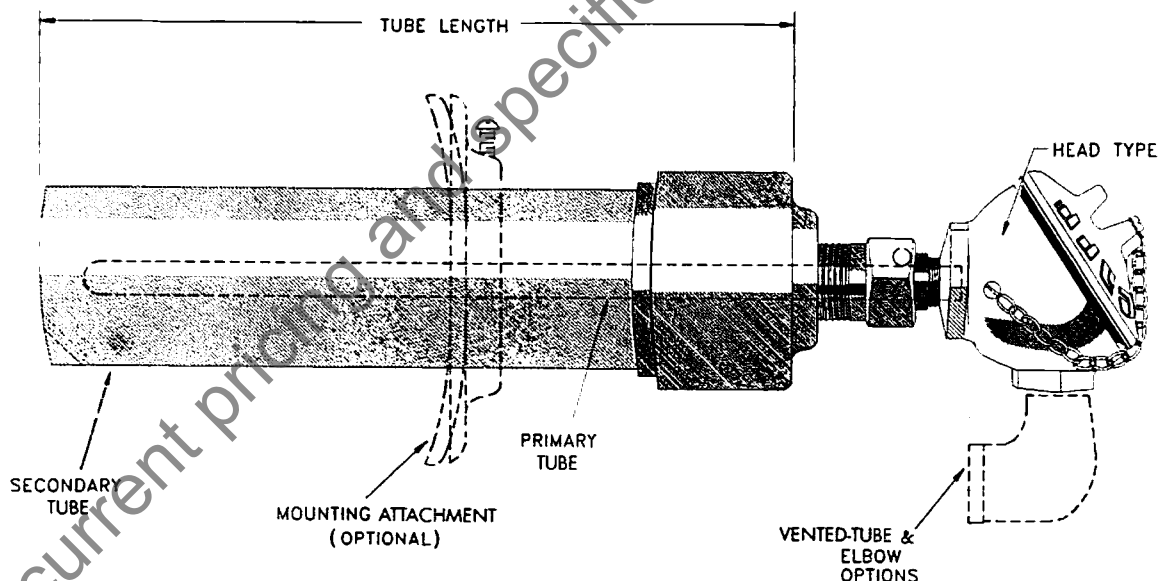
CAPP/USA

STRAIGHT THERMOCOUPLE ASSEMBLIES WITH DOUBLE PROTECTION TUBES:

100 %
CAPP/USA

100 %
MADE IN USA



METAL SECONDARY TUBE



CERAMIC SECONDARY TUBE

COMPLETE ORDERING INFORMATION ON THE NEXT PAGE

THERMOCOUPLES

CAPP/USA STRAIGHT THERMOCOUPLE ASSEMBLIES WITH DOUBLE PROTECTION TUBES: (CONTINUED)

1

ORDERING IS EASY AND ONLY 2-STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE 3 CHOICES BELOW.

To Fit Honeywell Model	Type Element	Primary Material	Tube O.D.	Second Material	Tube O.D.	Min. & Max. Tube Lengths	Max. Temp °F	STOCK NO.	Initial 12"	For Each Add'l 6"
5A25D	Type K	↓	.95"	Mullite	3"	Min. 12" Max. 36"	2300°	278955	\$149.00	\$39.00
6G22E	Type R		.36"	Nickel	1.25"	Min. 12" Max. 30"	1850°	278145	\$589.00	\$239.00
7G22E	Type S		.36"	Nickel	1.25"	Min. 12" Max. 30"	1850°	278148	\$589.00	\$239.00
6G22M	Type R		.36"	Inconel	.840"	Min. 12" Max. 36"	2400°	278146	\$509.00	\$166.00
7G22M	Type S		.36"	Inconel	.840"	Min. 12" Max. 36"	2400°	278149	\$509.00	\$166.00
6G25H	Type R		.69"	Silicon Carbide	1.75"	Min. 12" Max. 36"	2800°	278150	\$512.00	\$155.00
7G25H	Type S		.69"	Silicon Carbide	1.75"	Min. 12" Max. 36"	2800°	278151	\$512.00	\$155.00
6G25D	Type R		.69"	Mullite	2"	Min. 12" Max. 36"	2800°	278152	\$576.00	\$155.00
7G25D	Type S		.69"	Mullite	2"	Min. 12" Max. 36"	2800°	278153	\$576.00	\$155.00
6G25DD	Type R	↓	.69"	Mullite	3"	Min. 12" Max. 36"	2800°	278154	\$589.00	\$169.00
7G25DD	Type S		.69"	Mullite	3"	Min. 12" Max. 36"	2800°	278155	\$589.00	\$169.00

MUST SPECIFY LENGTH

SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - SELECT 1 TYPE OF HEAD:

- GP:** GENERAL PURPOSE WITH A 1/2" NPT CONDUIT CONN. NO CHARGE
SC50: SCREW-COVER WITH A 1/2" NPT CONDUIT CONN. \$16.00
SC75: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. \$16.00

CHOICE 2 - SELECT MOUNTING ATTACHMENTS:

(THIS CHOICE IS OPTIONAL)

- AF:** ADJUSTABLE FLANGE FOR SECOND TUBE-METAL \$12.00
AS: ADJUSTABLE SADDLE FOR SECOND TUBE-CERAMIC. \$16.00

CHOICE 3 - SELECT VENTED-TUBE OR ELBOW:

- VT:** VENTED TUBE \$17.00
E: DRIP-PROOF ELBOW \$13.00

EXAMPLE STOCK NO.: 278955-GP-AF-VT-30. ← TUBE LENGTH

EXAMPLE PRICE: \$295.00

**DID YOU KNOW ? THAT YOU CAN CALL CAPP/USA WITH ANY
THERMOCOUPLE COMPANY'S PART No. AND WE'LL GLADLY MAKE IT FOR YOU**

THERMOCOUPLES

1

CHOOSING THE RIGHT PROTECTION TUBE MATERIAL FOR YOUR PROCESS

TYPE OF PROCESS	APPLICATION	SUGGESTED PROTECTION TUBE MATERIAL	
Heat Treating	Annealing: up to 1200°F	Carbon Steel/Wrought Iron	
	over 1200°F	310 S.S.	Incoloy
	Carburizing	Inconel	
	Hardening: up to 1200°F	Carbon Steel/Wrought Iron	
	1200° to 2000°F		Incoloy
	over 2000°F	Mullite	
	Lead	446 S.S. (Drilled)	
	Nitriding		Incoloy
	Salt Baths: cyanide	Inconel	Incoloy
Iron and Steel	neutral	446 S.S., Mullite	
	high speed	446S.S., Mullite	
	Open Hearth	310 S.S., 446 S.S.	Incoloy
	Billet Heating, Brazing, Patenting, Butt-Welding, Slab Heating: up to 2000°F	LT-1, 446 S.S.	Incoloy
	over 2000°F	Mullite, Silicon Carbide	
	Bright Anneal: Batch	Unprotected	
	Continuous	Mullite, Silicon Carbide	
	Foundry		Quartz
	Forging	Mullite, Silicon Carbide	
	Galvanizing	Carbon Steel, Wrought Iron.	
	Soaking Pits: up to 2000°F	310 S.S.	
	over 2000°F	Mullite, Silicon Carbide	
	Vacuum Melting: up to 3400°F		Aluminum Oxide
Non-Ferrous	up to 4000°F		Beryllium Oxide
	Aluminum	Cast Iron, Silicon Carbide	
	Brass or Bronze	446 S.S.	
	Lead	446 S.S. (Drilled)	
	Magnesium	Carbon Steel, Wrought Iron	
	Tin	Carbon Steel, Wrought Iron	
	Zinc	Carbon Steel, Wrought Iron	
		446 S.S., Silicon Carbide	
	Die Casting	Cast Iron, Silicon Carbide	
	Smelting	310 S.S., 446 S.S., Inconel	
Cement		Mullite, Silicon Carbide	
	Flues	310 S.S., 446 S.S.	
	Kilns: continuous	Mullite, Silicon Carbide	
Ceramics and Refractories	periodic	310 S.S., Inconel, Mullite	
		Silicon Carbide	
Chemical and Petroleum	Various	Carbon Steel, Wrought Iron	
Glass		304 S.S., 316 S.S.	
	Lehrs	Carbon Steel, Wrought Iron	
	Tanks: crown	Mullite	
Power	flues	310 S.S., 446 S.S., Inconel	
	Flue Gases	Carbon Steel, Wrought Iron, 446 S.S.	
	Preheaters	Carbon Steel, Wrought Iron, 304 S.S.	
	Steam Lines	Carbon Steel, Wrought Iron, 304 S.S.	
	Water Lines	Carbon Steel, Wrought Iron, 316 S.S.	
Gas Producers	Flues and Stacks	310 S.S.	
Incinerators	Flues and Stacks	310 S.S., 446 S.S.	

**CHOOSING THE RIGHT PROTECTION
TUBE BY TEMPERATURE RATING**

MAXIMUM TEMPERATURE (OXIDIZING)	RECOMMENDED PROTECTION TUBE MATERIAL
1000°F / 540°C	MONEL
1000°F / 540°C	CARBON STEEL
1250°F / 675°C	WROUGHT IRON
1250°F / 675°C	YOLOY
1600°F / 870°C	CAST IRON
1650°F / 900°C	304 STAINLESS STEEL
1700°F / 925°C	316 STAINLESS STEEL
2000°F / 1090°C	NICKEL
2000°F / 1090°C	INCOLOY
2100°F / 1150°C	446 STAINLESS STEEL
2100°F / 1150°C	INCONEL
2200°F / 1215°C	KANTHAL
2200°F / 1215°C	QUARTZ
2350°F / 1290°C	HASTELLOY
2500°F / 1370°C	METAL-CERAMIC
2900°F / 1600°C	SILICA
3000°F / 1650°C	CARBOFRAX
3100°F / 1700°C	MULLITE / PORCELAIN
3150°F / 1730°C	REFRAX
3400°F / 1870°C	ALUMINA
4200°F / 2315°C	BERYLLIUM-OXIDE
4200°F / 2315°C	TANTALUM

THERMOCOUPLES

HOW TO BUILD-YOUR-OWN PROTECTION TUBES

1

STEP 1: SELECT PROTECTION TUBE MATERIAL:

(MOST "COMMON" SELECTIONS LISTED,
HOWEVER MANY OTHERS AVAILABLE TO YOU).

- | | |
|----------------------------|------------------------|
| A. SILLRAMIC | G. 446 STAINLESS STEEL |
| B. QUARTZ | H. CARBON STEEL |
| C. ALUMINA | I. KANTHAL |
| D. MULLITE | J. INCONEL |
| E. DURAX (SILICON-CARBIDE) | K. NICKEL |
| F. 316 STAINLESS STEEL | L. CAST IRON |

STEP 2: IF CHOICES A THRU E WERE CHOSEN, SELECT:

- | | |
|--------------------------|------------------------------|
| A. TUBE W/ FITTINGS | C. TUBE W/ REFRACTORY COLLAR |
| B. TUBE WITHOUT FITTINGS | |

STEP 2: IF CHOICES F THRU L WERE CHOSEN, SELECT:

- | | |
|----------------------|--------------------|
| A. CLOSED-ENDED TUBE | B. OPEN-ENDED TUBE |
|----------------------|--------------------|

STEP 3: SELECT TUBE DIMENSIONS (INCHES):

MOST "COMMON" CHOICES: (NOT ALL CHOICES SHOWN)

- | | | |
|--------------------------|--------------------------|--------------------------|
| A. .234 I.D. X .359 O.D. | H. 1.0 I.D. X 1.25 O.D. | O. .269 I.D. X .405 O.D. |
| B. .438 I.D. X .688 O.D. | I. 1.38 I.D. X 2.0 O.D. | P. .622 I.D. X .840 O.D. |
| C. .688 I.D. X .938 O.D. | J. .75 I.D. X .688 O.D. | Q. 1.049 I.D. X 1.315 |
| D. .375 I.D. X .50 O.D. | K. 1.0 I.D. X 2.0 O.D. | O.D. |
| E. .235 I.D. X .36 O.D. | L. 1.6 I.D. X 3.0 O.D. | R. .855 I.D. X 1.63 O.D. |
| F. .625 I.D. X .875 O.D. | M. 1.0 I.D. X 1.75 O.D. | |
| G. .875 I.D. X 1.13 O.D. | N. .364 I.D. X .540 O.D. | |

STEP 4: SELECT MOUNTING BUSHING / THREAD:

- | | | |
|---------|---------|----------|
| A. 1/4" | D. 3/4" | G. 1.25" |
| B. 1/8" | E. 3/8" | H. 1.50" |
| C. 1/2" | F. 1.0" | |

STEP 5: SELECT LENGTH OF TUBE:

SPECIFY LENGTH OF TUBE IN INCHES

STEP 6: SELECT IMMERSION LENGTH OF TUBE:

SPECIFY IMMERSION LENGTH IN INCHES

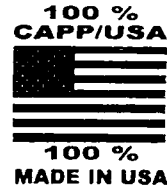
IF YOU CAN DRAW IT, DESCRIBE IT, or EXPLAIN IT.....

.....THEN WE CAN MAKE IT !

TALK TO ONE OF OUR ENGINEERS TODAY - (800) 356-8000

CAPP/USA PROTECTION TUBES - METAL, CLOSED-ENDED:

1



SELECT YOUR STOCK NO. & MOUNTING BUSHING CHOICE:

Material Of Tube	Max. Length Of Tube	Tube Dimensions	Thread Conn. NPT	Tube Type Construction	STOCK NO.
316S.S.	120"	.269 x .405" I.D. O.D.	1/8"	Drawn	277658
446S.S.	120"	.622 x .840" I.D. O.D.	1/2"	Drawn	277659
446S.S.	120"	1.049 x 1.315" I.D. O.D.	1"	Drawn	277662
446S.S.	30"	.562 x 1.00" I.D. O.D.	1/2"	Drilled	278243
446S.S.	24"	.375 x .750" I.D. O.D.	3/8"	Drilled	278244
Carbon Steel	120"	.269 x .405" I.D. O.D.	1/8"	Drawn	278237
Carbon Steel	120"	.364 x .540" I.D. O.D.	1/4"	Drawn	278235
Carbon Steel	120"	.599 x .315" I.D. O.D.	1"	Drawn	278234
Carbon Steel	120"	.622 x .840" I.D. O.D.	1/2"	Drawn	278238
Kanthal	36"	.648 x .75" I.D. O.D.	3/4"	Drawn	278256

SEE FOLLOWING PAGES FOR PRICES.

CONTINUED ON THE NEXT PAGE

THERMOCOUPLES

1

CAPP/USA PROTECTION TUBES - METAL, CLOSED-ENDED: (CONTINUED)

Material Of Tube	Max. Length Of Tube	Tube Dimensions	Thread Conn NPT	Tube Type Construction	STOCK NO.
Inconel	120"	.622 x .840" I.D. O.D.	1/2"	Drawn	278254
Inconel	120"	1.049 x 1.315" I.D. O.D.	1"	Drawn	278255
Nickel	24"	.375 x .75" I.D. O.D.	3/8"	Drilled	278248
Nickel	30"	.625 x 1.25" I.D. O.D.	3/4"	Drilled	278247
Nickel	120"	.625 x .875" I.D. O.D.	1/2"	Drawn	278246
Cast Iron	48"	.855 x 1.63" I.D. O.D.	1"	Cast	278239

SEE FOLLOWING PAGES FOR PRICES.

* **MUST SPECIFY LENGTH OF PROTECTION TUBE**
(MIN. LENGTH IS 12". SEE ABOVE ORDERING TABLE FOR MAX. LENGTHS.)

CHOICE 1 - MOUNTING BUSHINGS:

SS75: 3/4" STAINLESS STEEL \$30.00
CS38: 3/8" CARBON STEEL \$25.00
CS50: 1/2" CARBON STEEL \$25.00
CS75: 3/4" CARBON STEEL \$25.00
CS1: 1" CARBON STEEL \$25.00
CS125: 1 1/4" CARBON STEEL \$25.00
CS150: 1 1/2" CARBON STEEL \$25.00

* **MUST SPECIFY IMMERSION LENGTH.**

NOTE: SUBTRACT 3" FROM OVERALL TUBE FOR MAX. LENGTH.

SPECIFIED TUBE LENGTH

MTG. BUSHING

IMMERSION LENGTH

EXAMPLE STOCK NO.: 278235-24"-SS75 - 18".

EXAMPLE PRICE: \$79.00

(SEE NEXT PAGE FOR ALL TUBE PRICES)

CAPP/USA PROTECTION TUBES - METAL, CLOSED-ENDED: (CONTINUED)

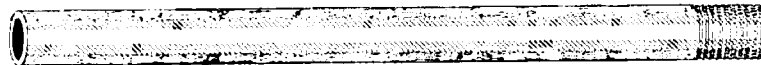
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PROTECTION TUBE PRICING:

SELECT-A-LENGTH & SELECT-A-TUBE												
Stock No.	To Fit Honeywell No.	12"	18"	24"	30"	36"	42"	48"	54"	60"	66"	72"
277658	30351271	\$49.00	\$64.00	\$79.00	\$98.00	\$109.00	\$129.00	\$144.00	\$158.00	\$183.00	\$192.00	\$206.00
277659	30352649	\$55.00	\$83.00	\$107.00	\$133.00	\$155.00	\$176.00	\$199.00	\$224.00	\$241.00	\$259.00	\$280.00
277662	30355841	\$114.00	\$149.00	\$216.00	\$239.00	\$296.00	-	-	-	-	-	-
278243	30006993	\$192.00	\$276.00	\$359.00	\$444.00	-	-	-	-	-	-	-
278244	30006994	\$133.00	\$169.00	\$199.00	-	-	-	-	-	-	-	-
278237	30009405	\$95.00	\$103.00	\$112.00	\$119.00	\$129.00	\$139.00	\$146.00	\$158.00	\$166.00	-	-
278235	30009406	\$36.00	\$44.00	\$49.00	\$49.00	\$59.00	\$61.00	\$67.00	\$72.00	\$75.00	-	\$89.00
278234	30357725	\$79.00	\$88.00	\$132.00	\$155.00	\$199.00	\$154.00	\$165.00	\$199.00	\$219.00	-	-
278238	30003957	\$25.00	\$35.00	\$38.00	\$39.00	\$41.00	\$43.00	\$45.00	\$47.00	\$50.00	\$54.00	\$56.00
278256	30362975	\$579.00	\$655.00	\$729.00	\$779.00	\$880.00	-	-	-	-	-	-
278254	30351440	\$104.00	\$139.00	\$184.00	\$219.00	\$259.00	\$299.00	\$339.00	\$379.00	\$421.00	\$459.00	\$499.00
278255	30357727	\$149.00	\$195.00	\$245.00	\$299.00	\$348.00	\$399.00	\$578.00	\$499.00	\$555.00	-	-
278248	30008287	\$178.00	\$245.00	\$255.00	-	-	-	-	-	-	-	-
278247	30008507	\$237.00	\$356.00	\$467.00	\$1,349.00	-	-	-	-	-	-	-
278246	30009410	\$188.00	\$270.00	\$359.00	\$448.00	\$459.00	\$499.00	\$535.00	\$570.00	\$609.00	-	-
278239	30042667	\$35.00	\$49.00	\$52.00	\$67.00	\$83.00	\$104.00	\$125.00	-	-	-	-

THERMOCOUPLES

CAPP/USA PROTECTION TUBES - METAL, OPEN-ENDED:



SELECT YOUR STOCK NO. & MOUNTING BUSHING CHOICE:

Material Of Tube	Min. / Max. Length Of Tube	Tube Dimensions	Thread Conn. NPT	Tube Type Construction	STOCK NO.
Stainless Steel (304)	Min. 12" Max. 120" ↓	.364 x .540" I.D. O.D.	1/4"	Drawn	278949 See Length Below
Carbon Steel		.269 x .405" I.D. O.D.	1/8"	Drawn	278950 See Length Below
Carbon Steel		.364 x .540" I.D. O.D.	1/4"	Drawn	278952 See Length Below
Carbon Steel		.622 x .840" I.D. O.D.	1/2"	Drawn	278953 See Length Below

SELECT-A-LENGTH & SELECT-A-TUBE:

STOCK NO.	To Fit Honeywell No.	12"	18"	24"	30"	36"	42"	48"	54"	60"
278949	30351274- Length	\$44.00	\$57.00	\$65.00	\$76.00	\$88.00	-	\$112.00	\$126.00	\$136.00
278950	30071401- Length	\$25.00	\$32.00	\$37.00	\$42.00	\$51.00	\$53.00	\$56.00	\$60.00	\$66.00
278952	30071402- Length	\$26.00	\$32.00	\$38.00	\$43.00	\$53.00	\$58.00	\$63.00	\$66.00	\$77.00
278953	30071457- Length	\$25.00	\$26.00	\$31.00	\$32.00	\$35.00	-	\$49.00	-	-

CAPP/USA STOCKS LENGTHS UP TO 120" LONG--
JUST ASK US FOR PRICING!

(CONTINUED ON NEXT PAGE)

CAPP/USA PROTECTION TUBES -
METAL, OPEN-ENDED:
(CONTINUED)

CHOICE 1 - MOUNTING BUSHINGS:

<u>SS75:</u>	3/4" STAINLESS STEEL	\$29.00
<u>CS38:</u>	3/8" CARBON STEEL	\$25.00
<u>CS50:</u>	1/2" CARBON STEEL	\$25.00
<u>CS75:</u>	3/4" CARBON STEEL	\$25.00
<u>CS1:</u>	1" CARBON STEEL	\$25.00
<u>CS125:</u>	1 1/4" CARBON STEEL	\$25.00
<u>CS150:</u>	1 1/2" CARBON STEEL	\$25.00

* **MUST SPECIFY IMMERSION LENGTH.**

NOTE: SUBTRACT 3" FROM OVERALL TUBE FOR MAX. LENGTH.

TUBE LENGTH IMMERSION LENGTH

EXAMPLE STOCK NO.: 278949-48"-CS38-24".

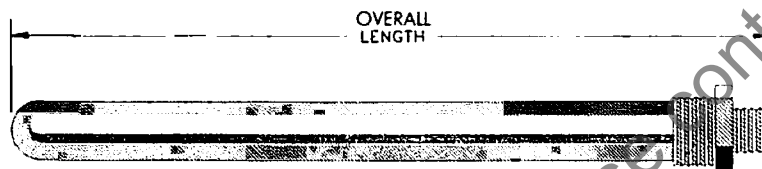
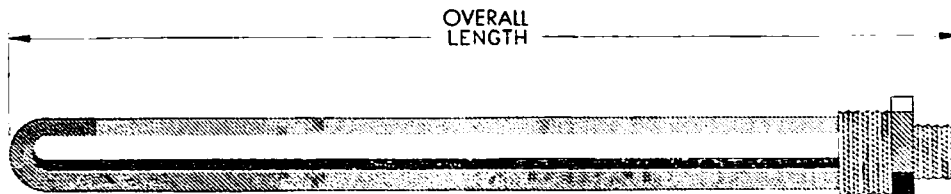
EXAMPLE PRICE: **\$137.00**

For current pricing and specifications, please contact us.

THERMOCOUPLES

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CAPP/USA PROTECTION TUBES - CERAMIC:



**OUR CERAMIC PROTECTION TUBES ARE
AVAILABLE TO YOU 3 DIFFERENT WAYS:**

1. **PLAIN TUBES WITH FITTINGS:**
2. **TUBES WITHOUT FITTINGS: OR . . .**
3. **TUBES WITH A REFRACTORY-COLLAR.**

PLAIN TUBES WITH FITTINGS:

Material of Tube	Tube Dimensions (IN.)	Head Conn. NPT	Mounting Thread (NPT)	STOCK NO.	SELECT-A-LENGTH & SELECT-A-TUBE							
					To Fit Honeywell No.	12"	18"	24"	30"	36"	42"	48"
Sillramic	234 I.D. x 359 O.D.	1/2"	1/3"	277438	30014708-Length	\$61.00	\$69.00	\$73.00	\$89.00	\$116.00	\$118.00	\$129.00
Sillramic	234 I.D. x 359 O.D.	1/2"	3/4"	277461	30014709-Length	\$74.00	\$79.00	\$82.00	\$89.00	\$106.00	-	\$129.00
Sillramic	438 I.D. x 688 O.D.	1/2"	3/4"	277462	30077800-Length	\$44.00	\$62.00	\$75.00	\$93.00	\$119.00	\$124.00	\$136.00
Sillramic	688 I.D. x 938 O.D.	3/4"	1 1/4"	277463	30077803-Length	\$64.00	\$79.00	\$95.00	\$93.00	\$119.00	\$124.00	\$136.00
Quartz	375 I.D. x 500 O.D.	1/2"	3/4"	277464	30014707-Length	\$74.00	\$86.00	\$99.00	\$119.00	\$139.00	-	-
99% Alumina	438 I.D. x 688 O.D.	1/2"	3/4"	279007	30690542-Length	\$80.00	\$101.00	\$119.00	\$140.00	\$171.00	\$211.00	\$241.00

*Max Length Of All Tubes Is 48" Except For Stock No. 277464 Which Is 36" Max.

MUST SPECIFY LENGTH

LOOKING FOR MULLITE INSTEAD OF SILLRAMIC JUST ASK!

CAPP/USA PROTECTION TUBES - CERAMIC: (CONTINUED)

1

PROTECTION TUBES WITHOUT FITTINGS:

Material Of Tube	Tube Dimensions (I.N.)	Tube Type Construction	STOCK NO.	To Fit Honeywell No.	SELECT-A-LENGTH & SELECT-A-TUBE						
					12"	18"	24"	30"	36"	42"	48"
Sillramic	235 I.D. x 360 O.D.	Closed Ended	277468	30005467-	\$27.00	\$42.00	\$58.00	\$74.00	\$93.00	\$105.00	\$119.00
Sillramic	312 I.D. x 500 O.D.	Closed Ended	277469	30003914-	\$29.00	\$45.00	\$66.00	\$79.00	\$99.00	-	\$129.00
Sillramic	438 I.D. x 688 O.D.	Closed Ended	277470	30003901-	\$33.00	\$52.00	\$69.00	\$76.00	\$104.00	\$119.00	\$140.00
Sillramic	625 I.D. x 875 O.D.	Closed Ended	277471	30003917-	\$37.00	\$61.00	\$78.00	\$99.00	\$119.00	\$146.00	\$191.00
Sillramic	875 I.D. x 1113 O.D.	Closed Ended	277475	30003918-	\$39.00	-	\$84.00	\$109.00	-	-	\$184.00
Sillramic	1001 I.D. x 125 O.D.	Closed Ended	277479	30003919-	-	\$69.00	\$93.00	-	\$139.00	-	-
Sillramic	1381 I.D. x 200 O.D.	Open Ended	277612	30041108-	-	\$120.00	-	-	\$221.00	-	-
Quartz	375 I.D. x 500 O.D.	Closed Ended	277613	30003904-	\$39.00	\$68.00	\$88.00	\$109.00	\$131.00	-	-

Must Specify Length

PROTECTION TUBES WITH A REFRACTORY - COLLAR:

Material Of Tube	Tube Dimensions (I.N.)	STOCK NO.	To Fit Honeywell No.	SELECT-A-LENGTH & SELECT-A-TUBE						
				12"	18"	24"	30"	36"	42"	48"
Sillramic	438 I.D. x 688 O.D.	277614	30041105- Length	\$45.00	\$64.00	\$82.00	\$105.00	\$131.00	\$150.00	\$178.00
Sillramic	750 I.D. x 100 O.D.	277615	30041121- Length	\$51.00	\$77.00	\$106.00	\$129.00	\$151.00	\$174.00	\$191.00
Sillramic	1001 I.D. x 125 O.D.	277616	30041106- Length	\$74.00	\$83.00	-	\$126.00	\$149.00	-	-

Must Specify Length

- ALL TUBES ARE CLOSED-ENDED.
- REFRACTORY - COLLARS ARE AT THE OPEN-END OF THE TUBE.
- MAXIMUM LENGTH OF ALL TUBES IS 48" EXCEPT STK. NO. 277616.

SECONDARY PROTECTION TUBES: (WITHOUT FITTINGS)

Material Of Tube	Tube Dimensions (I.N.)	STOCK NO.	To Fit Honeywell No.	SELECT-A-LENGTH & SELECT-A-TUBE						
				12"	18"	24"	30"	36"	42"	48"
Mullite	1001 I.D. x 200 O.D.	279008	30042226- Length	\$109.00	\$124.00	\$139.00	\$155.00	\$169.00	\$180.00	\$196.00
Mullite	1001 I.D. x 300 O.D.	279009	30042227- Length	\$123.00	\$153.00	\$179.00	\$210.00	\$236.00	\$251.00	\$242.00
Mullite	1601 I.D. x 300 O.D.	279010	30042228- Length	\$152.00	\$160.00	\$198.00	\$206.00	\$226.00	\$240.00	-
Silicon Carbide (Durax)	1001 I.D. x 175 O.D.	279011	30003906- Length	\$69.00	\$88.00	\$101.00	\$119.00	\$143.00	\$165.00	\$200.00

- MAXIMUM LENGTH OF ALL TUBES IS 48". EXCEPT STK. NO. 279010

MUST SPECIFY LENGTH

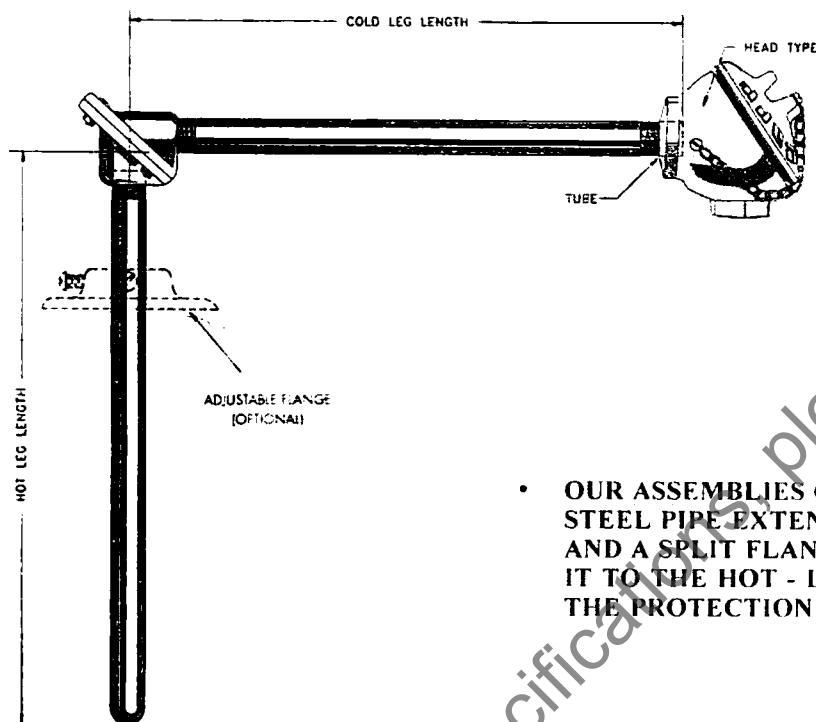
CAPP/USA ALSO OFFERS A COMPLETE ARRAY OF PROTECTION TUBES OVER 48" LONG -- JUST ASK.

THERMOCOUPLES

1

CAPP/USA

RIGHT - ANGLE THERMOCOUPLE ASSEMBLIES WITH PIPE EXTENDED PROTECTION TUBES:



100 %
CAPP/USA

100 %
MADE IN USA

- OUR ASSEMBLIES COME WITH A CARBON STEEL PIPE EXTENSION ON THE COLD - LEG AND A SPLIT FLANGE ELBOW CONNECTING IT TO THE HOT - LEG. THE PROTECTION TUBE IS ON THE HOT-LEG.

ORDERING IS EASY AND ONLY 2-STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW:
2. SELECT AN OPTION FROM THE 5 CHOICES ON THE NEXT PAGE.

To Fit Honeywell Model	Gauge	Type Element	Material Of Tube	Max. Temp. °F	Max. Length Of Hot Leg	O.D. Of Tube	STOCK NO.	Initial 12"	For Each Add'l 6"
3B50B	14	Type J	Carbon Steel	1200°	120"	.540"	278156	\$138.00	\$9.00
5B50B		Type K	Carbon Steel	1200°	120"	.540"	278157	\$138.00	\$9.00
3A50W	8	Type J	Carbon Steel	1200°	120"	.840"	278158	\$133.00	\$7.00
3A50B		Type J	Cast Iron	1400°	48"	1.62"	278159	\$136.00	\$16.00
5A50D		Type K	Cast Iron	1600°	48"	1.62"	278160	\$139.00	\$17.00
5A50L		Type K	Nickel	1800°	120"	.875"	278165	\$269.00	\$48.00
5A50LA		Type K	Nickel	1800°	30"	1.25"	278166	\$289.00	\$78.00
5A52LA		Type K	Nickel	1800°	30"	1.25"	278167	\$419.00	\$196.00
5B50LA	14	Type K	Nickel	1800°	24"	.75"	278168	\$289.00	\$83.00

RIGHT-ANGLE THERMOCOUPLE ASSEMBLIES WITH PIPE EXTENDED PROTECTION TUBES: (CONTINUED)

ORDERING INFORMATION: (CONTINUED)

To Fit Honeywell Model	Gauge	Type Element	Material Of Tube	Max. Temp. °F	Max. Length Of Hot Leg	O.D. Of Tube	STOCK NO.	Initial 12"	For Each Add'l 6"
5A50P	8	Type K	Resistat (446 SS)	1850°	30"	1"	278170	\$209.00	\$27.00
5A50PA		Type K	Resistat (446 SS)	1850°	120"	.840"	278171	\$173.00	\$22.00
5B50P	14	Type K	Resistat (446 SS)	1850°	24"	.75" (19mm)	278172	\$215.00	\$33.00
3B50S		Type J	304 SS	1200°	120"	.540"	278173	\$144.00	\$15.00
5B50S	8	Type K		1800°			278174	\$144.00	\$15.00
3A50M		Type J	Inconel	1500°	120"	.840"	278175	\$174.00	\$41.00
3B50M		Type K		2200°			278176	\$174.00	\$41.00
3B52M		Type K		2200°			278177	\$174.00	\$41.00
5A50R		Type K	Sillramic	2450°	48"	.938"	278178	\$165.00	\$23.00
5B50R	14	Type K	Sillramic	2100°	48"	.687"	278179	\$150.00	\$20.00
6G50R	-	Type R	Sillramic	2800°	48"	.687"	278180	\$589.00	\$129.00
7G50R		Type S		2800°			278181	\$589.00	\$129.00
5B51C	14	Type K	Carbucouple	1800°	18"	1.06"	278182	\$227.00	\$35.00

SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - SELECT 1 TYPE OF HEAD:

- GP:** GENERAL PURPOSE WITH A 1/2" NPT CONDUIT CONN. NO CHARGE
SC50: SCREW-COVER WITH A 1/2" NPT CONDUIT CONN. \$16.00
SC75: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. \$16.00

CHOICE 2 - MUST SPECIFY COLD-LEG LENGTH-...ADD \$6.00 FOR EACH ADD'L 6" MINIMUM LENGTH IS 12" & MAXIMUM IS 48" ...ADD \$98.00 FOR TYPE R OR S FOR EACH ADD'L 6".

CHOICE 3 - MUST SPECIFY HOT-LEG LENGTH- MINIMUM LENGTH IS 12" & MAXIMUM LENGTHS ARE LISTED BY STOCK NO. IN ABOVE CHART.

CHOICE 4 - SELECT MOUNTING ATTACHMENT: OPTIONAL

- AFC:** ADJUSTABLE FLANGE FOR COLD-LEG. (OPTIONAL). \$12.00
AFH: ADJUSTABLE FLANGE FOR HOT-LEG. (OPTIONAL). \$12.00

THERMOCOUPLES

CAPP/USA

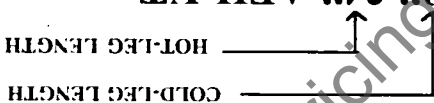
**RIGHT-ANGLE THERMOCOUPLE ASSEMBLIES WITH
PIPE EXTENDED PROTECTION TUBES: (CONTINUED)**

ORDERING INFORMATION: (CONTINUED)

CHOICE 5 - SELECT CONDUIT OUTLETS & WIRE:

- L: CONDUIT OUTLET ON LEFT**
- R: CONDUIT OUTLET ON RIGHT**
- T: CONDUIT OUTLET ON TOP**
- VT: VENTED-TUBE (FOR TYPES R&S ONLY) \$17.00**
- W: PREMIUM-GRADE T/C WIRE (BASE METAL T/C'S ONLY) \$15.00**

NO CHARGE.



EXAMPLE STOCK NO.: 278171-SC75-18"-24"-AFH-VT.
EXAMPLE PRICE: \$268.00

THERMOCOUPLES

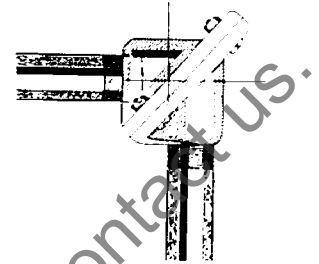
SPARE FLANGED ELBOWS & GASKETS

FOR ALL RIGHT - ANGLE T/C'S.

1

FLANGED ELBOWS:

FOR ALL ANGLE-TYPE THERMOCOUPLES.
USED TO CONNECT HOT-LEG & COLD-LEG
TUBES.



FITS PIPE SIZES	ELBOW STOCK NO.	PRICE	GASKET STOCK NO.	PRICE	TO FIT HONEYWELL	
					ELBOW	GASKET
3/8" x 3/8"	278937	\$66.00	278947	\$2.49	30014194-9	30353400-1
3/8" x 1/4"	278940	\$66.00	278947	\$2.49	30014194-10	30353400-1
1/4" x 1/4"	278942	\$69.00	278947	\$2.49	30014194-8	30353400-1
1/2" x 1/4"	278944	\$66.00	278947	\$2.49	30014194-7	30353400-1
1/2" x 3/8"	278936	\$66.00	278947	\$2.49	30014194-6	30353400-1
1/2" x 1/2"	273178	\$66.00	278947	\$2.49	30014194-5	30353400-1
3/4" x 1/2"	278945	\$66.00	278946	\$2.49	30014194-4	30353400-2
3/4" x 3/4"	278943	\$66.00	278946	\$2.49	30014194-3	30353400-2
1" x 1/2"	278934	\$79.50	278946	\$2.49	30014194-2	30353400-2
1" x 1"	201691	\$79.50	278946	\$2.49	30014194-1	30353400-2

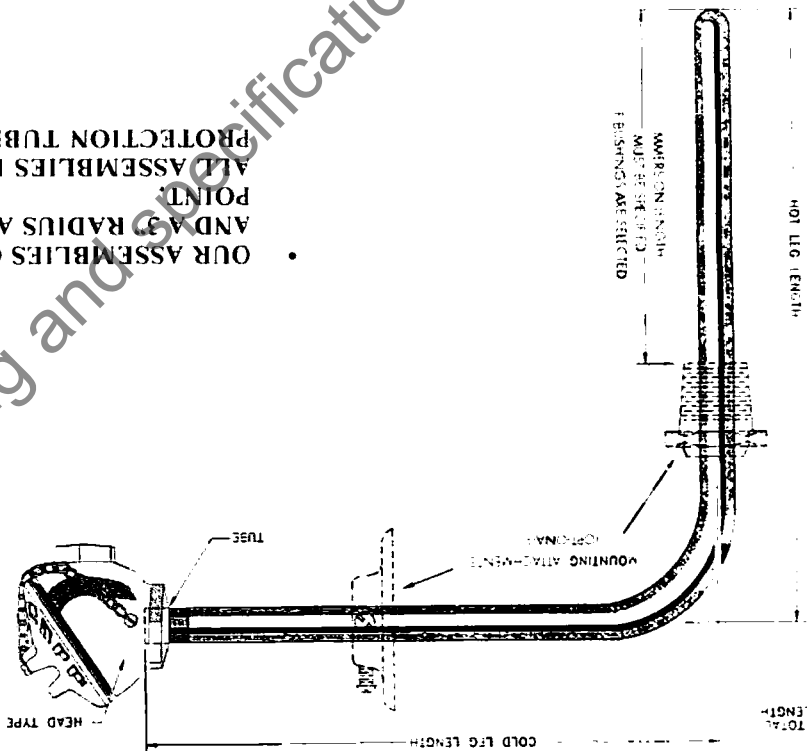
ALL FLANGED ELBOWS ARE CAST IRON.

1

THERMOCOUPLES

CAPP/USA 90° BENDED THERMOCOUPLE ASSEMBLIES W/FULL-LENGTH PROTECTION

TUBES:



- OUR ASSEMBLIES COME WITH A 90° BEND AND A 3" RADIUS AT THE APPROPRIATE POINT. ALL ASSEMBLIES HAVE A FULL LENGTH PROTECTION TUBE ALSO.

ORDERING IS EASY AND ONLY 2-STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE 5 CHOICES ON THE NEXT PAGE.

To Fit Honeywell Model	Type Element	Material Of Tube	Max. Temp. °F	Protection Tube Length	O.D. of Tube	STOCK NO.	Initial	For Each Add'l 6"
3B56B	Type J	Carbon Steel	1000°	Min. 12" Max. 120"	5/40"	278183	\$129.00	\$9.00
3A56W	Type J	Carbon Steel	1000°	Min. 12" Max. 120"	8/40"	278184	\$134.00	\$6.00
3A56V	Type K	Steel	1000°	Min. 12" Max. 120"	8/40"	278185	\$177.00	\$38.00
3A56PA	Type J	Resistal (446 SS)	1500°	Min. 12" Max. 120"	8/40"	278186	\$169.00	\$19.00
3B56S	Type J	304 SS	1200°	Min. 12" Max. 120"	5/40"	278188	\$136.00	\$14.00
3B56S	Type K		1850°	Min. 12" Max. 120"	5/40"	278189	\$136.00	\$14.00
3A56M	Type J	Inconel 601	1500°	Min. 12" Max. 120"	8/40"	278190	\$176.00	\$38.00
3A56M	Type K		2200°	Min. 12" Max. 120"	8/40"	278191	\$176.00	\$38.00

THERMOCOUPLES

**CAPP/USA 90° BENDED THERMOCOUPLE ASSEMBLIES
WITH FULL-LENGTH PROTECTION TUBES:**

(CONTINUED)

ORDERING INFORMATION: (CONTINUED)

SELECT AN OPTION FROM EACH CHOICE BELOW:

CHOICE 1 - SELECT 1 TYPE OF HEAD:

GP: GENERAL PURPOSE WITH A 1/2" NPT CONDUIT CONN. NO CHARGE

SC50: SCREW-COVER WITH A 1/2" NPT CONDUIT CONN. \$16.00

SC75: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. \$16.00

CHOICE 2 - SELECT MOUNTING ATTACHMENTS:

(THESE CHOICES ARE OPTIONAL)

AHF: ADJUSTABLE FLANGE FOR HOT-LEG=FITS .540" & .840" O.D. TUBE \$12.00

AFC: ADJUSTABLE FLANGE FOR COLD-LEG=FITS .540" & .840" O.D. TUBE \$12.00

1/2: 1/2" NPT BUSHING=FITS .540" O.D. TUBE \$25.00

3/4: 3/4" NPT BUSHING=FITS .540" O.D. TUBE \$25.00

3/4SS: 3/4" NPT S.S. BUSHING=FITS .540" O.D. S.S. TUBE \$29.00

1: 1" NPT BUSHING=FITS .540" & .840" O.D. TUBE \$25.00

1 1/4: 1 1/4" NPT BUSHING=FITS .540" & .840" O.D. TUBE \$25.00

1 1/2: 1 1/2" NPT BUSHING=FITS .540" & .840" O.D. TUBE \$25.00

*** MUST SPECIFY IMMERSION LENGTH. (SEE NOTES ALSO)**

NOTES:

• IMMERSION LENGTH FOR T/C'S WITH 1/2" & 3/4" BUSHINGS IS HOT-LEG LENGTH

MINUS 4"

• IMMERSION LENGTH FOR T/C'S WITH 1" & 1 1/4" BUSHINGS IS HOT-LEG LENGTH

MINUS 4 1/2"

• IMMERSION LENGTH FOR T/C'S WITH 1 1/2" BUSHING IS HOT-LEG LENGTH MINUS 5"

CHOICE 3 - MUST SPECIFY LENGTH OF PROTECTION

TUBE=HOT LEG PLUS COLD LEG.

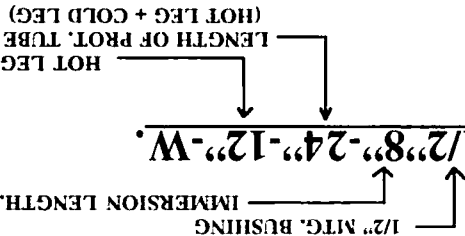
CHOICE 4 - MUST SPECIFY LENGTH OF HOT-LEG

(6" IS MIN./36" IS MAX.)

CHOICE 5 - WIRE:

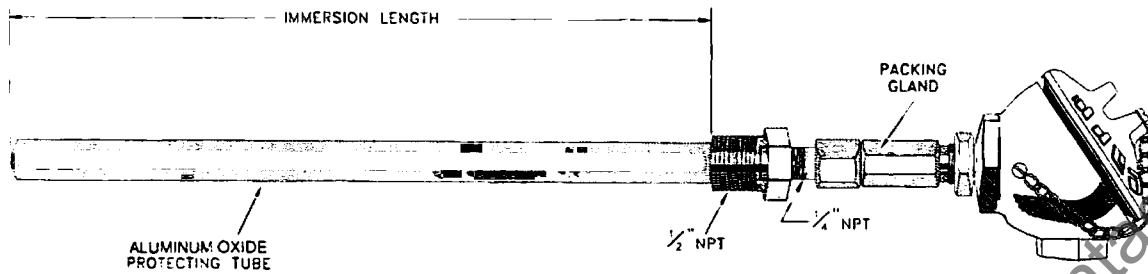
W: PREMIUM GRADE T/C WIRE. \$15.00

EXAMPLE STOCK NO.: 278183-GP-1/2"-8"-24"-12"-W.
EXAMPLE PRICE: \$169.00

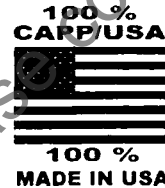


THERMOCOUPLES

1 CAPP/USA HIGH TEMPERATURE THERMOCOUPLES:



CAPP / USA HIGH TEMPERATURE ASSEMBLIES CONSIST OF ELEMENTS MADE OF EITHER TUNGSTEN, RHENIUM, OR IRIIDIUM FOR EXTREMELY HOT APPLICATIONS. ALL ASSEMBLIES HAVE AN ALUMINUM-OXIDE PROTECTION TUBE.



ELEMENTS AND THEIR APPLICATIONS:

**TUNGSTEN / TUNGSTEN+
26% RHENIUM OR
TUNGSTEN 26% RHENIUM-
TUNGSTEN 5% RHENIUM.....**

**CHEMICAL REACTORS;
VACUUM FURNACES;
HIGH-TEMP. FURNACES.**

THESE ELEMENTS CANNOT WITHSTAND EXTREME VIBRATIONS OR SHOCK, AND CAN BE DAMAGED IF EXPOSED TO METALLIC VAPORS, CARBON, OR FREE OXYGEN.

THERMOCOUPLES

CAPP/USA HIGH-TEMPERATURE THERMOCOUPLES

(CONTINUED)

1

ORDERING INFORMATION:

TO FIT HONEYWELL MODEL	STOCK NO.	ELEMENT TYPE	PROTECTION TUBE DIMENSIONS	MAX. TEMP. °F.
30692653-1	278467 *	TUNGSTEN-74% TUNGSTEN +26% RHENIUM.	.25" I.D. X .38" O.D. OPEN-ENDED TUBE	3350°
30692653-2	278491 *	TUNGSTEN-74% TUNGSTEN +26% RHENIUM.	.25" I.D. X .38" O.D. CLOSE-ENDED TUBE (VENTED)	3350°
30691962-1	278492 *	TUNGSTEN-5% RHENIUM- TUNGSTEN 26% RHENIUM.	.25" I.D. X .38" O.D. OPEN-ENDED TUBE	3350°
30691962-2	278495 *	TUNGSTEN-5% RHENIUM- TUNGSTEN 26% RHENIUM.	.25" I.D. X .38" O.D. CLOSE-ENDED TUBE (VENTED)	3350°

MUST SELECT FROM THE FOLLOWING LIST OF IMMERSION LENGTHS:

5", 11", 17", 23", or 29"

FOR OTHER / SPECIAL IMMERSION LENGTHS, CONSULT CAPP AND WE'LL MAKE IT TO SUIT YOUR NEEDS.

EXAMPLE STOCK NO.: 278467-23".

*** SPECIAL: MUST CONSULT CAPP/USA FOR PRICING--DUE TO THE EVERYDAY CHANGES OF THE PRICE OF PRECIOUS METALS.**

THERMOCOUPLES

1 CAPP/USA HIGH TEMPERATURE THERMOCOUPLES (CONTINUED)

REPLACEMENT TUBES & ELEMENTS FOR HIGH TEMPERATURE THERMOCOUPLES

REPLACEMENT PROTECTION TUBES:

TUBE CONSTRUCTION	TUBE LENGTHS (IN INCHES)	MAT'L. OF TUBE	DIMENSIONS OF TUBE	MOUNTING THREAD (IN NPT)	STOCK NO.
					FOR TUNGSTEN RHENIUM
Open End	5, 11, 17, 23 OR 29" SELECT-A-LENGTH.	ALUMINUM OXIDE	O.D.=38" I.D.=25"	1/2" NPT.	*277424
Closed End-Vented					*277425
Closed End-Not Vented					-

REPLACEMENT ELEMENTS:

TYPE	STOCK NUMBERS
Tungsten 5% Rhenium-Tungsten 26% Rhenium	*277427
Tungsten-74% Tungsten 26% Rhenium	*277431

MUST SPECIFY INSERT LENGTH.

ALL ELEMENTS SUPPLIED WITH ALUMINUM -
OXIDE INSULATORS.

*PLEASE CONSULT CAPP/USA FOR PRICING.

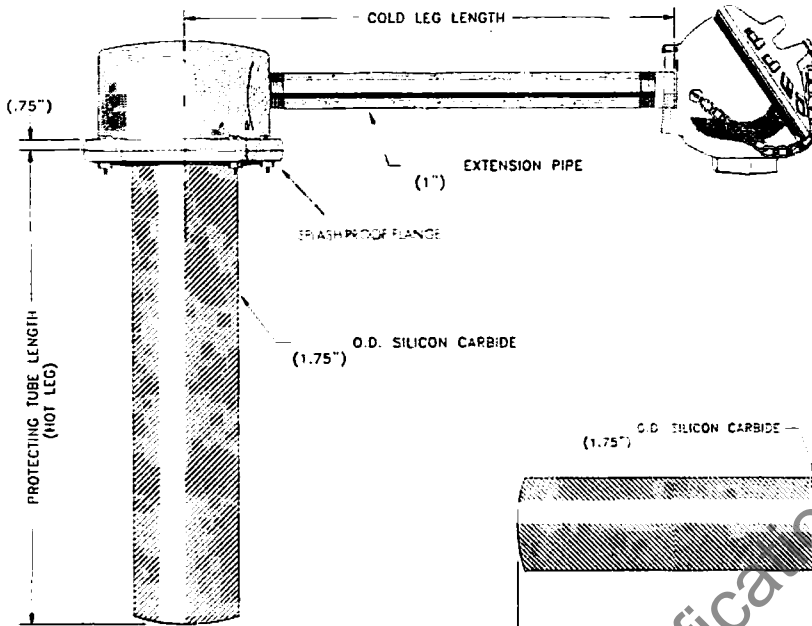
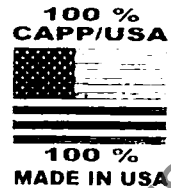
THERMOCOUPLES

CAPP/USA VAT, VESSEL, POT TYPE

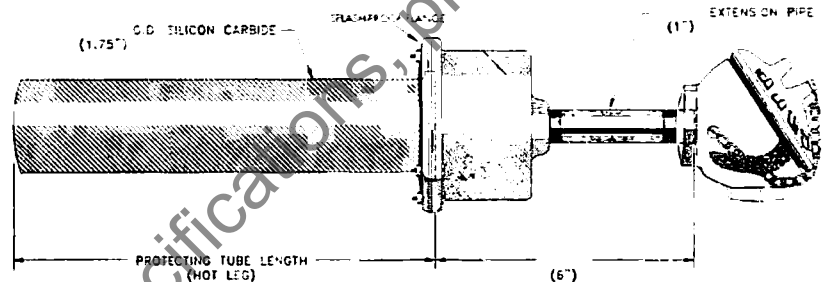
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THERMOCOUPLES:

TO FIT HONEYWELL SERIES: 3A70A, 5A70A,
3A71A, 5A71A



THESE T/C'S ARE PRIMARILY
USED IN VATS, VESSELS, OR
POTS WHICH ARE PRODUCING
STEEL, ALUMINUM OR OTHER
HOT OR MOLTEN LIQUIDS



ANGLE TYPE

TYPE J STOCK NO.: 277564 — SEE TABLE BELOW

TYPE K STOCK NO.: 277565 — SEE TABLE BELOW

- MAX. TEMP. RATING: 1400°F/TYPE J.

- MAX. TEMP. RATING: 2400°F/TYPE K.

- PROTECTION TUBE O.D.: 1.75".

STRAIGHT TYPE

TYPE J STOCK NO.: 277561 — SEE TABLE BELOW

TYPE K STOCK NO.: 277563 — SEE TABLE BELOW

- MAX. TEMP. RATING: 1400°F/TYPE J.

- MAX. TEMP. RATING: 2400°F/TYPE K.

- PROTECTION TUBE O.D.: 1.75".

SELECT YOUR STOCK NO. ABOVE & YOUR OPTIONS BELOW:

CHOICE 1- SELECT HOT-LEG LENGTH:

		STOCK NO.		
		TYPE J	TYPE K	EACH
S24:	24" STRAIGHT-TYPE	277561-24	277563-24	\$269.00
S30:	30" STRAIGHT-TYPE	277561-30	277563-30	\$283.00
S36:	36" STRAIGHT-TYPE	277561-36	277563-36	\$308.00
A12:	12" ANGLE-TYPE	277564-12	277565-12	\$229.00
A18:	18" ANGLE-TYPE	277564-18	277565-18	\$248.00
A24:	24" ANGLE-TYPE	277564-24	277565-24	\$275.00
A30:	30" ANGLE-TYPE	277564-30	277565-30	\$293.00
A36:	36" ANGLE-TYPE	277564-36	277565-36	\$309.00

CONTINUED NEXT PAGE

THERMOCOUPLES

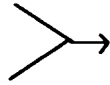
1 CAPP/USA VAT, VESSEL, POT TYPE THERMOCOUPLES: (CONTINUED)

CHOICE 2 - SELECT COLD-LEG LENGTH:

CL12: 12" STANDARD

CL18: 18" \$8.00

CL24: 24" \$14.00



FOR ANGLE-TYPES ONLY

CHOICE 3 - SELECT TYPE OF HEAD:

SC50: SCREW-COVER WITH A 1/2" NPT CONDUIT CONN. \$16.00

SC75: SCREW-COVER WITH A 3/4" NPT CONDUIT CONN. \$16.00

GP50: GENERAL-PURPOSE WITH A 1/2" NPT CONDUIT CONN. NO CHARGE

CHOICE 4 - CONDUIT OUTLETS:

T: TOP CONDUIT OUTLET NO CHARGE

R: RIGHT CONDUIT OUTLET NO CHARGE

L: LEFT CONDUIT OUTLET NO CHARGE

HOT-LEG LENGTH

EXAMPLE STOCK NO.: 277561-24"-SC50-T.

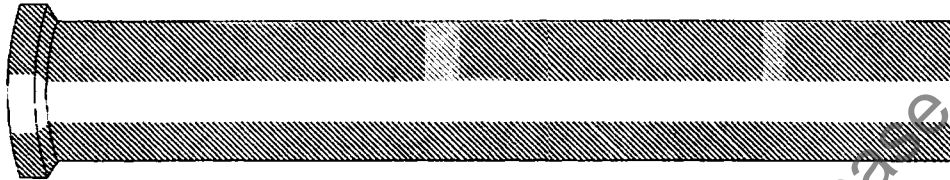
EXAMPLE PRICE: \$285.00

**STOCK-UP ON SPARE PROTECTION TUBES
FOR THESE T/C'S ON THE NEXT PAGE!**

THERMOCOUPLES

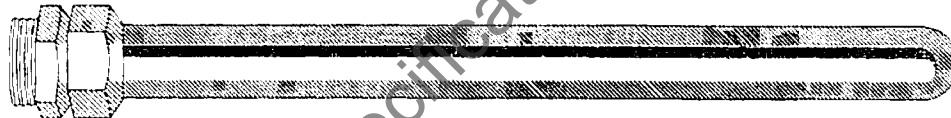
CAPP/USA SPARE REPLACEMENT PROTECTION TUBES FOR VAT, VESSEL, & POT TYPE THERMOCOUPLES:

1



SILICON-
CARBIDE
TUBE.

METALRAMIC
TUBE.



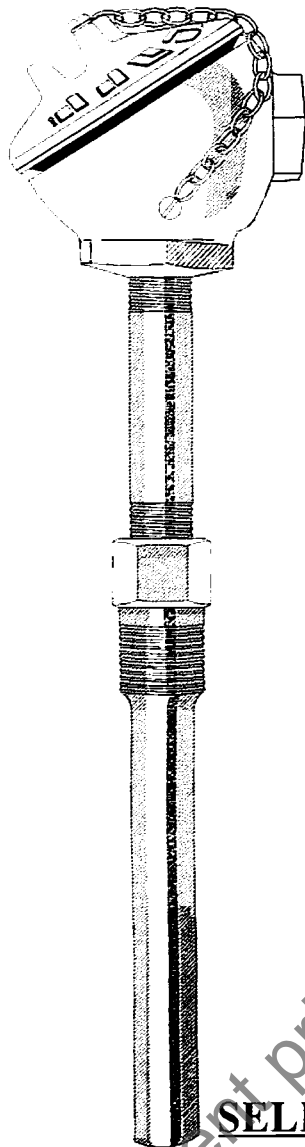
SELECT YOUR STOCK NO. AND TUBE LENGTH:

Material Of Tube	Tube Dimensions I.D. O.D.	Thread Conn. Npt.	Tube Type Construction	Stock No.	SELECT - A- LENGTH					
					12"	18"	24"	30"	36"	48"
Silicon- Carbide	1.0 X 1.75 I.D. O.D.	-	Closed-Ended Tube With Collar At Open-End.	277570 To Fit Honeywell 30351533	\$79.00	\$99.00	\$109.00	\$139.00	\$164.00	\$314.00
Silicon- Carbide	1.0 X 1.75 I.D. O.D.	-	Molded-Tube With Collar At Open-End.	277569 To Fit Honeywell 30373080	\$224.00	\$231.00	\$249.00	\$265.00	\$461.00	-
Silicon- Carbide	.563 X 1.5 I.D. O.D.	1"	Molded-Tube	277568 To Fit Honeywell 30373079	\$269.00	\$397.00	-	-	-	-
Metalramic (Metal Ceramic)	.625 X .875 I.D. O.D.	3/4"	Closed-Ended	277566 To Fit Honeywell 30362976	\$261.00	\$312.00	\$405.00	\$599.00	\$620.00	-

THERMOCOUPLES

1

CAPP/USA HIGH-SPEED THERMOCOUPLES WITH PIPE EXTENSIONS AND PRESSURE TIGHT WELLS:



ORDERING IS EASY AND ONLY 2 STEPS:

1. SELECT YOUR STOCK NO. FROM THE CHOICES BELOW.
2. SELECT AN OPTION FROM THE 3 CHOICES BELOW.

To Fit Honeywell Model	Wire Gauge	Element Type	Max. Temp.	STOCK NO.	Matching Well	Selection
					Well Stock No. For Single Element	Well Stock No. For Duplex Element
1D37A	20	Type T	550°F	279088	279067	279069
3D37A	20	Type J	1000°F	279092	279064	279054
5D37A	20	Type K	1200°F	279096	279045	279061
					279050	279044
3B37A	14	Type J	1150°F	279098	279069	
5B37A	14	Type K	1200°F	279102	279054	
					279061	
					279044	

Stock No.	Initial 12" (Single Element)	Addl. 6" Lengths	Stock No.	Initial 12" (Duplex Element)	Addl. 6" Lengths
279088	\$47.00	\$8.00	279088	\$89.00	\$14.00
279092	\$47.00	\$8.00	279092	\$89.00	\$14.00
279096	\$49.00	\$9.00	279096	\$95.00	\$16.00
279098	\$47.00	\$8.00	279098	\$89.00	\$14.00
279102	\$49.00	\$9.00	279102	\$95.00	\$16.00

SELECT AN OPTION FROM EACH CHOICE:

CHOICE 1 - SELECT 1 TYPE OF HEAD:

GP:	GENERAL PURPOSE WITH A 1/2" NPT CONDUIT CONN.	\$27.00
SC50:	SCREW-COVER WITH A 1/2" NPT CONDUIT CONN.	\$38.00
SC75:	SCREW-COVER WITH A 3/4" NPT CONDUIT CONN.	\$38.00
SC75D:	SCREW-COVER WITH A 3/4" NPT CONDUIT CONN., FOR DUPLEX ELEMENTS.	\$38.00

CONTINUED ON THE NEXT PAGE

THERMOCOUPLES

CAPP/USA HIGH-SPEED THERMOCOUPLES WITH PIPE EXTENSIONS AND PRESSURE TIGHT WELLS:

(CONTINUED)

1

ORDERING CHOICES: (CONTINUED)

CHOICE 2 - SELECT PIPE CONNECTIONS:

<u>N35:</u>	CARBON-STEEL NIPPLE 3.5" (8.9cm)	\$ 6.00
<u>N4:</u>	CARBON-STEEL NIPPLE 4" (10.2cm)	\$ 6.00
<u>N6:</u>	CARBON-STEEL NIPPLE 6" (15.2cm)	\$ 6.00
<u>N8:</u>	CARBON-STEEL NIPPLE 8" (20.3cm)	\$ 9.00
<u>N10:</u>	CARBON-STEEL NIPPLE 10" (25.4cm)	\$ 9.00
<u>U35:</u>	NIPPLE & UNION CONN. 3.5" (8.9cm)	\$22.00
<u>U4:</u>	NIPPLE & UNION CONN. 4" (10.2cm)	\$22.00
<u>U6:</u>	NIPPLE & UNION CONN. 6" (15.2cm)	\$22.00
<u>U8:</u>	NIPPLE & UNION CONN. 8" (20.3cm)	\$24.00
<u>U10:</u>	NIPPLE & UNION CONN. 10" (25.4cm)	\$24.00

CHOICE 3 - DO-IT-YOURSELF ELEMENT LENGTH:

**MUST SPECIFY ELEMENT LENGTH BY FOLLOWING
THIS PROCEDURE AND EXAMPLE:**

- PIPE NIPPLE LENGTH = 6" PLUS(+)
- WELL LAG = 2" PLUS(+)
- WELL IMMERSION LENGTH = 5.5" PLUS(+)
- DESIGN CONSTRUCTION = 2" EQUALS(=)

**ELEMENT
LENGTH = 15.5"**

NOTE: T/C WELLS SOLD SEPARATELY - SEE NEXT PAGE FOR WELLS

EXAMPLE STOCK NO.: 279088-SC50-N4-18"

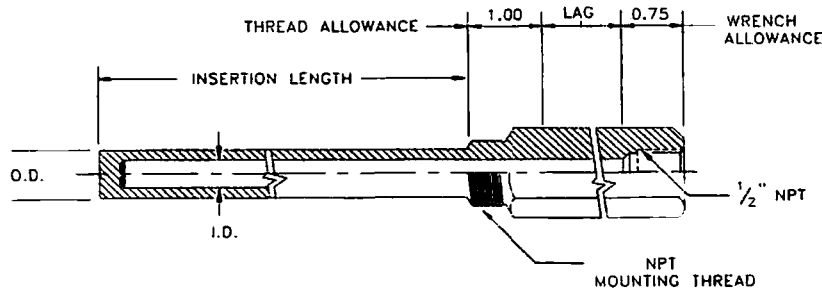
EXAMPLE PRICE: \$99.00

ELEMENT LENGTH

THERMOCOUPLES

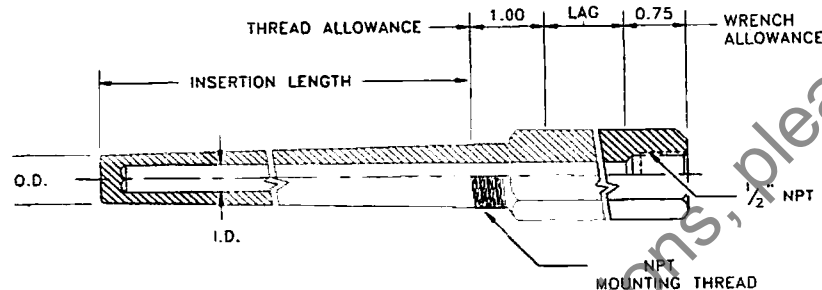
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CAPP/USA WELL SELECTION FOR HIGH-SPEED THERMOCOUPLES WITH PIPE-EXTENSIONS:



STRAIGHT-DRILLED
HEX HEAD WELL

CHOICE 1 - SELECT YOUR WELL TYPES



TAPERED-DRILLED
HEX HEAD WELL

STOCK NO.	TYPE OF WELL	I.D. X O.D. WELL DIMENSIONS	(N.P.T.) THREADS
279045	STRAIGHT	0.260 x 0.50	3/4"
279050	STRAIGHT	0.260 x 0.50	1"
279054	STRAIGHT	0.385 x 0.766	3/4"
279061	STRAIGHT	0.385 x 0.766	1"
279064	TAPERED	0.260 x 0.625	3/4"
279067	TAPERED	0.260 x 0.625	1"
279069	TAPERED	0.385 x 0.766	1"
279044	ROUND	0.385 x 0.766	1 1/4"

CHOICE 2 - SELECT INSERTION LENGTH:

25: 2.5" INSERTION LENGTH
45: 4.5" INSERTION LENGTH
75: 7.5" INSERTION LENGTH

105: 10.5" INSERTION LENGTH
135: 13.5" INSERTION LENGTH

Well Stock No.	Well Lengths:					Adder for 2" & 3" Lags		Comments
	2 1/2"	4 1/2"	7 1/2"	10 1/2"	13 1/2"	2" Lag	3" Lag	
279045	\$98.00	\$125.00	\$157.00	\$175.00	\$255.00	\$20.00	\$29.00	1). ALL PRICES ARE BASED ON 316 S.S. WELL MATL.
279050	\$91.00	\$125.00	\$157.00	\$175.00	\$260.00	\$20.00	\$29.00	
279054	\$106.00	\$131.00	\$170.00	\$219.00	\$260.00	\$20.00	\$29.00	
279061	\$106.00	\$131.00	\$170.00	\$219.00	\$260.00	\$20.00	\$29.00	
279064	\$106.00	\$131.00	\$170.00	\$219.00	\$260.00	\$20.00	\$29.00	
279067	\$106.00	\$131.00	\$170.00	\$219.00	\$260.00	\$20.00	\$29.00	2). ALL PRICES ARE BASED ON A 1" LAG.
279069	\$106.00	\$144.00	\$170.00	\$219.00	\$341.00	\$20.00	\$29.00	
279044	\$106.00	\$144.00	\$166.00	\$205.00	\$296.00	\$24.00	\$36.00	

CONTINUED ON NEXT PAGE

CAPP/USA WELL SELECTION (CONTINUED)

CHOICE 3 - SELECT WELL MATERIAL:

B: BRASS

SS: 316 STAINLESS STEEL

C: CARBON STEEL

M: MONEL

H: HASTELLOY-C OR B

I: INCONEL

N: NICKEL

IY: INCOLOY

(ALL WELLS SUPPLIED IN 316 STAINLESS STEEL)

CONSULT CAPP/USA FOR PRICING ON WELLS IN OTHER MATERIALS.

CONSULT CAPP/USA FOR ANY WELL MATERIALS NOT SHOWN IN THIS TABLE.

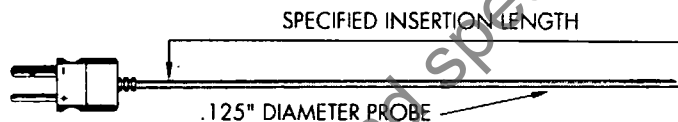
CHOICE 4 - SPECIFY LAG LENGTH OR NO LAG:

MAXIMUM LAG LENGTH IS 9.5"

LAG LENGTHS ARE AVAILABLE IN 0.5" INCREMENTS.

CAPP/USA SLIM-JIM SABREFOOD THERMOCOUPLES FOR FOOD PROCESSORS / MANUFACTURERS:

THE SLIM-JIM SABREFOOD THERMOCOUPLE SENSES THE INTERNAL TEMPERATURE OF FOODS. THE SLIM-JIM ALSO PROVIDES A BROAD AND IDEAL TEMP. RANGE OF -30°F TO 500°F.



ORDERING INFORMATION:

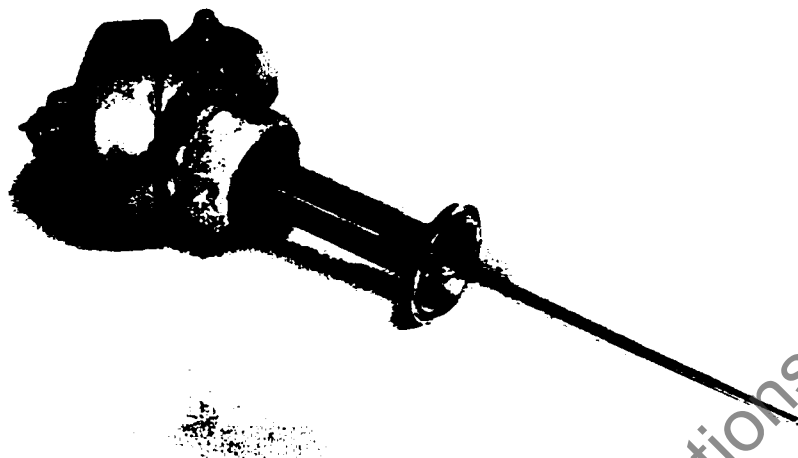
To Fit Honeywell Model	Element Type	STK. NO. For 4" Insertion Length	STK. NO. For 6" Insertion Length	STK. NO. For 8" Insertion Length	Length Of Extension Cable	Type Of End Connection
30689939-4",6",8"	J	279458	279462	279467	15'	None
30689939-4",6",8"	J	279459	279463	279468	15'	Quick Conn.
30363763-4",6",8"	I	279456	279460	279464	15'	None
30363763-4",6",8"	I	279457	279461	279465	15'	Quick Conn.

NOTE: CABLE EXTENSIONS ALSO AVAILABLE IN 5' AND 10' LENGTHS - JUST ASK US.

THERMOCOUPLES

1

CAPP/USA SANITARY RTD'S and THERMOCOUPLES FOR THE FOOD, DAIRY, & PHARMACEUTICAL INDUSTRY



- Meet the requirements of 3-A standard #09-07.
- Unmatched RTD stability. Less than 0.05°C shift per year.
- Compatible with recorders, controllers and most other readout instrumentation.
- Mechanically and electrochemically polished to assure imperfection-free surfaces.
- Easily cleaned in place.
- Ladish, Cherry-Burrell, Alfa-Laval or Alloy Products Corp. sanitary cap fittings.
- Replacement probes for older bulb and capillary systems.

The 3-A line of CAPP sanitary thermocouple and RTD probes offers an unmatched combination of construction, integrity and operating performance. These temperature sensing probes were designed especially for the food, beverage and pharmaceutical industries and are in full compliance with sanitary standards established by the 3-A Sanitary Standards Council for dairy equipment. Platinum RTDs are offered in a choice of Reference (.003923Ω/Ω/°C) or DIN (.00385Ω/Ω/°C) temperature coefficients and have a temperature range of -320°F to 900°F. Thermocouple units are offered in J, K, T and E calibrations with temperature ranges covering 32°F to 2300°F.

Imperfection-free Surfaces

All product contact surfaces are fabricated from stainless steel which conforms to AISI and ASTM quality standards. The sheath and sanitary cap are precisely joined to the lagging extension component

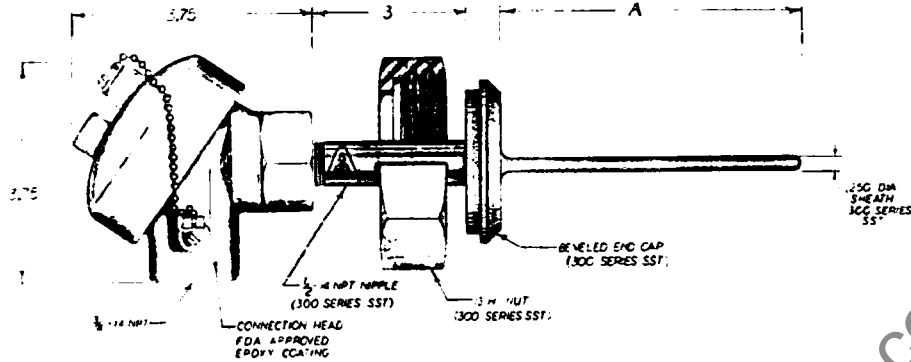
which is fabricated to extremely tight tolerances by a unique process engineered by CAPP. The sheath, cap and 1/4" radius are then ground and polished to a No. 4 finish to assure that there are no pits, folds or crevices. The surfaces of the CAPP sanitary probe are virtually free of sites for bacterial growth and corrosion. CAPP can supply probes utilizing sanitary caps as manufactured by Tri-Clover, Cherry-Burrell, Alfa-Laval or Alloy Products Corporation.

Epoxy Coated Connection Head

A variety of connection head options is available. However, the standard CAPP sanitary probe unit has a large 3.75" connection head which is epoxy coated to withstand caustic washdown and to make cleaning easier and lower in cost. A terminal block is mounted inside the connection head for electrical connections. The conduit connection is 3/4"-14 NPT although 1/2"-14 NPT connections are available upon special order.

SEE FOLLOWING PAGES FOR SPECIFICATIONS AND COMPLETE ORDERING INFORMATION.

PROBES WITH BEVEL SEAT FITTINGS



PLATINUM RESISTANCE TEMPERATURE DETECTORS

315198 SANITARY PROBE \$288.00*

"A" SHEATH LENGTH (In inches - 3" minimum)*				
315198	3 1/2	E	T(2")	CONNECTION HEAD
				E - Industrial size epoxy coated
				O - Other (please specify)
				N - No connection head. (3" of Teflon insulated leads exit epoxy sealed nipple.)*
				CAP MANUFACTURER (TUBE SIZE)**
315198	3 1/2	E	T(2")	Specify tube in 1", 1 1/2", 2", 2 1/2", 3", or 4" sizes
				A - Alloy Products (16A)
				C - Cherry-Burrell (16A-14)
				L - Alfa-Laval (16A)
				T - Tri-Clover (16A)
315198	3 1/2	E	T(2")	PLATINUM SENSING ELEMENT DESIGNATION
				1 - 100 ohms \pm 0.1 Reference
				2 - 100 ohms \pm 0.1 DIN
				3 - 200 ohms \pm 0.2 Reference
				4 - 200 ohms \pm 0.2 DIN
315198	3 1/2	E	T(2")	5 - Other (please specify)
				1 = Example Stock No.: \$308.00

THERMOCOUPLE TEMPERATURE DETECTORS

315211 SANITARY THERMOCOUPLE \$240.00*

"A" SHEATH LENGTH (In inches - 3" minimum)*				
↓	↓	↓	↓	CONNECTION HEAD
				E - Industrial size epoxy coated
				O - Other (please specify)
				N - No connection head. (3" of Teflon Insulated leads exit epoxy sealed nipple.)*
				CAP MANUFACTURER (TUBE SIZE)**
↓	↓	↓	↓	Specify tube in 1", 1 1/2", 2", 2 1/2", 3", or 4" sizes
				A - Alloy Products (16A)
				C - Cherry-Burrell (16A-14)
				L - Alfa-Laval (16A)
				T - Tri-Clover (16A)
↓	↓	↓	↓	THERMOCOUPLE CALIBRATION
				J - Iron/Constantan
				K - Chromel/Alumel
				T - Copper/Constantan
				E - Chromel/Constantan
↓	↓	↓	↓	THERMOCOUPLE JUNCTION
				U - Ungrounded G - Grounded
315211	3 1/2	E	T(2")	K G = Example Stock No.: \$260.00

NOTE: For special configurations or materials, please contact CAPP.

* ADD \$1.00 FOR EVERY INCH OF SHEATH LENGTH OVER 3".

* SUBTRACT \$60.00 FROM PRICE IF ORDERED WITH NO CONN. HEAD.

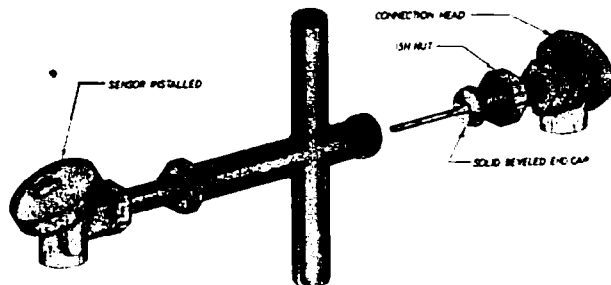
** TUBE ADDERS:

2" TUBE ADD \$20.00

2 1/2" TUBE ADD \$52.00

3" TUBE ADD \$97.00

4" TUBE ADD \$249.00



THERMOCOUPLES

1

CAPP/USA SANITARY RTD'S and THERMOCOUPLES

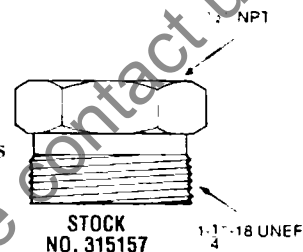
SPRING-LOADED PROBES AND THERMOWELLS

SPRING-LOADED RESISTANCE TEMPERATURE DETECTORS

315167 SANITARY PROBE \$185.00			
"X" THERMOWELL LENGTH			
10 1/8" Inches \$69.00			
11 7/8" Inches \$80.00			
13 1/8" Inches \$120.00			
CONFIGURATION OPTIONS			
T - Sensor with thermowell (as shown). 316 st. steel			
S - Sensor with nipple but without thermowell. (No adder)			
I - Sensor with retrofit adaptor nut to fit specified thermowell. (No adder)			
PLATINUM SENSING ELEMENT DESIGNATION			
1 - 100 ohms \pm 0.1 Reference			
2 - 100 ohms \pm 0.1 DIN			
3 - 200 ohms \pm 0.2 Reference			
4 - 200 ohms \pm 0.2 DIN			
5 - Other (please specify)			
315167	10 1/8	T	I = Example Stock No.: \$254.00

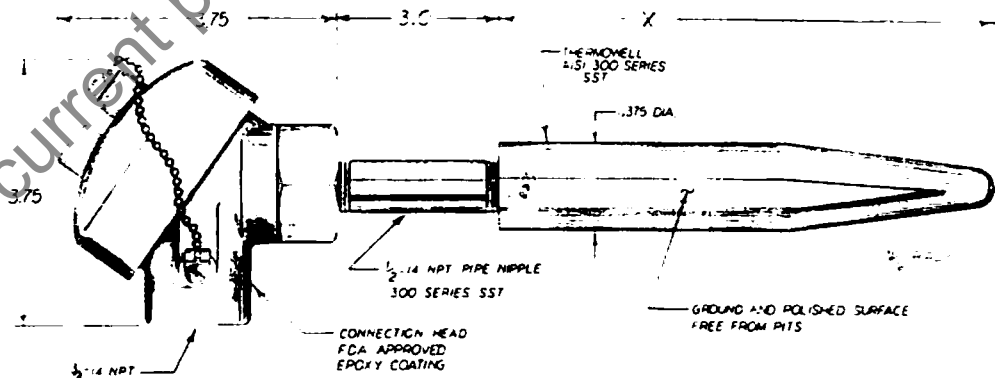
NOTE: The CAPP Retrofit Adaptor Nut

A special step-down adaptor allows fast and easy retrofitting of new sensors to older bulb and capillary systems. The step-down adaptor (315157) is essentially a diameter reduction nut which allows the precise mating of CAPP spring-loaded probes with *in-place* Anderson or Taylor manufactured thermowells as are generally used for bulb and capillary applications.

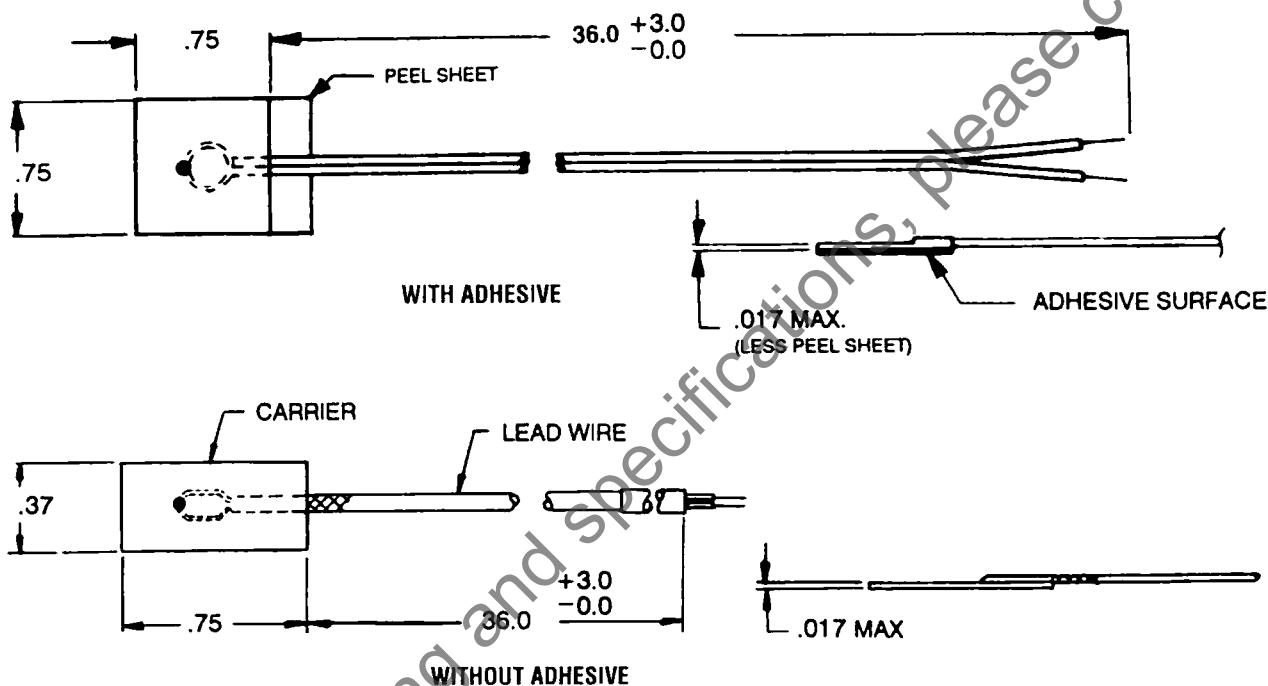
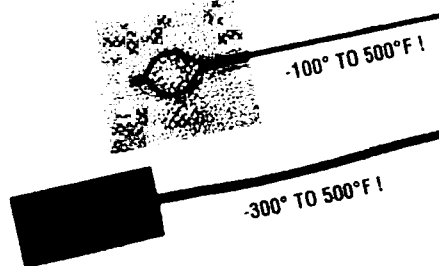


SPRING-LOADED THERMOCOUPLE TEMPERATURE SENSORS

315184 SANITARY THERMOCOUPLE \$130.00				
"X" THERMOWELL LENGTH				
10 1/8" Inches	\$69.00			
11 7/8" Inches	\$80.00			
13 1/8" Inches	\$120.00			
CONFIGURATION OPTIONS				
T - Sensor with thermowell (as shown). 316 st. steel.				
S - Sensor with nipple but without thermowell. (No adder)				
I - Sensor with retrofit adaptor nut to fit specified thermowell. (No adder)				
THERMOCOUPLE CALIBRATION				
J - Iron/Constantan				
K - Chromel/Alumel				
T - Copper/Constantan				
E - Chromel/Constantan				
THERMOCOUPLE JUNCTION				
U - Ungrounded G - Grounded				
315184	10 1/8	T	K	G = Example Stock No.: \$199.00



CAPP/USA STICK-ON SURFACE THERMOCOUPLES



Now Available with Pressure Sensitive Adhesive! Low Mass, Flexible, Insulated, Fast Response, Rugged Construction.

Low cost, versatile CAPP stick-on thermocouples can be used for a wide variety of surface temperature measurements. The thermocouple is embedded in a paper-thin laminate intended for surface applications. CAPP stick-on thermocouples are available with factory applied pressure sensitive adhesive. You may also purchase them without pre-applied cement so that you can select the adhesive best suited for your application.

Without Adhesive Stock No.	Each	With Adhesive Stock No.	Each	ANSI TC	Positive Lead	Positive Lead Color	Negative Lead (Red)
ORDERING INFORMATION:							
315462	\$12.80	315468	\$14.00	E	Chromel	Purple	Constantan
315463	\$12.80	315469	\$14.00	T	Copper	Blue	Constantan
315465	\$12.80	315470	\$14.00	K	Chromel	Yellow	Alumel
315467	\$12.80	315471	\$14.00	J	Iron	White	Constantan

THERMOCOUPLES

1

CAPP/USA HEAVY-DUTY INDUSTRIAL THERMOCOUPLE SURFACE SENSOR

This CAPP series of HEAVY DUTY surface sensors provides a practical method for measuring surface temperatures in areas where this type device may be subjected to abuse during service. These sensors can be bolted or clamped into place on a flat surface. Mounting plates can be formed to mate with special radius on request.

Specifications:

Operating Temperature Range

Type K 0°C to 1260°C (32°F to 2300°F)

Type T -184°C to 372°C (-300°F to 700°F)

Type J 0°C to 760°C (32°F to 1400°F)

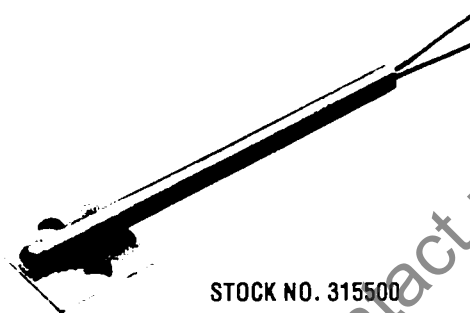
Type E 0°C to 871°C (32°F to 1600°F)

Accuracy

Per standard limits of error as stated in ANSI MC96.1 (1975)

Time Response

8 seconds (Ungrounded). 5 seconds (Grounded)
for the sensor to reach 63.2% of a step change in temperature in water flowing at 3 feet per second transverse to the sensor.
(ASTM-E-644)



STOCK NO. 315500

Insulation Resistance

The insulation resistance between outer sensor insulation clamped between two metal plates and the commoned lead wire is 50 megohms with 50 Volts DC applied to a dry sensor at room temperature.
(ASTM-E-644)

Lead Wire

#20 AWG stranded thermocouple conductors, fiberglass insulated.

Mounting

Sensor can be bolted, clamped or welded into place.

ORDERING INFORMATION: EACH: \$49.75

315500-J-G

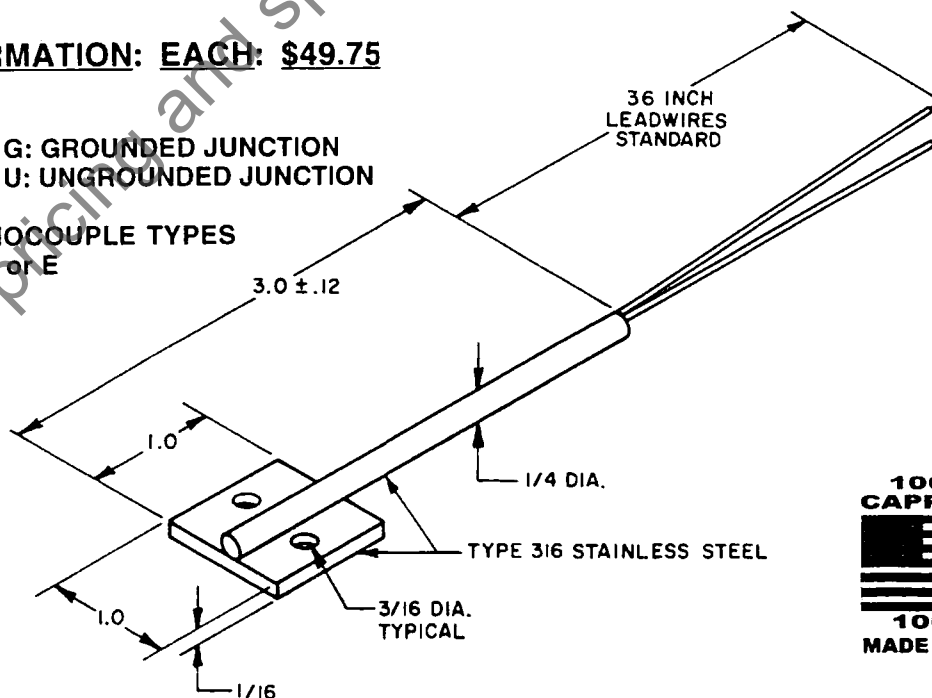
G: GROUND JUNCTION
U: UNGROUND JUNCTION

THERMOCOUPLE TYPES
J, K, T, or E

STOCK NO.

SAMPLE STOCK NO.:

315500-J-G

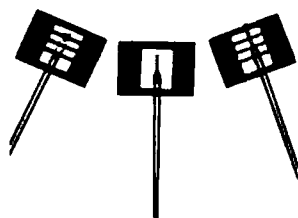


100 %
CAPP/USA
MADE IN USA

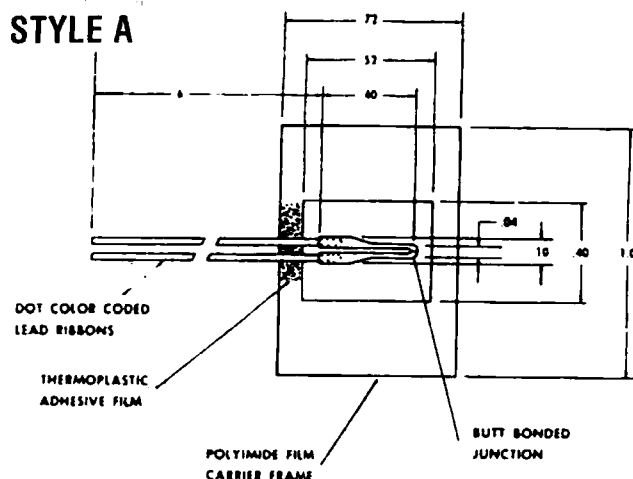
THERMOCOUPLES

CAPP/USA BUTT-BONDED FOIL THERMOCOUPLES ISO 9001 CERTIFIED

1



STYLE A



•Low mass provides accuracy, fast response:

Thin foil thermocouples, with butt bonded junctions, provide accurate, fast response sensors for surface temperature measurements. Thin, flat junctions and filaments result in the sensor having the ruggedness, flexibility, compliance, and handling ease characteristics of foil grids. They are available in a free filament style with removable carrier and in a matrix type with sensor embedded in paper thin laminate. Thermocouple grade materials are used throughout to assure accuracy. Thin foil, 0.0002" and 0.0005" thick, gives extremely low mass and thermal inertia. Thin, flat junctions and filaments provide maximum thermal coupling to the mounting surface. Errors caused by thermal conduction between junction and leads are negligible, since the length to thickness ratio of filaments ranges from 500:1 to 2,000:1.

•Thin junction good thermal contact:

A special butt bonding method produces thermocouples with no increase in thickness or mass at the junction. Location of the junction is definite and concise, essentially at right angles to the plane of the foil, not spread out.

•Applied easily to any surface with variety of adhesives very versatile:

CAPP Foil Thermocouples of the free filament style are intended for application with various ceramic cements and flame or plasma sprayed ceramic coatings, although more conventional cements may also be used. For handling ease, the free filament styles are supported on a temporary carrier of polyimide film. The polyimide film is tough, flexible, and dimensionally stable. It is exceptionally heat resistant and inert. Portions of the carrier can be easily cut away with scissors or knife. The foil sensor is fastened to the polyimide film carrier at one or two points only by a thermoplastic adhesive. During installation, the carrier can be peeled from the sensor or released by the application of heat. Although intended to be removed, all or part of the polyimide carrier, due to its heat resistance and inertness, may be left in the sensor installation with little or no loss in thermocouple performance. The carrier will withstand the prolonged heating at 600–750°F required for the curing of most ceramic cements. It will not melt or burn, and higher temperatures, especially above 1,000°F, merely result in harmless decomposition of the film. Grounded junctions have response times in the 1 to 5 millisecond range.

•Economical use with standard readout equipment:

Modern procedures utilized in manufacturing CAPP Foil Thermocouples result in low-cost, highly efficient units that have a wide variety of laboratory applications. Because these thermocouples can be used with any standard readout equipment, the purchase of additional equipment is not necessary.

•Prefabricated and ready to use saves time:

CAPP Foil Thermocouples of the matrix style are prefabricated and ready to use. They have the foil sensor embedded in a paper thin laminate of glass-reinforced, high temperature polymer and are intended for surface application by adhesive bonding. Thin and flexible, they can be bonded to flat or curved surfaces. Low thermal inertia results in exceptionally fast response for an ungrounded thermocouple: 10 milliseconds for 63% response to step change when properly bonded.

•Maximum heat resistance provides long service life:

The polymer used in the matrix laminate, which limits the life of the unit at elevated temperatures, has been selected for maximum heat resistance and electrical properties. Recent developments in polymer science make it possible to obtain a life of many thousand hours at 500°F, hundreds of hours at 600°F, tens of hours at 700°F, and short time excursions to 800°F.

Stock No.	Style	Material: Thermocouple and Leads	Foil Thickness	Leads	Temperature Range*	Adhesive Application Notes	Price
ORDERING INFORMATION:							
315348	A	Chrome/Alumel Type K	0.0002	0.001 × 0.03	–320–1,500°F	See NOTE 1	\$19.50
315350	A	Chrome/Alumel Type K	0.0005	0.002 × 0.03	–320–1,500°F	See NOTE 1	\$17.50
315356	A	Chrome/Constantan Type E	0.0002	0.001 × 0.03	–320–1,200°F	See NOTE 1	\$19.50
315357	A	Chrome/Constantan Type E	0.0005	0.002 × 0.03	–320–1,200°F	See NOTE 1	\$17.50
315358	A	Copper/Constantan Type T	0.0002	0.001 × 0.03	–320–700°F	See NOTE 1	\$19.50
315359	A	Copper/Constantan Type T	0.0005	0.002 × 0.03	–320–700°F	See NOTE 1	\$17.50
315360	B	Chrome/Alumel Type K	0.0002	0.001 × 0.03	–320–1,500°F	See NOTE 2	\$19.50

cont.

THERMOCOUPLES

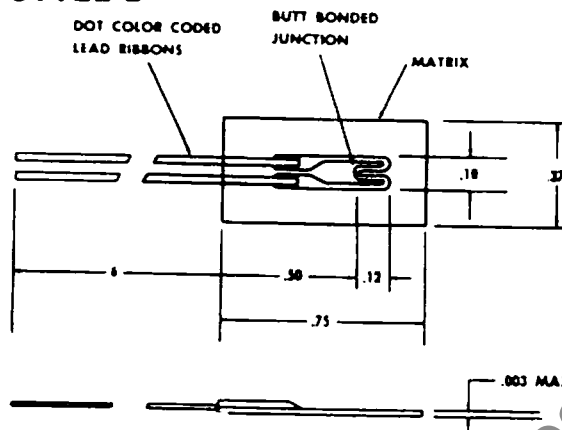
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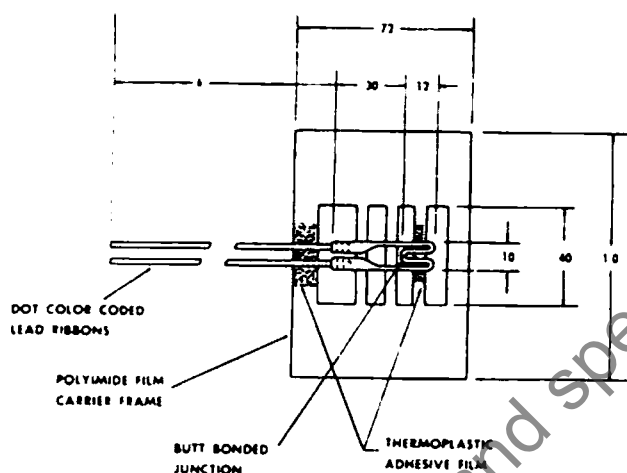
CAPP/USA BUTT-BONDED FOIL THERMOCOUPLES ISO 9001 CERTIFIED

(cont.)

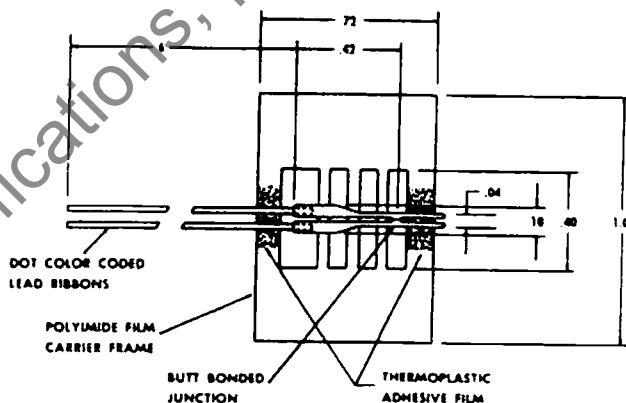
STYLE D



STYLE B



STYLE C



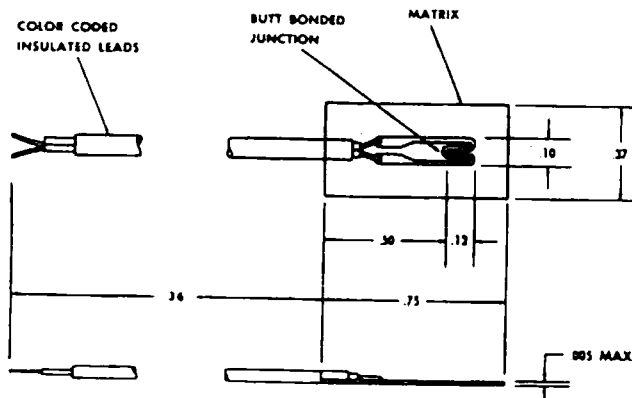
Stock No.	Style	Material: Thermocouple and Leads	Foil Thickness	Leads	Temperature Range*	Adhesive Application Notes	Price
ORDERING INFORMATION: (cont.)							
315361	B	Chromel/Alumel Type K	0.0005	0.002 x 0.03	-320-1,500°F	See NOTE 2	\$17.50
315363	B	Chromel/Constantan Type E	0.0002	0.001 x 0.03	-320-1,200°F	See NOTE 2	\$19.50
315365	B	Chromel/Constantan Type E	0.0005	0.002 x 0.03	-320-1,200°F	See NOTE 2	\$17.50
315366	B	Copper/Constantan Type T	0.0002	0.001 x 0.03	-320-700°F	See NOTE 2	\$19.50
315367	B	Copper/Constantan Type T	0.0005	0.002 x 0.03	-320-700°F	See NOTE 2	\$17.50
315368	C	Chromel/Alumel Type K	0.0002	0.001 x 0.03	-320-1,500°F	See NOTE 2	\$19.50
315369	C	Chromel/Alumel Type K	0.0005	0.002 x 0.03	-320-1,500°F	See NOTE 2	\$17.50
315483	C	Chromel/Constantan Type E	0.0002	0.001 x 0.03	-320-1,200°F	See NOTE 2	\$19.50
315484	C	Chromel/Constantan Type E	0.0005	0.002 x 0.03	-320-1,200°F	See NOTE 2	\$17.50
315485	C	Copper/Constantan Type T	0.0002	0.001 x 0.03	-320-700°F	See NOTE 2	\$19.50
315486	C	Copper/Constantan Type T	0.0005	0.002 x 0.03	-320-700°F	See NOTE 2	\$17.50
315487	D	Chromel/Alumel Type K	0.0002	0.001 x 0.03	-320-500°F continuous 600°F 600 hrs. 700°F 10 hrs.	See NOTE 3	\$26.00
315488	D	Chromel/Constantan Type E	0.0002	0.001 x 0.03	-320-500°F continuous 600°F 600 hrs. 700°F 10 hrs.	See NOTE 3	\$26.00
315489	D	Copper/Constantan Type T	0.0002	0.001 x 0.03	-320-500°F continuous 600°F 600 hrs. 700°F 10 hrs.	See NOTE 3	\$26.00



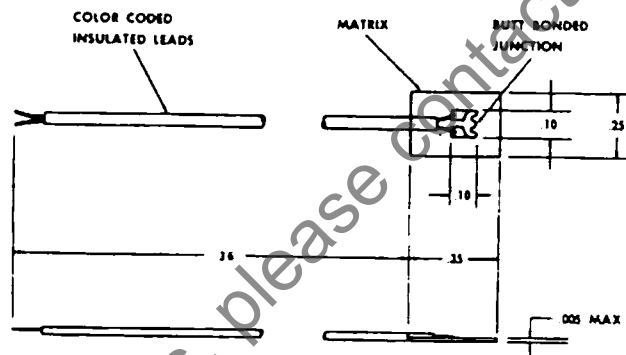
CAPP/USA BUTT-BONDED FOIL THERMOCOUPLES ISO 9001 CERTIFIED

(cont.)

STYLE E



STYLE F



Stock No.	Style	Material: Thermocouple and Leads	Foil Thickness	Leads	Temperature Range*	Adhesive Application Notes	Price
ORDERING INFORMATION: (cont.)							
315490	E	Chromel/Alumel Type K	0.0005	#30 (0.010 dia.) Fiberglass Insulated, Fiberglass Overbraid	-320-500°F continuous 600°F 600 hrs. 700°F 10 hrs.	See NOTE 3	\$26.00
315491	E	Chromel/Constantan Type E	0.0005	#30 (0.010 dia.) Fiberglass Insulated, Fiberglass Overbraid	-320-500°F continuous 600°F 600 hrs. 700°F 10 hrs.	See NOTE 3	\$26.00
315492	E	Copper/Constantan Type T	0.0005	#30 (0.010 dia.) Fiberglass Insulated, Fiberglass Overbraid	-320-500°F continuous 600°F 600 hrs. 700°F 10 hrs.	See NOTE 3	\$26.00
315493	F	Chromel/Alumel Type K	0.0002	#36 (0.005 dia.) Fiberglass Insulated, Fiberglass Overbraid	-320-500°F continuous 600°F 600 hrs. 700°F 10 hrs.	See NOTE 3	\$38.00
315494	F	Chromel/Constantan Type E	0.0002	#36 (0.005 dia.) Fiberglass Insulated, Fiberglass Overbraid	-320-500°F continuous 600°F 600 hrs. 700°F 10 hrs.	See NOTE 3	\$38.00
315495	F	Copper/Constantan Type T	0.0002	#36 (0.005 dia.) Fiberglass Insulated, Fiberglass Overbraid	-320-500°F continuous 600°F 600 hrs. 700°F 10 hrs.	See NOTE 3	\$38.00

*Temperature Range: The temperature range low limit given is the lowest temperature for which EMF values are tabulated. The temperature range high limit is greatly influenced by environmental conditions, and accuracy and lifetime requirements. High limit may vary from that given depending on service conditions and installation method. Values given are those generally applied to fine wire thermocouples.

ADHESIVE APPLICATION NOTES:

NOTE 1

CAPP Foil Thermocouples are intended primarily for application with ceramic cements, such as Sauereisen, Allen P-1 or PBX, Melbond, Astroceram, etc. The free foil thermocouple can be easily brushed into a thin layer of cement, following application and drying of a thin insulating layer, to produce an ungrounded junction. Care must be taken in the choice of a cement to avoid incompatible materials, for instance, cements containing phosphoric acid are not recommended for use with thermocouples having copper in one leg. To remove carrier film during installation, peel back carefully or touch with hot soldering iron for quick release. Installation can be made directly to nonconductive materials with any of a variety of cements. Grounded junction may be made on conductive materials if desired.

NOTE 2

CAPP Foil Thermocouples (Styles B and C), are designed for versatility of application. Ceramic cements, organic cements, or flame or plasma sprayed ceramic oxides may be used. Multiple cross bars in carrier frame restrain foil during flame or plasma spraying process. Foil and lead ribbons are temporarily attached to only two of the cross bars permitting others to be easily trimmed away if desired. Type shown in Style C with center bars removed, provides large open center window. Type shown in Style B requires least space and has longest filament length between junction and leads.

NOTE 3

CAPP Foil Thermocouples (Styles D, E, and F), are designed for easy installation with conventional thermal or chemical setting adhesives such as phenolic, epoxies, acrylics and pressure-sensitive adhesives. Type shown in Style D is made for minimum mass and fastest response (less than 10 milliseconds for 63%, ungrounded). Type shown in Styles E and F feature rugged fiberglass insulated lead wires. Select adhesive to suit maximum expected operating temperature. Solvent release adhesives are not recommended. Epoxy adhesives, especially those suitable for use at 500°F, are generally most satisfactory.

THERMOCOUPLES

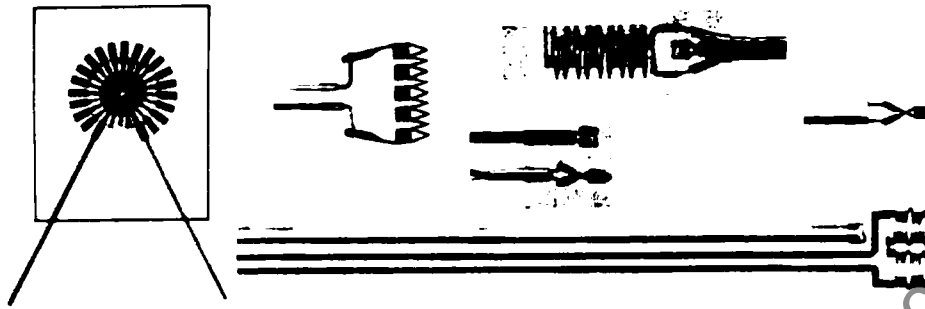
1

CAPP/USA MICRO-FOIL HEAT FLUX SENSORS

ISO 9001 CERTIFIED

100 %
CAPP/USA

100 %
MADE IN USA



For precise measurement of heat transfer
(loss or gain) through any surface material.

Effective with all methods of heat transfer,
including radiation, convection and conduction.

Wide range of configurations and sizes to meet
nearly any installation application.

Directly interfaced with simple microvolt meters,
recorders or sophisticated computer
instrumentation.

Easily attached to any flat or curved surface and
totally non-invasive.

Several dual function models available which
measure *both* heat transfer and surface
temperature.

Temperature range from -330°F (-184°C) to 500°F
(260°C).

Determining thermal properties of materials.

Heat exchange characteristics within living tissues.

Aerodynamic wind tunnel studies.

Thermal stress analysis.

Structural heat transfer monitoring.

Process control in heat treating, rolling mills and
glass production.

Heat loss determination in housing structures.

Monitoring solar heat collector performance.

Checking insulation efficiency.

Evaluating refrigeration and heating system
performance.

Proving architectural design energy conservation
efficiency.

To simplify the measurement of thermal transfer or movement, CAPP/USA has developed a unique line of Heat Flux Sensors to meet a broad range of measurement applications. Specifically, the CAPP Heat Flux sensor is designed to obtain a precise direct reading of thermal transfer through a surface in terms of energy per unit time per unit area.

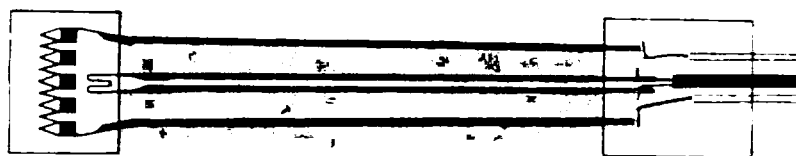
CAPP Heat Flux Sensors are being used in virtually every economic activity and a myriad of research and development programs.

THERMOCOUPLES

TECHNICAL OVERVIEW TO

CAPP/USA MICRO-FOIL HEAT FLUX SENSORS

1



**CAPP Heat Flux Sensors for the precise measurement
of heat loss or gain through materials.**

HEAT FLUX VS. SURFACE TEMPERATURE MEASUREMENT

The techniques of surface temperature measurement and their instruments are well known. Surface temperature measurements are perfectly satisfactory for applications in which only the immediate, single surface temperature data is required. However, the temperature of a single or outer surface is almost always the result of a thermal condition acting upon an inner surface as well as the thermal properties of the total material thickness.

Heat flux sensing devices are the only practical way of accurately measuring the thermal properties of a surface material and the thermal characteristics affecting both sides of that material.

EASY TO USE

Applications for CAPP Micro-Foil Heat Flux Sensors are practically unlimited — not only because of their high performance and reliability — but also because of their ease of installation.

The sensors are very thin and flexible and can be attached to flat or curved surfaces without damage to those surfaces. They require no special wiring, reference junctions or signal conditioning. Readout is accomplished by connecting the sensors to any direct reading microvolt meter or recorder. Upon connecting the sensor leads to the meter or recorder, one is provided a direct measurement of the heating or cooling transfer rate through a material in BTU's or other units. This is made possible because there is a direct relationship or calibration factor between the micro voltage change and the heat flux rate.

HOW HEAT FLUX SENSORS WORK

A Simplified Explanation

The function of a heat flux sensor is to measure heat transfer (loss or gain) through a surface. It does this by differentiating temperature between opposite sides of certain rigid materials thereby allowing a direct measurement of the heat loss or gain through the material surface.

Before heat flux sensors were developed the typical method for determining heat/loss transfer was to install two temperature measuring devices, one on either side of the rigid material to be measured.

(See Figure A).

The differential or change between the readings could then be mathematically calculated to show heat loss or gain through the surface provided the thermal characteristics of the material were known.

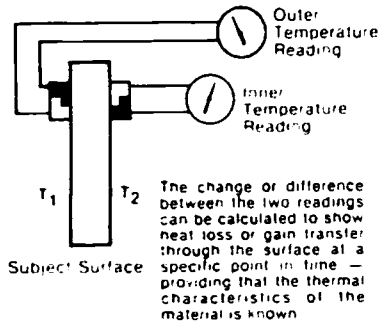
THERMOCOUPLES

TECHNICAL OVERVIEW CONTINUED

1

In a great many situations, however, it is neither desirable nor possible to install temperature measuring devices on both sides of a rigid material — even if thermal characteristics of the material is known. Also, instantaneous

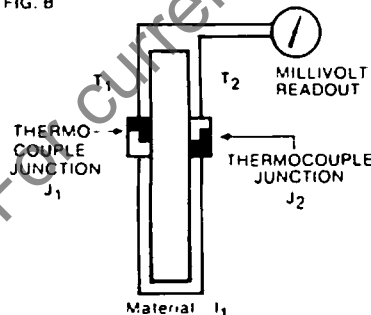
FIG. A



direct reading measurements are not practical. The heat flux sensor allows these same heat transfer measurements to be made from a single, convenient surface with instantaneous readout. And *nothing* need be known about the properties of the surface materials.

By way of simplified explanation, the heat flux sensor (See Figure B) is constructed much like the example shown in figure A — with two temperature measuring elements physically separated by a thermal insulating material. When the heat begins to "transfer" through surface (T_1), the thermal energy at junction (J_1)

FIG. B

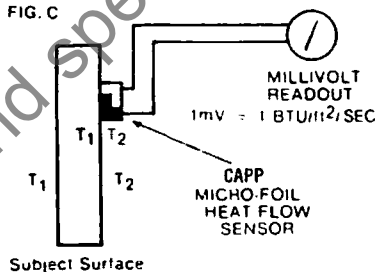


generates a small voltage. As the heat passes through the material (I_1) to reach thermocouple junction (J_2), it generates the differential voltage. In other words, as the temperature of J_1 is warmer or cooler than the temperature at J_2 , that temperature differential, in turn, creates a similar differential in voltage. Since the temperature differential is proportional to the voltage differential, the heat (or cooling) transfer rate can be directly read out as a function of voltage.

If such a heat flux device were to be embedded within a subject material, it would tend to become an integral part of that material duplicating and reading out the heat/loss transfer characteristics of the composite material.

Due to the unique design of the CAPP Micro-Foil Heat Flux Sensors it is not necessary to implant or in any way damage or invade the subject surface

FIG. C



in order to achieve highly reliable and precise readings. (See Figure C). The CAPP Heat Flux Sensors are extremely thin and flexible so that when properly mounted they become virtually a "component" of the subject surface. The CAPP Heat Flux Sensor faithfully simulates the action and reaction of the temperature changes (transfer or heat) through the subject surface.

UNIQUE CONSTRUCTION

Conventional heat flux sensors are usually fabricated with wire and electroplated junctions which tend to create excessive thermal losses within the sensor as well as a bulky configuration.

The unique CAPP Micro-Foil Heat Flux Sensors are fabricated with special homogeneous alloys and extremely thin foil legs between junctions. This greatly reduces thermal loss due to leg conduction. Equally important is that the formation of CAPP sensor junctions is achieved by a unique bonding process which joins dissimilar metals without degradation of physical or thermal properties. Moreover, the overall fabrication results in a very thin, strong and flexible sensor unit.

CALIBRATION

CAPP Micro-Foil Heat Flux Sensors are individually calibrated at a base temperature of 70°F (21°C). Generally, they are calibrated conductively for low levels. Calibration is a constant EMF output for a constant heat transfer rate. Each sensor is individually packaged with its calibration data.

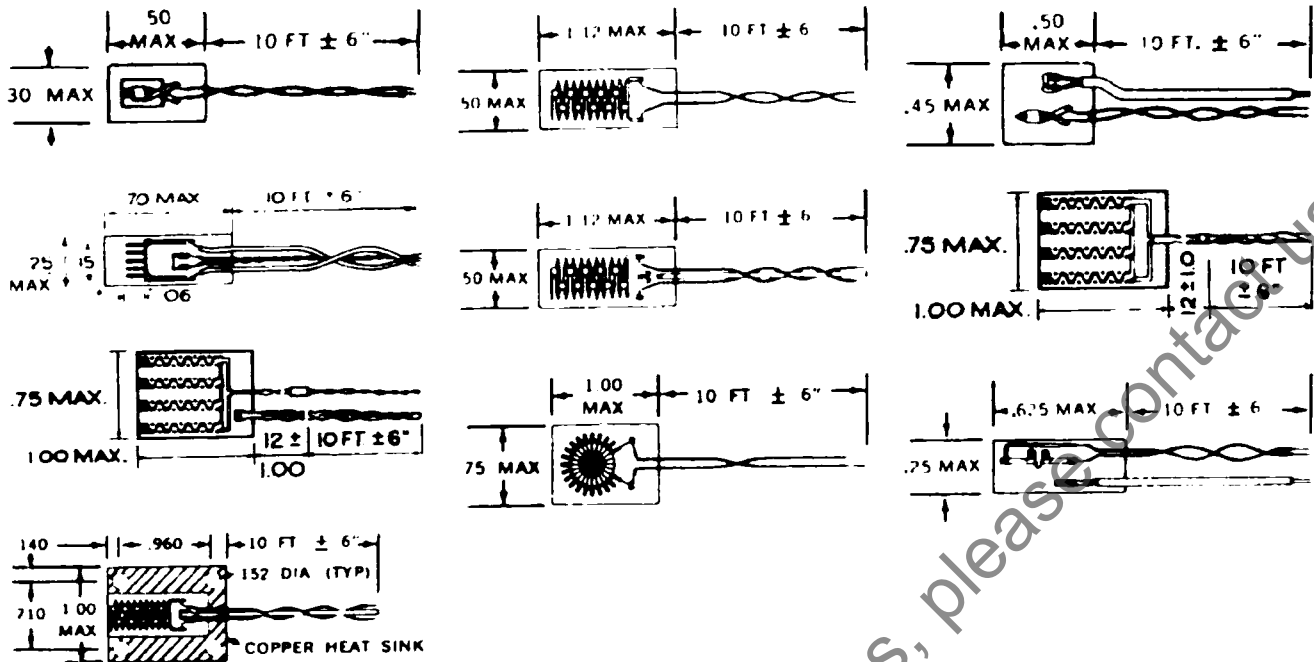
QUALITY IS NO. 1:

CAPP/USA Micro-Foil Heat Flux Sensors are made in the USA, and are ISO 9001 certified.

THERMOCOUPLES

CAPP/USA MICRO-FOIL HEAT FLUX SENSORS

1



Stock No.	Nominal Sensitivity ($\mu\text{V}/\text{Btu}/\text{ft}^2\text{-Hr.}$)	Maximum Recommended Heat Flux ($\text{Btu}/\text{ft}^2\text{-Sec.}$)	Response Time (Seconds)	Max. Sensor Resistance	Maximum Operating Temp.	Nominal Thickness	Thermal Capacitance ($\text{Btu}/\text{ft}^2\text{-}^\circ\text{F}$)	Thermal Impedance ($^\circ\text{F}/\text{Btu}/\text{ft}^2\text{-hr}$)	Price
COMPLETE ORDERING INFORMATION:									
315407	0.02	50	.020	5 Ω	500°F	.003"	.01	.003	\$32.40
315415	0.06	25	.060	5 Ω	500°F	.005"	.02	.005	\$32.40
315416	0.2	10	.400	5 Ω	500°F	.012"	.05	.012	\$32.40
315418	0.2	50	.020	20 Ω	500°F	.003"	.01	.003	\$176.85
315420	0.6	25	.060	20 Ω	500°F	.005"	.02	.005	\$176.85
315421	2.0	10	.400	20 Ω	500°F	.012"	.05	.012	\$176.85
315422 ¹	0.02	50	.020	5 Ω	500°F	.003"	.01	.003	\$115.00
315423 ¹	0.06	25	.060	5 Ω	500°F	.005"	.02	.005	\$115.00
315424 ¹	0.2	10	.400	5 Ω	500°F	.012"	.05	.012	\$115.00
315425 ¹	0.1	50	.020	10 Ω	500°F	.003"	.01	.003	\$175.15
315426 ¹	0.3	25	.060	10 Ω	500°F	.005"	.02	.005	\$175.15
315427 ¹	1.0	10	.400	10 Ω	500°F	.012"	.05	.012	\$175.15
315429 ¹	0.2	50	.020	20 Ω	500°F	.003"	.01	.003	\$191.00
315431 ¹	0.6	25	.060	20 Ω	500°F	.005"	.02	.005	\$191.00
315433 ¹	2.0	10	.400	20 Ω	500°F	.012"	.05	.012	\$191.00
315435	1.1	50	.020	100 Ω	500°F	.004"	.01	.003	\$309.20
315436	3.3	25	.060	100 Ω	500°F	.006"	.02	.005	\$309.20
315437	11.0	10	.400	100 Ω	500°F	.013"	.05	.012	\$309.20
315438 ¹	1.1	50	.020	100 Ω	500°F	.004"	.01	.003	\$357.90
315441 ¹	3.3	25	.060	100 Ω	500°F	.006"	.02	.005	\$357.90
315443 ¹	11.0	10	.400	100 Ω	500°F	.013"	.05	.012	\$357.90
315445	0.2	50	.020	15 Ω	500°F	.003"	.01	.003	\$309.20
315446	0.6	25	.060	15 Ω	500°F	.005"	.02	.005	\$309.20
315447	2.2	10	.400	15 Ω	500°F	.012"	.05	.012	\$309.20
315449 ¹	0.2	50	.020	50 Ω	500°F	.003"	.01	.003	\$256.00
315451 ¹	0.6	25	.060	50 Ω	500°F	.005"	.02	.005	\$256.00
315453 ¹	2.0	10	.400	50 Ω	500°F	.012"	.05	.012	\$256.00
315455	0.2	50	.020	20 Ω	500°F	.195"	.01	.003	\$266.15
315458	0.6	25	.060	20 Ω	500°F	.195"	.02	.005	\$266.15
315460	2.0	10	.400	20 Ω	500°F	.195"	.05	.012	\$266.15

1. These sensors employ Type "T" thermocouples for surface temperature measurement.
Note: All leads are Teflon insulated AWG #30 wire.

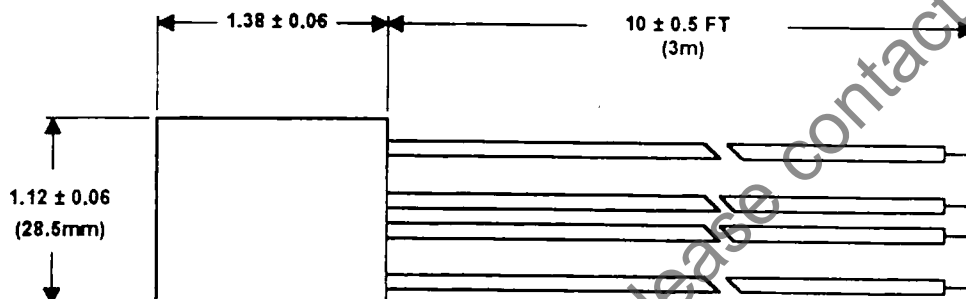
THERMOCOUPLES

1



CAPP/USA INDUSTRIAL MICRO-FOIL HEAT FLUX SENSORS

NEW!



A quality, lower cost, industrial standard Micro-Foil Heat Flux Sensor for precise measurement of heat transfer (loss or gain) through any surface material.

Pictured are Stock No.'s:

315560

315559

315558

315555



This CAPP Industrial Micro-Foil Heat Flux Sensor was developed using a new micro-foil technology and materials. The process produces a sensor at a lower cost per unit with the same high standards and basic performance characteristics as our other Micro-Foil Heat Flux Sensors.

Each Micro-Foil Heat Flux Sensor functions as a self-generating thermopile transducer. It requires no special wiring, reference junctions, or signal conditioning. A readout is accomplished by connecting a sensor to any direct reading DC millivoltmeter or recorder. To obtain maximum resolution on a very low level application, a microvoltmeter may be used.

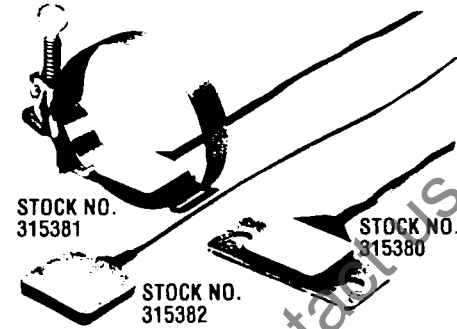
The Micro-Foil Heat Flux Sensor is designed for the precise measurement of heat loss or gain on any surface. It can be mounted on a flat or curved surface, and employs butt-bonded junctions with a very low thermal profile for efficient reading. The sensor is available with or without any integral thermocouple for discrete temperature measurement, and is also available in two different sensitivity ranges. All models utilize a 40 junction thermopile construction. The carrier is a polyimide film (Dupont Kapton) which is bonded using a Teflon lamination process.

Stock No.	Nominal Sensitivity $\mu\text{V/Btu/ft}^2 \text{ hr}$ ($\mu\text{V/W/m}^2$)	*Maximum Recommended Heat Flux $\text{Btu/ft}^2 \text{ hr}$ (W/m^2)	Integral T/C	Response Time	Thermal Capacitance $\text{Btu/ft}^2 \text{ }^\circ\text{F}$ ($\text{W-s/m}^2 \text{ }^\circ\text{C}$)	Thermal Resistance $^\circ\text{F/Btu/ft}^2 \text{ hr}$ ($^\circ\text{C/W/m}^2$)	Price
ORDERING INFORMATION:							
315555	3.0 (1.0)	30,000 (95,000)	No	0.60 sec.	0.03 (600)	0.01 (0.002)	\$92.00
315558	6.5 (2.0)	20,000 (63,000)	No	0.70 sec.	0.05 (1,000)	0.02 (0.004)	\$92.00
315559	3.0 (1.0)	30,000 (95,000)	Yes	0.60 sec.	0.03 (600)	0.01 (0.002)	\$99.00
315560	6.5 (2.0)	20,000 (63,000)	Yes	0.70 sec.	0.05 (1,000)	0.02 (0.004)	\$99.00

Note: *Maximum heat flux is limited by the maximum temperature reached by the lamination material in the sensor. This temperature is influenced by the direction of heat flow. The maximum heat flow given is for conditions where the substrate temperature maintained is less than 100 °F. and the heat flow is into the surface.

CAPP/USA CAN TEST & CERTIFY ALL OF YOUR THERMOCOUPLES & RTD'S

CAPP sensors are designed for applications where it is impractical to penetrate a vessel with an immersion sensor—yet a rugged industrial configuration is required. These styles are ideal for use in energy management systems, process plants, refineries, utilities and many other field applications.



*Stk. No. 315381: Clamp not included.
Min. 2" pipe dia. recommended.

Specifications

Operating Temperature Range

-73°C to 260°C (-100°F to 500°F) continuous -157°C to 316°C (-250°F to 600°F) for short periods.

Accuracy

Per standard limits of error as stated in ANSI MC96.1 (1975)

Time Response

1/2 second (Ungrounded), 1/4 second (Grounded) for the sensor to reach 63.2% of a step change in temperature in water flowing at 3 feet per second transverse to the sensor. (ASTM-E-644)

Insulation Resistance

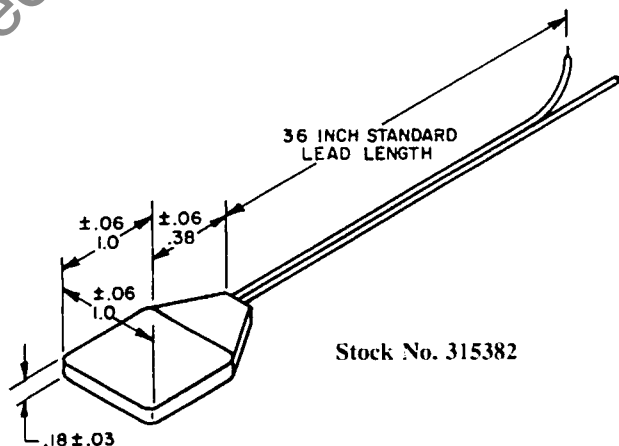
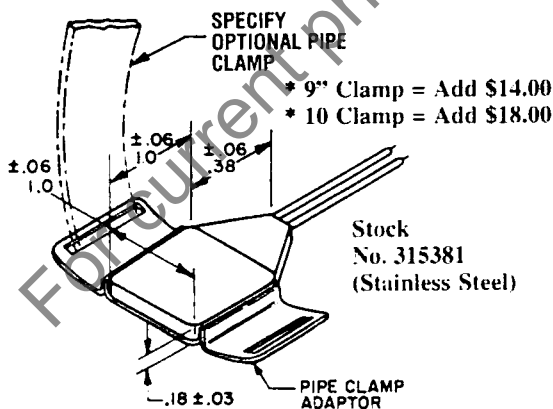
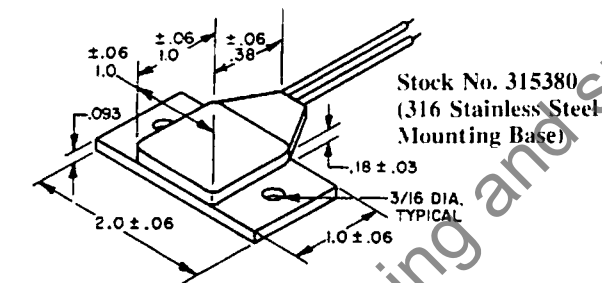
The insulation resistance between outer sensor insulation clamped between two metal plates and the common lead wire is 50 megohms minimum with 50 Volts DC applied to a dry sensor at room temperature. (ASTM-E-644)

Lead Wire

#20 AWG stranded thermocouple conductors, fiberglass insulated.

Mounting

Sensors can be bolted, clamped or welded into place.



ORDERING INFORMATION: \$48.00

315380 - J - G	G: GROUNDED JUNCTION.
315381* -	U: UNGROUNDED JUNCTION.
315382 -	THERMOCOUPLE TYPES J, K, E, or T.
STOCK NO.'S	

THERMOCOUPLES

1

CAPP/USA CLIP-ON THERMOCOUPLES

The Clip-On method for temperature measurement provides an easy convenient method for fast portable diagnostic measurement almost anywhere in your facility. The clamp will fit on small diameter tubes or pipes as well as flat surfaces. Direct connection to any thermocouple readout device will provide a fast accurate indication of the surface temperature. The clamp and measuring area is padded to provide a more accurate measurement and to protect the measuring surface from scratches.

SPECIFICATIONS:

Operating Temperature Range
-40°F to 500°F (-40°C to 260°C)

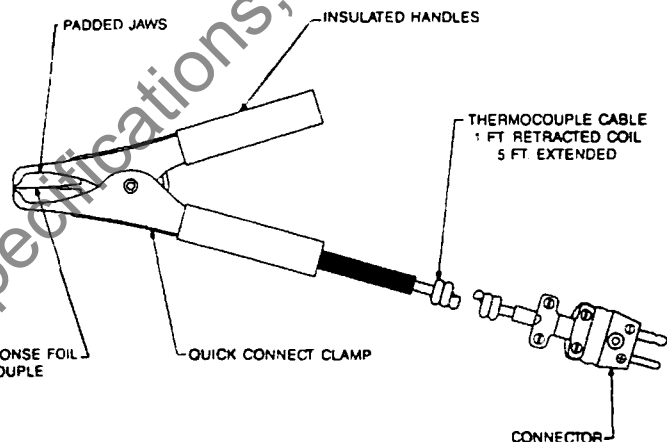
Accuracy
+/-4.0°F or 3/4% of temperature, whichever is greater.

Time Response
Less than 0.5 sec.



Insulation Resistance
50 megohms with 50 Vdc at room temperature.

Lead Wire
#28 AWG stranded retractable TPE insulated.



ORDERING INFORMATION:

SELECT AN OPTION FROM THESE CHOICES:

- 1: STOCK NO. 315502 FLAT OR ROUND CLAMP 0.08" TO 1.0": EACH \$63.15
STOCK NO. 315505 ROUND CLAMP 1.0" TO 2": EACH \$76.05
- 2: TYPE K
TYPE T
TYPE E
- 3: 1 = LEADS ONLY
2 = MALE CONNECTOR

EXAMPLE STOCK NO.: 315502-K-1 \$63.15

CAPP/USA THERMOCOUPLES & RTD'S FOR SPECIAL PURPOSES AND APPLICATIONS

1

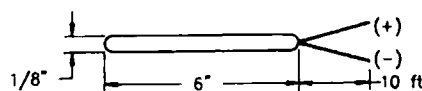


Fig. 1

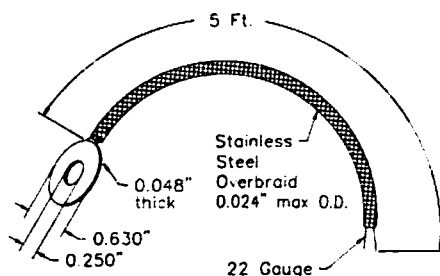


Fig. 3

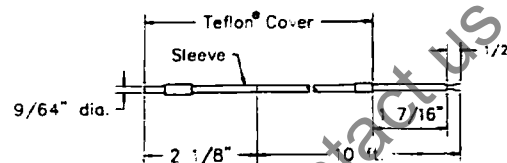


Fig. 2

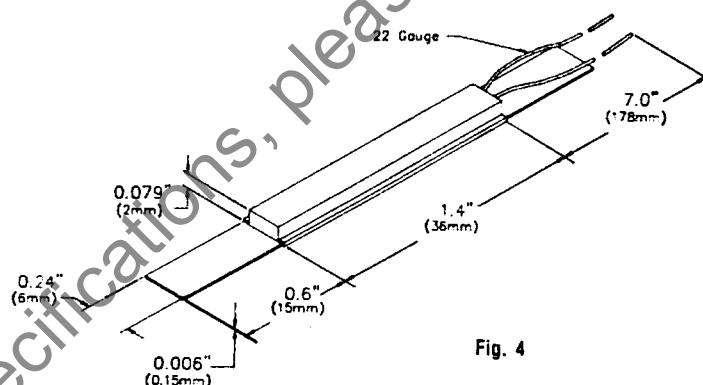


Fig. 4

Thermocouples and RTD Types

Figure 1: 30206 and 312927 are designed for general applications. They are encased in a thin stainless steel sheath and can be used in mildly corrosive fluids.

Figure 2: 312929 type J thermocouple is specially designed for measuring temperature in corrosive fluids. It is completely Teflon[®] coated including the lead wire.

Figure 3: 312930 and 312931 are 1/4" washer thermocouples. Their application is under any 1/4 bolt. the leadwire is fiberglass with stainless steel overbraid.

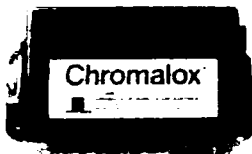
Figure 4: Stock No. 275075 is a platinum RTD 2-wire specially designed for measuring the temperatures of flat surfaces such as platens, molds, and dies. It is encased in a thin stainless steel sheath. It has a temperature coefficient of 0.00385 ohms/°C (international curve IPTS68).

Stock No.	Sensor Type	Material	Price
30206	Thermocouple J	Iron constantan	\$38.00
312927	Thermocouple K	Chromel alumel	\$38.00
312929	Thermocouple J	Iron constantan	\$85.00

Stock No.	Sensor Type	Material	Price
312930	Thermocouple J	Iron constantan	\$55.00
312931	Thermocouple K	Chromel alumel	\$55.00
275075	RTD 100 ohm	Platinum	\$85.00

THERMOCOUPLES

1



CHROMALOX NCT NONCONTACT THERMOCOUPLES

The Chromalox NCT is a fixed installation system ideal for thermocouple replacement in packaging and converting machinery, ovens, dryers and heaters. NCT sensors measure temperature in food, paper, plastics, textiles or anywhere temperature measurement is critical to a product or process.

The NCT comes in four separate models. Each model consists of a Nema 4 sensing head, 15 foot cable, electronic circuit card mounted in a standard Nema 12 enclosure.

These thermocouples can't scratch, tear, smear or contaminate because they don't make contact with your product.

They're easier and safer to install and maintain because they can be positioned away from hot and hazardous processes and moving products.

They remain accurate over a much longer time because they're not subjected to the abuse a contact device receives.

And they deliver better accuracy, better repeatability and faster response time than most contact thermocouples.

In the long run, NCT thermocouples can help you improve quality, speed production, and save money.

There are no electronics in the NCT sensing head, so it's small enough to fit in tight places.

If you need to get in close, the NEMA-4 sensing Head can withstand ambient temperature to 185°F (85°C) without a cooling jacket.

The NCT has excellent optical resolution for the price. So you can mount it further away, and still focus on small target areas.

Microprocessor technology makes it possible to offer a wide temperature range and two outputs: Type J and 1mV/degree.

ORDERING INFORMATION:

Stock No.	PCN	Description	Price
284083	309569	J T/C Output, 0 to 1000°F (0-18 to 538°C), Std. Focus, NCT JSF Series.	\$695.00
284084	309577	Close Focus Version of NCT-J, NCTJCF Series.	\$750.00
284085	309585	1 mV/°F Output, 0 to 1000°F, Std. Focus NCTVSF Series.	\$695.00
284087	309593	1 mV/°F Output, 0 to 1000°F, Close Focus NCTVCF Series.	\$750.00
ACCESSORIES			
284091	309690	NEMA-4 Box for Electronics Card	\$150.00
284092	309702	Air Purge Collar	\$120.00
284095	309737	Conduit Adaptor	\$85.00
284099	309753	110/220 Vac to 12 Vac Power Supply	\$70.00
284103	309761	Mounting Nut (spares)	\$25.00
284105	309770	Fixed Bracket (spares)	\$25.00
284107	309788	Operator's Manual (extra copies)	\$20.00

Note: Standard Focus, 2" spot at 24" distance.
Close Focus, 0.3" spot at 2" distance.

THERMOCOUPLE SOURCE



Direct temperature output—22 precise temperatures for inputs to transmitters, controllers, recorders, alarms and data acquisition systems. Accuracy of $\pm 0.1\%$ based on the latest ASTM, IPTS, JIS and NBS curves for exact temperature simulation.

Cold junction compensated—Built-in compensator for cold junction eliminates the need for millivolt tables or external compensators. Thermocouple types J and K are available in °F.

Hand held—(2 1/8 x 4 x 2 1/4 inches) with attached thermocouple wire, the Series 22 is always ready for use in the shop, plant, or field. Two AA alkaline batteries provide more than 1,000 hours of continuous duty—enough for a year of daily use. Lightweight (6 oz.) and ambient compensated for use in control room or field—from the arctic to the desert. Weight: 1 lb.

ORDERING INFORMATION:

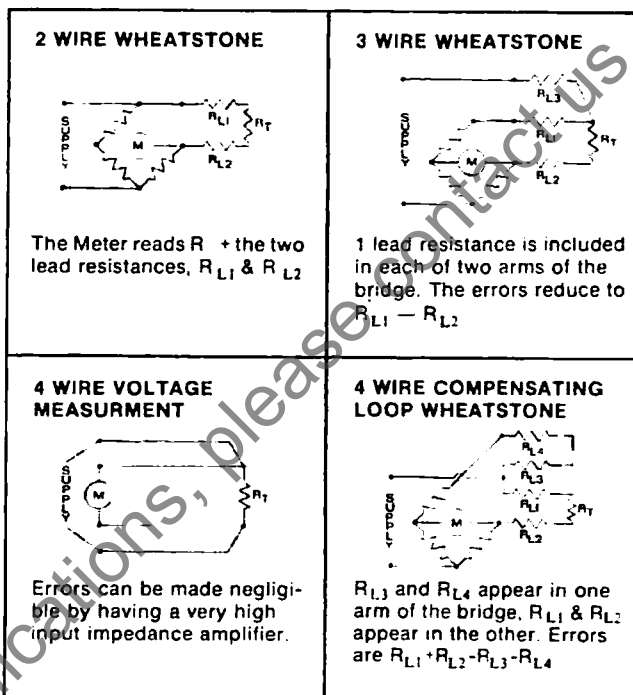
Stock No.	PCN	Series	Description	Price
284101	209235	22J	J Thermocouple Source 1000°F	\$262.00
284104	209243	22K	K Thermocouple Source 2100°F	\$262.00

TECHNICAL OVERVIEW TO R.T.D.'S

CHARACTERISTICS OF THE 3 STANDARD R.T.D. ELEMENT MATERIALS:

	PLATINUM	NICKEL	COPPER
MAXIMUM OPERATING TEMPERATURE	630°C	300°C	316°C
ACCURACY	± .1%	± .5%	± .2%
COST	HIGH	MEDIUM	LOW
LINEARITY	NEARLY	NON	MOST
RESISTANCE	HIGH	HIGH	LOW
R/T CHARACTERISTIC REPRODUCIBILITY	EXCELLENT	GOOD	POOR

TYPICAL BRIDGE CIRCUITS FOR 2, 3, & 4 WIRE R.T.D.'S:



RESISTANCE CHARTS: TEMPERATURES STATED IN DEGREES CELSIUS. RESISTANCE STATED IN OHMS.

°C.	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-100	60.25	56.18	52.09	47.98	43.85	39.68	35.49	31.27	27.02	22.73	18.40
0	100.00	96.09	92.16	88.22	84.27	80.31	76.33	72.33	68.32	64.30	60.25

°C.	0	10	20	30	40	50	60	70	80	90	100
0	100.00	103.90	107.79	111.67	115.54	119.39	123.24	127.07	130.89	134.70	138.50
100	138.50	142.29	146.08	149.82	153.58	157.32	161.05	164.76	168.47	172.16	175.84
200	175.84	179.51	183.17	186.82	190.46	194.08	197.69	201.30	204.89	208.46	212.03
300	212.03	215.59	219.13	222.66	226.18	229.69	233.19	236.67	240.15	243.61	247.06
400	247.06	250.50	253.93	257.34	260.75	264.14	267.52	270.89	274.25	277.60	280.93
500	280.93	284.26	287.57	290.87	294.16	297.44	300.70	303.96	307.20	310.43	313.65
600	313.65	316.86	320.05	323.24	326.41	329.57	332.72	335.86	338.99	342.10	345.21

CONTINUED ON THE NEXT PAGE

cont.

RESISTANCE CHARTS - CONTINUED

PLATINUM, 100 OHMS AT 0°C CONTINUED:

2

Platinum, 100 OHMS at 0°C

(SAMA) Alpha=.00391

°C	0	1	2	3	4	5	6	7	8	9
-190	21.63	21.20	20.76	20.32	19.89	19.45	19.01	18.58	18.14	17.70
-180	25.97	25.54	25.10	24.67	24.24	23.80	23.37	22.94	22.50	22.07
-170	30.27	29.84	29.41	28.98	28.55	28.12	27.69	27.26	26.83	26.40
-160	34.54	34.12	33.69	33.26	32.84	32.41	31.98	31.56	31.13	30.70
-150	38.79	38.36	37.94	37.52	37.09	36.67	36.24	35.82	35.40	34.97
-140	43.01	42.58	42.16	41.74	41.32	40.90	40.48	40.06	39.63	39.21
-130	47.20	46.78	46.36	45.94	45.52	45.10	44.68	44.27	43.85	43.43
-120	51.37	50.95	50.53	50.12	49.70	49.28	48.87	48.45	48.03	47.62
-110	55.51	55.10	54.68	54.27	53.86	53.44	53.03	52.61	52.20	51.78
-100	59.64	59.23	58.82	58.40	57.99	57.58	57.16	56.75	56.34	55.93
-90	63.74	63.34	62.92	62.52	62.10	61.69	61.28	60.87	60.46	60.05
-80	67.83	67.42	67.02	66.61	66.20	65.79	65.38	64.97	64.56	64.15
-70	71.90	71.50	71.09	70.68	70.28	69.87	69.46	69.06	68.65	68.24
-60	75.96	75.56	75.15	74.74	74.34	73.93	73.53	73.12	72.72	72.31
-50	80.00	79.60	79.19	78.79	78.38	77.98	77.58	77.17	76.77	76.36
-40	84.03	83.62	83.22	82.82	82.42	82.01	81.61	81.21	80.81	80.40
-30	88.04	87.64	87.24	86.84	86.44	86.03	85.63	85.23	84.83	84.43
-20	92.04	91.64	91.24	90.84	90.44	90.04	89.64	89.24	88.84	88.44
-10	96.02	95.63	95.23	94.83	94.43	94.03	93.63	93.24	92.84	92.44
0	100.00	99.60	99.21	98.81	98.41	98.01	97.62	97.22	96.82	96.42
10	103.96	103.56	103.16	102.76	102.36	101.96	101.56	101.16	100.76	100.36
20	107.92	107.52	107.12	106.72	106.32	105.92	105.52	105.12	104.72	104.32
30	111.86	111.46	111.06	110.66	110.26	109.86	109.46	109.06	108.66	108.26
40	115.78	115.38	114.98	114.58	114.18	113.78	113.38	112.98	112.58	112.18
50	119.70	119.30	118.90	118.50	118.10	117.70	117.30	116.90	116.50	116.10
60	123.60	123.20	122.80	122.40	122.00	121.60	121.20	120.80	120.40	120.00
70	127.50	127.10	126.70	126.30	125.90	125.50	125.10	124.70	124.30	123.90
80	131.38	130.98	130.58	130.18	129.78	129.38	128.98	128.58	128.18	127.78
90	135.25	134.85	134.45	134.05	133.65	133.25	132.85	132.45	132.05	131.65
100	139.11	138.71	138.31	137.91	137.51	137.11	136.71	136.31	135.91	135.51
110	142.95	142.55	142.15	141.75	141.35	140.95	140.55	140.15	139.75	139.35
120	146.79	146.39	145.99	145.59	145.19	144.79	144.39	143.99	143.59	143.19
130	150.61	150.21	149.81	149.41	149.01	148.61	148.21	147.81	147.41	147.01
140	154.42	154.02	153.62	153.22	152.82	152.42	152.02	151.62	151.22	150.82
150	158.22	157.82	157.42	157.02	156.62	156.22	155.82	155.42	155.02	154.62
160	162.01	161.61	161.21	160.81	160.41	160.01	159.61	159.21	158.81	158.41
170	165.79	165.39	164.99	164.59	164.19	163.79	163.39	162.99	162.59	162.19
180	169.55	169.15	168.75	168.35	167.95	167.55	167.15	166.75	166.35	165.95
190	173.30	172.90	172.50	172.10	171.70	171.30	170.90	170.50	170.10	169.70
200	177.04	176.64	176.24	175.84	175.44	175.04	174.64	174.24	173.84	173.44
210	180.77	180.37	179.97	179.57	179.17	178.77	178.37	177.97	177.57	177.17
220	184.49	184.09	183.69	183.29	182.89	182.49	182.09	181.69	181.29	180.89
230	188.20	187.80	187.40	187.00	186.60	186.20	185.80	185.40	185.00	184.60
240	191.89	191.49	191.09	190.69	190.29	189.89	189.49	189.09	188.69	188.29

RESISTANCE CHARTS - CONTINUED**PLATINUM, 100 OHMS AT 0°C CONTINUED:**

°C	0	1	2	3	4	5	6	7	8	9
250	195.57	195.94	196.31	196.68	197.04	197.41	197.78	198.14	198.51	198.88
260	199.24	199.61	199.98	200.34	200.71	201.08	201.44	201.81	202.17	202.54
270	202.90	203.27	203.64	204.00	204.36	204.73	205.10	205.46	205.82	206.19
280	206.55	206.92	207.28	207.64	208.01	208.37	208.74	209.10	209.46	209.82
290	210.19	210.55	210.91	211.28	211.64	212.00	212.36	212.73	213.09	213.45
300	213.81	214.17	214.54	214.90	215.26	215.62	215.98	216.34	216.70	217.06
310	217.42	217.78	218.15	218.51	218.87	219.23	219.59	219.95	220.31	220.67
320	221.02	221.38	221.74	222.10	222.46	222.82	223.18	223.54	223.90	224.26
330	224.61	224.97	225.33	225.69	226.05	226.40	226.76	227.12	227.48	227.83
340	228.19	228.55	228.90	229.26	229.62	229.98	230.33	230.69	231.04	231.40
350	231.76	232.11	232.47	232.82	233.18	233.54	233.89	234.25	234.60	234.96
360	235.31	235.67	236.02	236.38	236.73	237.08	237.44	237.79	238.15	238.50
370	238.85	239.21	239.56	239.91	240.27	240.62	240.97	241.33	241.68	242.03
380	242.38	242.74	243.09	243.44	243.79	244.14	244.50	244.85	245.20	245.55
390	245.90	246.25	246.60	246.96	247.31	247.66	248.01	248.36	248.71	249.06
400	249.41	249.76	250.11	250.46	250.81	251.16	251.51	251.86	252.21	252.56
410	252.90	253.25	253.60	253.95	254.30	254.65	255.00	255.34	255.69	256.04
420	256.39	256.74	257.08	257.43	257.78	258.13	258.47	258.82	259.17	259.51
430	259.86	260.21	260.55	260.90	261.25	261.59	261.94	262.28	262.63	262.98
440	263.32	263.67	264.01	264.36	264.70	265.05	265.39	265.74	266.08	266.42
450	266.77	267.11	267.46	267.80	268.15	268.49	268.83	269.18	269.52	269.86
460	270.21	270.55	270.89	271.24	271.58	271.92	272.26	272.60	272.95	273.29
470	273.63	273.97	274.32	274.66	275.00	275.34	275.68	276.02	276.36	276.70
480	277.04	277.39	277.73	278.07	278.41	278.75	279.09	279.43	279.77	280.11
490	280.45	280.79	281.13	281.46	281.80	282.14	282.48	282.82	283.16	283.50
500	283.84	284.18	284.51	284.85	285.19	285.53	285.87	286.20	286.54	286.88
510	287.22	287.55	287.89	288.23	288.56	288.90	289.24	289.57	289.91	290.25
520	290.58	290.92	291.25	291.59	291.93	292.26	292.60	292.93	293.27	293.60
530	293.94	294.27	294.61	294.94	295.28	295.61	295.94	296.28	296.61	296.95
540	297.28	297.61	297.95	298.28	298.62	298.95	299.28	299.61	299.95	300.28
550	300.61	300.94	301.28	301.61	301.94	302.27	302.61	302.94	303.27	303.60
560	303.93	304.26	304.60	304.93	305.26	305.59	305.92	306.25	306.58	306.91
570	307.24	307.57	307.90	308.23	308.56	308.89	309.22	309.55	309.88	310.21
580	310.54	310.87	311.20	311.52	311.85	312.18	312.51	312.84	313.17	313.49
590	313.82	314.15	314.48	314.80	315.13	315.46	315.79	316.11	316.44	316.77
600	317.10	317.42	317.75	318.08	318.40	318.73	319.05	319.38	319.70	320.03
610	320.36	320.68	321.01	321.33	321.66	321.98	322.31	322.63	322.96	323.28
620	323.61	323.93	324.26	324.58	324.90	325.23	325.55	325.87	326.20	326.52
630	326.84	327.17	327.49	327.81	328.14	328.46	328.78	329.10	329.43	329.75
640	330.07	330.39	330.71	331.04	331.36	331.68	332.00	332.32	332.64	332.96
650	333.28	333.61	333.93	334.25	334.57	334.89	335.21	335.53	335.85	336.17
660	336.49	336.81	337.13	337.45	337.77	338.08	338.40	338.72	339.04	339.36
670	339.68	340.00	340.32	340.63	340.95	341.27	341.59	341.91	342.22	342.54
680	342.86	343.18	343.49	343.81	344.13	344.44	344.76	345.08	345.39	345.71
690	346.03	346.34	346.66	346.98	347.29	347.61	347.92	348.24	348.55	348.87

cont.



RESISTANCE CHARTS - CONTINUED

PLATINUM, 100 OHMS AT 0°C CONTINUED:

2

Copper, 10 OHMS at 25°C

Alpha=.00427

°C	0	1	2	3	4	5	6	7	8	9
-190	1.471	1.430	1.389	1.348	1.306	1.265	1.223	1.182	1.140	1.099
-180	1.884	1.843	1.802	1.761	1.719	1.678	1.637	1.596	1.554	1.513
-170	2.295	2.254	2.213	2.172	2.131	2.090	2.049	2.008	1.967	1.925
-160	2.705	2.664	2.623	2.582	2.541	2.500	2.459	2.418	2.377	2.336
-150	3.112	3.072	3.031	2.990	2.949	2.909	2.868	2.827	2.786	2.745
-140	3.519	3.478	3.437	3.397	3.356	3.316	3.275	3.234	3.194	3.153
-130	3.923	3.883	3.842	3.802	3.762	3.721	3.681	3.640	3.600	3.559
-120	4.326	4.286	4.246	4.206	4.165	4.125	4.085	4.044	4.004	3.964
-110	4.728	4.688	4.648	4.608	4.567	4.527	4.487	4.447	4.407	4.366
-100	5.128	5.088	5.048	5.008	4.968	4.928	4.888	4.848	4.808	4.768
-90	5.526	5.486	5.446	5.407	5.367	5.327	5.287	5.247	5.208	5.168
-80	5.923	5.883	5.844	5.804	5.764	5.725	5.685	5.645	5.606	5.566
-70	6.318	6.279	6.239	6.200	6.160	6.121	6.081	6.042	6.002	5.962
-60	6.712	6.672	6.633	6.594	6.554	6.515	6.476	6.436	6.397	6.358
-50	7.104	7.064	7.025	6.986	6.947	6.908	6.869	6.830	6.790	6.751
-40	7.490	7.451	7.413	7.374	7.335	7.296	7.258	7.220	7.181	7.142
-30	7.876	7.838	7.799	7.761	7.722	7.683	7.645	7.606	7.568	7.529
-20	8.263	8.224	8.185	8.147	8.108	8.070	8.031	7.992	7.954	7.915
-10	8.649	8.610	8.572	8.533	8.494	8.456	8.417	8.378	8.340	8.301
0	9.035	8.996	8.958	8.919	8.881	8.842	8.805	8.765	8.726	8.687
10	9.421	9.404	9.387	9.370	9.353	9.336	9.319	9.302	9.285	9.268
20	9.807	9.800	9.793	9.786	9.779	9.772	9.765	9.758	9.751	9.744
30	10.194	10.200	10.207	10.214	10.221	10.228	10.235	10.242	10.249	10.256
40	10.580	10.600	10.620	10.640	10.660	10.680	10.700	10.720	10.740	10.760
50	10.966	11.005	11.043	11.082	11.120	11.159	11.198	11.236	11.275	11.313
60	11.352	11.391	11.429	11.468	11.507	11.545	11.584	11.622	11.661	11.700
70	11.738	11.777	11.816	11.854	11.893	11.931	11.970	12.009	12.047	12.086
80	12.124	12.163	12.202	12.240	12.279	12.318	12.356	12.395	12.433	12.472
90	12.511	12.549	12.588	12.627	12.665	12.704	12.742	12.781	12.820	12.858
100	12.897	12.935	12.974	13.013	13.051	13.090	13.129	13.167	13.206	13.244
110	13.283	13.322	13.360	13.399	13.437	13.476	13.515	13.553	13.592	13.631
120	13.669	13.708	13.746	13.785	13.824	13.862	13.901	13.940	13.978	14.017
130	14.055	14.094	14.133	14.171	14.210	14.248	14.287	14.326	14.364	14.403
140	14.442	14.480	14.519	14.557	14.596	14.635	14.673	14.712	14.751	14.789
150	14.828	14.867	14.906	14.945	14.984	15.022	15.061	15.100	15.139	15.178
160	15.217	15.256	15.295	15.334	15.373	15.412	15.451	15.490	15.529	15.568
170	15.607	15.646	15.685	15.724	15.763	15.802	15.840	15.879	15.918	15.957
180	15.996	16.035	16.074	16.113	16.152	16.191	16.230	16.269	16.308	16.347
190	16.386	16.425	16.464	16.503	16.542	16.581	16.620	16.659	16.698	16.737
200	16.776	16.815	16.854	16.893	16.932	16.971	17.010	17.049	17.088	17.127
210	17.166	17.205	17.244	17.283	17.321	17.360	17.399	17.438	17.477	17.516
220	17.555	17.594	17.633	17.672	17.711	17.750	17.789	17.828	17.867	17.906
230	17.945	17.984	18.023	18.062	18.101	18.140	18.179	18.218	18.257	18.296
240	18.335	18.374	18.413	18.452	18.491	18.530	18.569	18.608	18.648	18.687
250	18.726	18.765	18.804	18.843	18.882	18.921	18.960	18.999	19.038	19.077
260	19.116									

RESISTANCE CHARTS - CONTINUED

PLATINUM, 100 OHMS AT 0°C CONTINUED:

Nickel, 120 OHMS at 0°C

Alpha=.00672

°C	0	1	2	3	4	5	6	7	8	9
-70	73.10	72.45	71.80	71.15	70.50	69.85	69.20	68.55	67.90	67.25
-60	79.62	78.97	78.31	77.66	77.01	76.36	75.71	75.06	74.40	73.75
-50	86.17	85.51	84.86	84.20	83.55	82.89	82.24	81.58	80.93	80.27
-40	92.76	92.10	91.44	90.78	90.12	89.46	88.80	88.14	87.48	86.83
-30	99.41	98.74	98.07	97.41	96.74	96.07	95.41	94.75	94.08	93.42
-20	106.15	105.47	104.79	104.11	103.44	102.77	102.09	101.42	100.75	100.08
-10	113.00	112.31	111.62	110.93	110.25	109.56	108.87	108.19	107.51	106.83
0	120.00	119.29	118.58	117.88	117.17	116.47	115.77	115.08	114.38	113.69
10	127.17	127.90	128.63	129.36	130.09	130.82	131.56	132.29	133.03	133.77
20	134.52	135.26	136.01	136.76	137.51	138.26	139.02	139.77	140.53	141.29
30	142.06	142.82	143.59	144.36	145.13	145.90	146.68	147.46	148.23	149.01
40	149.79	150.58	151.36	152.15	152.94	153.74	154.53	155.33	156.13	156.93
50	157.74	158.55	159.36	160.17	160.98	161.80	162.62	163.44	164.26	165.08
60	165.90	166.73	167.56	168.38	169.21	170.05	170.88	171.72	172.56	173.40
70	174.25	175.10	175.95	176.80	177.66	178.51	179.37	180.24	181.10	181.97
80	182.84	183.71	184.59	185.46	186.34	187.22	188.10	188.98	189.87	190.75
90	191.64	192.53	193.42	194.32	195.21	196.11	197.01	197.91	198.82	199.73
100	200.64	201.55	202.46	203.38	204.30	205.22	206.14	207.06	207.99	208.92
110	209.85	210.78	211.72	212.66	213.60	214.54	215.49	216.44	217.39	218.34
120	219.29	220.25	221.21	222.17	223.14	224.10	225.07	226.04	227.01	227.99
130	228.96	229.94	230.92	231.90	232.89	233.88	234.87	235.86	236.85	237.85
140	238.85	239.85	240.85	241.86	242.86	243.87	244.88	245.89	246.91	247.93
150	248.95	249.97	251.00	252.02	253.05	254.09	255.12	256.16	257.21	258.25
160	259.30	260.35	261.40	262.45	263.51	264.57	265.63	266.60	267.76	268.83
170	269.91	270.98	272.06	273.14	274.22	275.30	276.39	277.48	278.57	279.67
180	280.77	281.87	282.98	284.09	285.21	286.33	287.45	288.57	289.70	290.83
190	291.96	293.10	294.24	295.38	296.52	297.67	298.82	299.97	301.13	302.29
200	303.46	304.62	305.80	306.97	308.15	309.34	310.52	311.72	312.91	314.11
210	315.31	316.52	317.72	318.94	320.15	321.37	322.59	323.82	325.05	326.29
220	327.53	328.77	330.02	331.27	332.52	333.78	335.05	336.32	337.59	338.86
230	340.14	341.42	342.71	344.00	345.30	346.59	347.90	349.20	350.51	351.82
240	353.14	354.46	355.79	357.12	358.45	359.79	361.13	362.47	363.82	365.18
250	366.53	367.89	369.26	370.62	372.00	373.37	374.75	376.13	377.52	378.91
260	380.31	381.70	383.11	384.52	385.93	387.34	388.77	390.19	391.62	393.05
270	394.49	395.93	397.38	398.82	400.28	401.73	403.19	404.66	406.12	407.60
280	409.07	410.55	412.03	413.52	415.01	416.51	418.01	419.51	421.02	422.53
290	424.05	425.57	427.09	428.62	430.16	431.70	433.24	434.78	436.33	437.89
300	439.44	441.00	442.57	444.13	445.70	447.28	448.86	450.44	452.02	453.61
310	455.20	456.80	458.40	460.00	461.60	463.20	464.80	466.40	468.00	469.60
320	471.20									

R.T.D. RESISTANCE TABLES

Temperature is stated in degrees Celsius. Resistance is stated in OHMS.

2

PLATINUM. 100 OHMS AT 0°C. ALPHA = .00385											
°C	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100
-100	60.25	56.18	52.09	47.98	43.85	39.68	35.49	31.27	27.02	22.73	18.40
0	100.00	96.09	92.16	88.22	84.27	80.31	76.33	72.33	68.32	64.30	60.25
°C	0	10	20	30	40	50	60	70	80	90	100
0	100.00	103.90	107.79	111.67	115.54	119.39	123.24	127.07	130.89	134.70	138.50
100	138.50	142.29	146.06	149.82	153.58	157.32	161.05	164.76	168.47	172.16	175.84
200	175.84	179.51	183.17	186.82	190.46	194.08	197.69	201.30	204.89	208.46	212.03
300	212.03	215.59	219.13	222.66	226.18	229.69	233.19	236.67	240.15	243.61	247.06
400	247.06	250.50	253.93	257.34	260.75	264.14	267.52	270.89	274.25	277.60	280.93
500	280.93	284.26	287.57	290.87	294.16	297.44	300.70	303.96	307.20	310.43	313.65
600	313.65	316.86	320.05	323.24	326.41	329.57	332.72	335.86	338.99	342.10	345.21

SELECTING YOUR CAPP/USA RTD:

Selecting your new RTD depends on many factors; listed here are factors that compare the three (3) standard element materials used in RTD's:

	PLATINUM	NICKEL	COPPER
MAXIMUM OPERATING TEMPERATURE	630° C	300° C	316°C
ACCURACY	±.1%	±.5%	±.2%
COST	HIGH	MEDIUM	LOW
LINEARITY	NEARLY	NON	MOST
RESISTANCE	HIGH	HIGH	LOW
R/T CHARACTERISTIC REPRODUCIBILITY	EXCELLENT	GOOD	POOR

HOW TO BUILD-YOUR-OWN R.T.D.**PLATINUM R.T.D. PROBE or ASSEMBLY:****STEP 1: SELECT TYPE OF R.T.D.:**

- A. PLAIN DETECTOR ELEMENT
- B. PLAIN DETECTOR ELEMENT W/ HEAD
- C. PLAIN DETECTOR ELEMENT W/ LEADS
- D. SPRING-LOADED ELEMENT
- E. SPRING-LOADED ELEMENT W/ WELL

STEP 2: SELECT INSERTION LENGTHS:

(INSERTION LENGTHS VARY PER APPLICATION)

MOST "COMMON" INSERTION LENGTHS:

- | | |
|------------------|------------------|
| A. 4.5" (114mm) | F. 10.5" (267mm) |
| B. 5.5" (140mm) | G. 11.5" (292mm) |
| C. 7.5" (191mm) | H. 13.5" (343mm) |
| D. 8.5" (216mm) | I. 23.5" (597mm) |
| E. 17.5" (445mm) | |

STEP 3: OPTIONAL SELECT WELL MATERIAL**MOST "COMMON" WELL MATERIALS:**

- A. CARBON STEEL
- B. 316 STAINLESS STEEL

STEP 4: OPTIONS:

- A. COMPRESSION FITTING(s)
- B. 200, 500, or 1000 OHM ELEMENT (100 OHM IS STANDARD)
- C. HEAD or COLD-END TERMINATION (GENERAL-PURPOSE HEADS ARE STANDARD)
- D. DUAL-BULB ELEMENT (DUPLEX)
- E. RTD EXTENSION WIRE

IF YOU CAN DRAW IT, DESCRIBE IT, or EXPLAIN IT.....

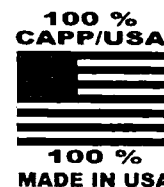
.....THEN WE CAN MAKE IT !

TALK TO ONE OF OUR ENGINEERS TODAY - (800) 356-8000

ALL CAPP/USA THERMOCOUPLES & RTD'S ARE MADE IN THE U.S.A.

BY AMERICAN WORKERS - GUARANTEED!

CAPP/USA RESISTANCE DETECTORS / R.T.D.'S



2 PLATINUM R.T.D.'S: COMPARE OURS TO BURNS®, HONEYWELL® & LEEDS AND NORTHRUP® RESISTANCE THERMOMETER DETECTORS.

THESE PLATINUM R.T.D.'S ARE USED IN MANY PROCESS APPLICATIONS WHERE TEMPERATURE NEEDS TO BE MEASURED EXTREMELY ACCURATELY.

CAPP / USA'S R.T.D.'S ACCURATELY MEASURE CHANGING TEMPERATURES WITHIN A RANGE FROM -310°F UP TO 1200°F. DUE TO THE RESISTANCE OF PLATINUM WIRE, VARYING TEMPERATURE CHANGES ARE RELATIVELY STABLE OVER TIME.

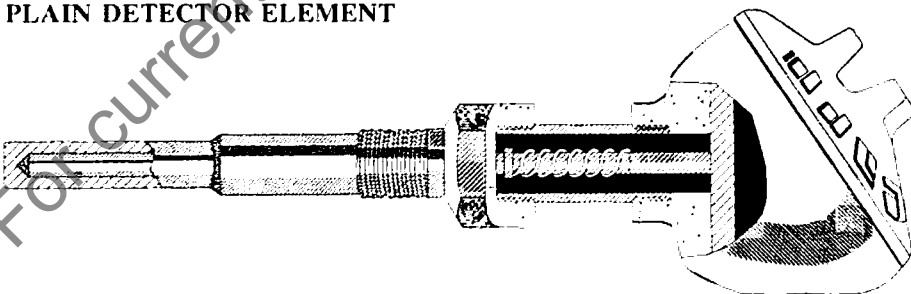
CAPP / USA R.T.D.'S ARE MADE AS R.T.D. ASSEMBLIES OR R.T.D. DETECTOR ELEMENTS. HERE ARE YOUR MANY CHOICES OF BOTH ASSEMBLIES AND DETECTOR ELEMENTS FOR YOUR APPLICATION(S).



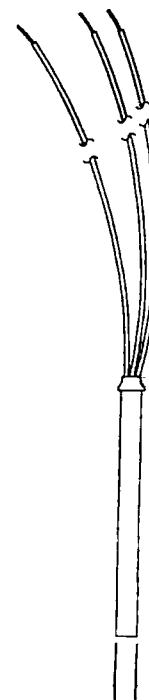
GENERAL-PURPOSE R.T.D. DETECTOR



PLAIN DETECTOR ELEMENT



SPRING-LOADED R.T.D.



PLAIN DETECTOR
WITH TEFLON LEADS

PLATINUM R.T.D.'S (CONTINUED)

SPECIFICATIONS OF PLATINUM R.T.D.'S:

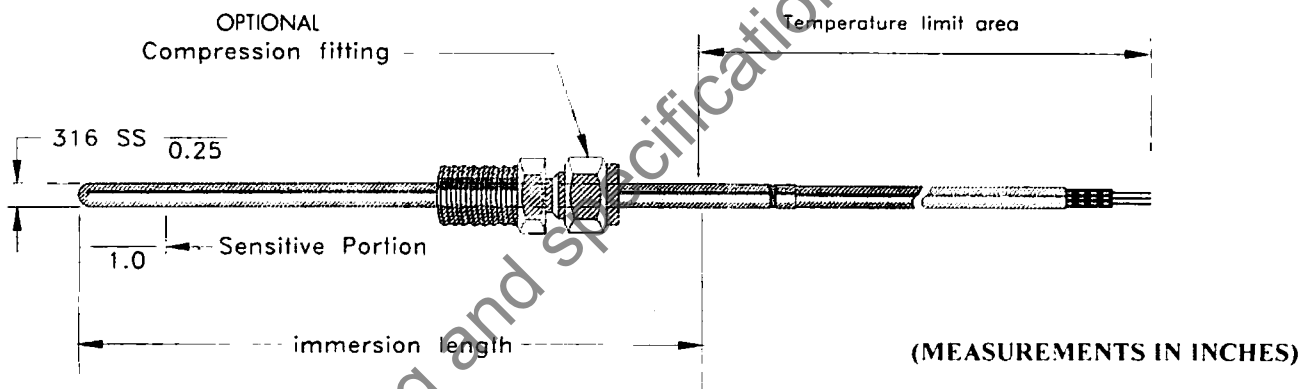
- TEMPERATURE RANGES: -310°F UP TO 905°F *
- 310°F UP TO 1200°F **

* RANGE LIMITS WHEN RTD IS IN 316S.S. SHEATH.
 ** RANGE LIMITS WHEN RTD IS IN INCONEL SHEATH.

- RESISTANCE: AT 30°F ELEMENT RESISTANCE IS 100 OR 200 OHMS.
- ACCURACY: 1/2% OF THE MEASURED TEMPERATURE.
- RESPONSE SPEED: 5.2 SECONDS FOR 64% RESPONSE TO STEP CHANGE IN TEMPERATURE.

ORDERING INFORMATION:

- PLAIN DETECTOR ELEMENT:



* CAPP STOCK NO. MODEL		INSERTION LENGTHS	TO FIT HONEYWELL
277747	\$115.00	5.5 IN. / 140mm.	HPODI-5 1/2 - 3A
277750	\$117.00	8.5 IN. / 216mm.	HPODI-8 1/2 - 3A
277753	\$125.00	11.5 IN. / 292mm.	HPODI-11 1/2 -3A
277755	\$150.00	17.5 IN. / 445mm.	HPODI-17 1/2-3A
277757	\$158.00	23.5 IN. / 597mm.	HPODI-23 1/2-3A

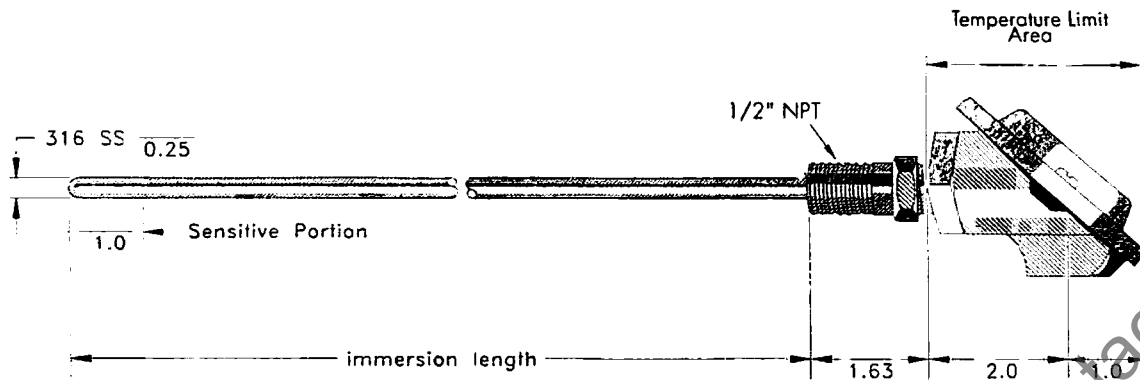
- * ALL ELEMENTS ARE 100 OHM / SPECIFY IF YOU WANT 200 OHM ELEMENT: \$20.00 ADD'L.
- * ALL ELEMENTS COME WITHOUT COMPRESSION FITTING / SPECIFY IF YOU WANT COMPRESSION FITTING. \$13.00 ADD'L.
- * CAPP CAN MAKE THESE TO LENGTHS OTHER THAN IN THE ABOVE TABLE; SPECIFY DESIRED LENGTH.

cont.



R.T.D.'S

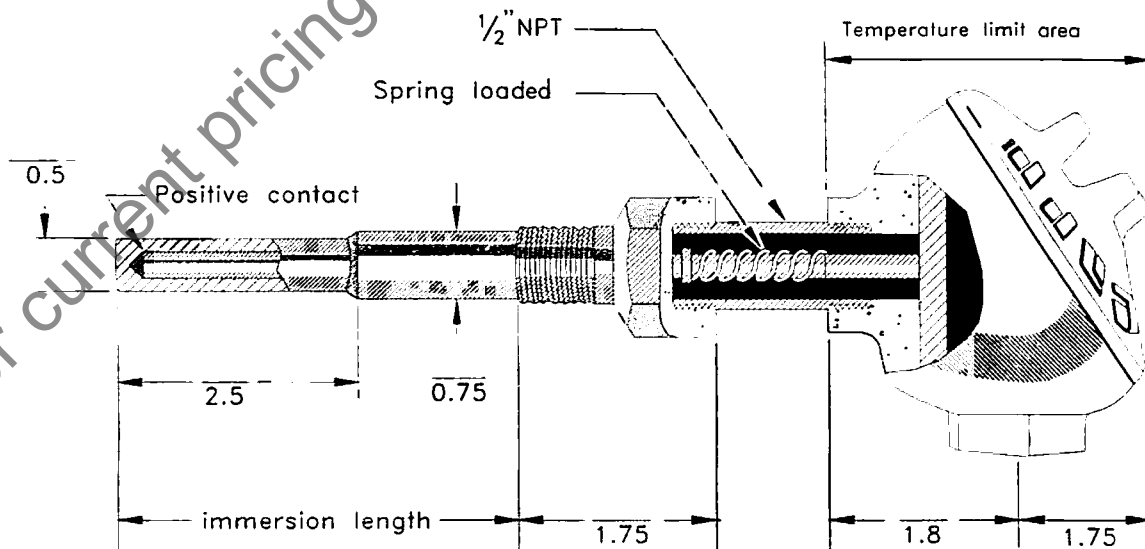
• GENERAL-PURPOSE R.T.D. DETECTOR:



* CAPP STOCK NO.		INSERTION LENGTHS	TO FIT HONEYWELL MODEL
277763	\$149.00	5.5 IN. / 140mm.	HP6A1-5 1/2-3A
277765	\$156.00	8.5 IN. / 216mm.	HP6A1-8 1/2-3A
277768	\$161.00	11.5 IN. / 292mm.	HP6A1-11 1/2-3A
277771	\$174.00	17.5 IN. / 445mm.	HP6A1-17 1/2-3A
277776	\$179.00	23.5 IN. / 597mm.	HP6A1-23 1/2-3A

- * ALL ELEMENTS ARE 100 OHM / SPECIFY IF YOU WANT 200 OHM ELEMENT: \$20.00 ADD'L.
- * ALL ELEMENTS HAVE GENERAL-PURPOSE HEADS / SPECIFY IF YOU WANT SCREW-COVER HEAD: \$10.00 ADD'L.
- * ALSO SPECIFY IF YOU REQUIRE A DUAL-ELEMENT BULB: \$130.00 ADD'L.

• SPRING-LOADED R.T.D. ASSEMBLY:



* CAPP STOCK NO.	INSERTION LENGTHS	TO FIT HONEYWELL MODEL
277778-WELL MATL. \$209.00	4.5 IN. / 114mm.	HP7E1-10.5-3A
277779-WELL MATL. \$230.00	7.5 IN. / 191mm.	HP7E1-13.5-3A
277780-WELL MATL. \$245.00	10.5 IN. / 267mm.	HP7E1-16.5-3A
277781-WELL MATL. \$256.00	16.5 IN. / 419mm.	HP7E1-22.5-3A

* ALL ASSEMBLIES HAVE 100 OHM ELEMENTS / SPECIFY IF YOU WANT 200 OHM ELEMENT: \$20.00 ADD'L.

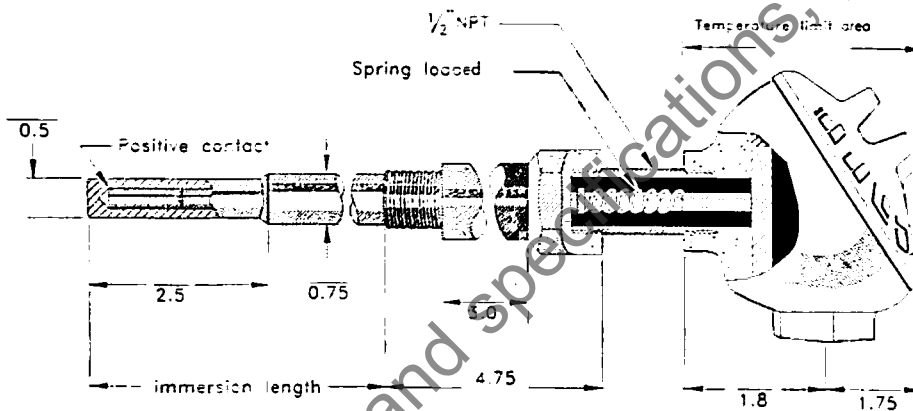
* SCREW-COVER HEAD IS STANDARD.

* SPECIFY WELL MATERIAL WHEN ORDERING:

WELL MATL. CHOICES:

- CARBON STEEL.
- 304 STAINLESS STEEL.
- 316 STAINLESS STEEL.

* SPRING-LOADED R.T.D. ASSEMBLY WITH 3" (76mm) WELL LAG:



* CAPP STOCK NO.	INSERTION LENGTHS	TO FIT HONEYWELL MODEL
277782-WELL MATL. \$229.00	4.5 IN. / 114mm.	HP7F1-13.5-3A
277783-WELL MATL. \$249.00	7.5 IN. / 191mm.	HP7F1-16.5-3A
277784-WELL MATL. \$269.00	10.5 IN. / 267mm.	HP7F1-19.5-3A
277785-WELL MATL. \$290.00	13.5 IN. / 343mm.	HP7F1-22.5-3A

* ALL ASSEMBLIES HAVE 100 OHM ELEMENTS / SPECIFY IF YOU WANT 200 OHM ELEMENT: \$20.00 ADD'L.

* ALL ASSEMBLIES HAVE WELLS WITH A LAG OF 3 INCHES (76mm.).

* SPECIFY WELL MATERIAL WHEN ORDERING:

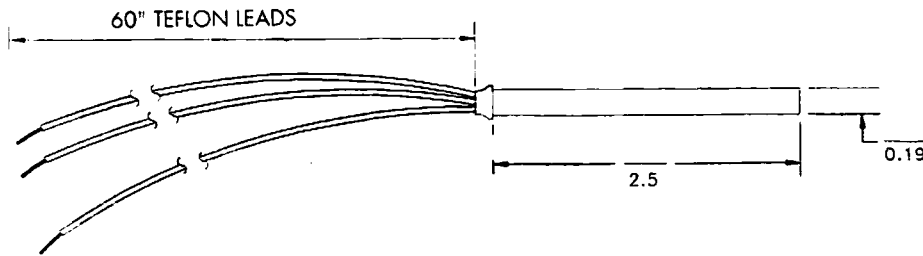
WELL MATL. CHOICES:

- CARBON STEEL.
- 304 STAINLESS STEEL.
- 316 STAINLESS STEEL.

cont.

R.T.D.'S

• PLAIN DETECTOR WITH TEFLON LEADS:



* <u>CAPP STOCK NO.</u> <u>MODEL</u>	<u>INSERTION LENGTHS</u>	<u>TO FIT HONEYWELL</u>
277786-100 OHM. \$119.00	2.5 IN. / 64mm.	HPOG1-2 1/2-3B
277788-200 OHM. \$139.00	2.5 IN. / 64mm.	HPOG2-2 1/2-3B
277789-200 OHM; \$239.00 2 ELEMENTS.	2.5 IN. / 64mm.	HPOG2-2 1/2-4A-D

- * ALL DETECTORS COME WITH 60 INCH TEFLON LEADS. OTHER LEAD LENGTHS ARE AVAILABLE - JUST ADD \$10.00 FOR EVERY 5 FEET!

SPECIAL NOTE:

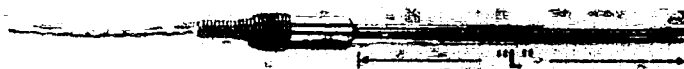
EXTENDED RANGES FROM EITHER 905°F OR 1200°F ARE AVAILABLE FROM CAPP / USA

R.T.D. TECH TIP:

INTERCHANGEABILITY FOR RTD ASSEMBLIES		
TEMP °F	± °F	± OHMS
-328	2.16	.50
-148	1.26	.30
32	.54	.10
212	1.26	.25
392	2.16	.45
572	3.24	.65
752	4.5	.85
932	5.4	1.00

CAPP/USA HERMETICALLY SEALED RTD ASSEMBLIES

Features: 1/4" diameter stainless steel sheath;
operating range -320°F to 900°F (up to 500°F lead
exit ambient); Teflon insulated 3-conductor cable.
Integral hermetic seal.



315102 1/4" DIAMETER SHEATHED HERMETICALLY SEALED PROBE. WITH CABLE \$145.00

RESISTANCE SPECIFICATION (Ohms @ 0°C)

10	100	±0.1 ($\alpha = 003923 \Omega/\Omega^\circ\text{C}$)
11	100	±0.1 ($\alpha = 00385 \Omega/\Omega^\circ\text{C}$)
20	200	±0.2 ($\alpha = 003923 \Omega/\Omega^\circ\text{C}$)
21	200	±0.2 ($\alpha = 00385 \Omega/\Omega^\circ\text{C}$)
50	500	±0.5 ($\alpha = .003923 \Omega/\Omega^\circ\text{C}$)
51	500	±0.5 ($\alpha = .00385 \Omega/\Omega^\circ\text{C}$)
99	Other	

SERVICE PARAMETER — SINUSOIDAL VIBRATION 20 to 2KHZ

S	Standard construction (up to 25 g's vibration)	NO CHARGE
H	Heavy duty construction (up to 50 g's vibration)	\$30.00

PROBE LENGTH (Specify "L" in inches)
(3" min. Standard Construction) (4" min. Heavy Duty Construction)

ADD \$1.20/INCH

NUMBER OF LEADS

B Single element, 3 wires

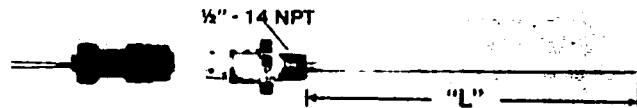
LEAD LENGTH Specify in inches (6" minimum)

ADD .08¢/INCH

315102 - 11 - H - 6 - B - 48 EXAMPLE STOCK NO. EXAMPLE PRICE = \$186.04

CAPP/USA RIGID PROBE RTD ASSEMBLIES WITH HERMETICALLY SEALED CONNECTOR

Features: 1/4" diameter 316 stainless steel sheath with hermetically sealed 4-pin connector; operating range - 320°F to 900°F (up to 500°F lead exit ambient); single or dual elements; Reference or DIN R vs. T characteristics, and 2, 3 or 4 wire element configurations.



(Mating connector) — Must be ordered separately
Stock No. 314946 Each = \$48.00

315105 1/4" DIAMETER SHEATHED PLATINUM PROBE, WITH HERMETIC CONNECTOR \$169.00

RESISTANCE SPECIFICATION (Ohms @ 0°C)

10	100	±0.1 ($\alpha = 003923 \Omega/\Omega^\circ\text{C}$)		
11	100	±0.1 ($\alpha = 00385 \Omega/\Omega^\circ\text{C}$)		
20	200	±0.2 ($\alpha = 003923 \Omega/\Omega^\circ\text{C}$)		
21	200	±0.2 ($\alpha = 00385 \Omega/\Omega^\circ\text{C}$)		
102	100	±0.1 Dual Element ($\alpha = .003923 \Omega/\Omega^\circ\text{C}$)		= \$47.00 ADDER
112	100	±0.1 Dual Element ($\alpha = .00385 \Omega/\Omega^\circ\text{C}$)		= \$47.00 ADDER
202	200	±0.2 Dual Element ($\alpha = 003923 \Omega/\Omega^\circ\text{C}$)		= \$52.00 ADDER
212	200	±0.2 Dual Element ($\alpha = 00385 \Omega/\Omega^\circ\text{C}$)		= \$52.00 ADDER
50	500	±0.5 ($\alpha = .003923 \Omega/\Omega^\circ\text{C}$)		NO CHARGE
51	500	±0.5 ($\alpha = .00385 \Omega/\Omega^\circ\text{C}$)		
502	500	±0.5 Dual Element ($\alpha = .003923 \Omega/\Omega^\circ\text{C}$)		\$63.00 ADDER
512	500	±0.5 Dual Element ($\alpha = .00385 \Omega/\Omega^\circ\text{C}$)		
99	Other			

SERVICE PARAMETER — SINUSOIDAL VIBRATION 20 to 2KHz

S	Standard construction (up to 25 g's vibration)	NO CHARGE
H	Heavy duty construction (up to 50 g's vibration)	\$30.00

PROBE LENGTH (Specify "L" in inches) ADD \$1.20/INCH
(3" min. Standard Construction) (4" min. Heavy Duty Construction)

NUMBER OF LEADS

- A Single element, 2 wires (see note 1)
- B Single element, 3 wires
- C Single element, 4 wires
- D Dual element, 2 wires per element
- F Single element, 2 wires and compensation loop

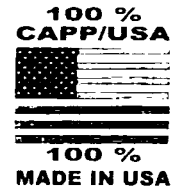
MATING CONNECTOR (optional)

Specify CAPP STOCK
number 314946 separately. Each = \$48.00

315105 - 10 - S - 8 - A EXAMPLE STOCK NO. EXAMPLE PRICE = \$178.60

NOTE 1 — Lead wire resistance to the element is not included for the two-wire configuration. The 3-wire and 4-wire units compensate for lead wire resistance.

CAPP/USA RESISTANCE THERMOMETER **BULBS-HIGH-SPEED NICKEL-A:**

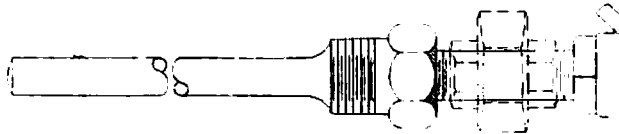


2

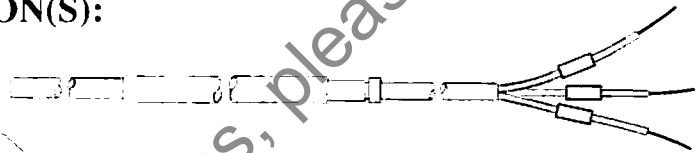
THESE RESISTANCE THERMOMETER BULBS ARE USED TO MEASURE RAPID TEMPERATURE CHANGES IN ALMOST ANY APPLICATION, DUE TO THEIR HIGH SPEED OF RESPONSE.

OUR BULBS CAN WITHSTAND TEMPERATURES UP TO 315°F; RESIST MOST CORROSIVE ENVIRONMENTS; AND CAN WITHSTAND MECHANICAL SHOCKS, ALL WITHOUT LOSING ANY CALIBRATION, ACCURACY, OR FAILURE.

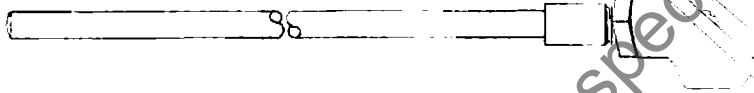
CAPP / USA BULBS COME IN THE FOLLOWING VARIETY OF STYLES FOR YOUR SUITABLE APPLICATION(S):



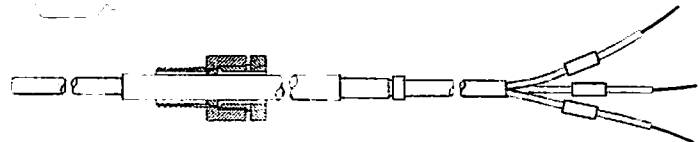
BULB IN A PIPE-EXTENDED WELL



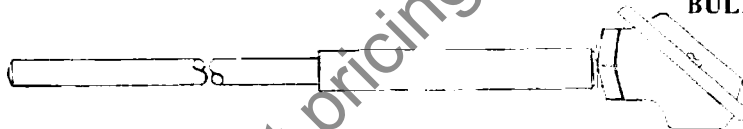
BULB WITH AN EXTENSION TUBE



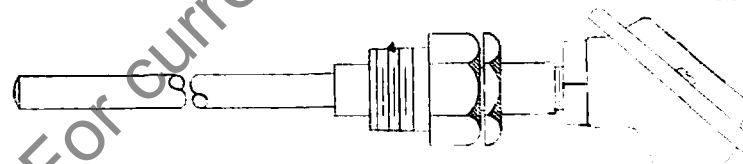
BULB WITH HEAD AND PLAIN TUBE



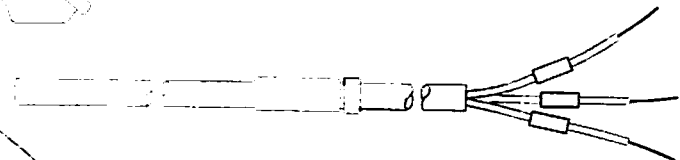
BULB WITH EXTENSION TUBE AND UNION CONN.



BULB WITH HEAD AND EXTENSION TUBE



BULB WITH HEAD, EXTENSION TUBE, AND UNION CONN.



PLAIN BULB

SPECIFICATIONS AND ORDERING INFORMATION ON NEXT PAGE

CAPP/USA RESISTANCE THERMOMETER BULBS, NICKEL-A CONT.

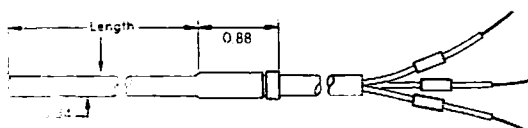
2

SPECIFICATIONS OF BULBS:

- TEMPERATURE RANGES: -105°F TO +315°F
- RESISTANCE: 924.1 OHMS AT 315°F
- ACCURACY: +43°F TO 305°F WITH MAX. ERROR OF $\pm 0.6^\circ\text{F}$
- RESPONSE SPEED: 6.4 SECONDS FOR 64% OF ANY STEP CHANGE.

ORDERING INFORMATION:

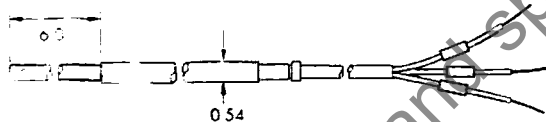
(ALL MEASUREMENTS IN INCHES)



TO FIT HONEYWELL MODEL SERIES
30335835:

PLAIN-BULB WITH FLEXIBLE CABLE
CONNECTIONS:

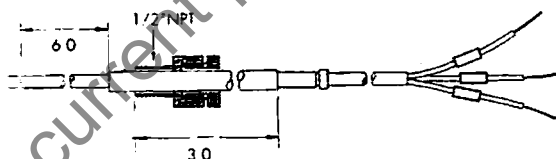
LENGTH	MATERIAL	STOCK NO.
6"	BRASS	277795 \$263.00
6"	STAINLESS STEEL	277796 \$293.00
8"	STAINLESS STEEL	277797 \$305.00
10"	STAINLESS STEEL	277798 \$350.00
12"	BRASS	277801 \$305.00
12"	STAINLESS STEEL	277804 \$330.00



TO FIT HONEYWELL MODEL SERIES
30355820:

BULB WITH AN EXTENSION-TUBE &
FLEXIBLE CABLE CONNECTIONS:

LENGTH	MATERIAL	STOCK NO.
9"	STAINLESS STEEL	277806 \$309.00
21"	STAINLESS STEEL	277808 \$384.00



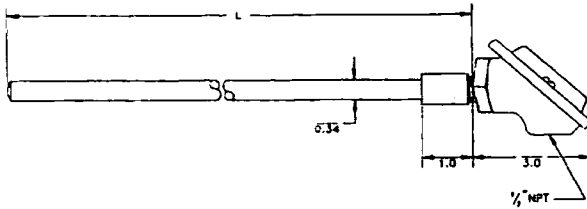
TO FIT HONEYWELL MODEL SERIES
30355824:

BULB WITH AN EXTENSION-TUBE,
UNION CONN. AND FLEXIBLE CABLE
CONNECTIONS:

LENGTH	MATERIAL	STOCK NO.
6"	STAINLESS STEEL	277812 \$440.00
12"	STAINLESS STEEL	277813 \$459.00

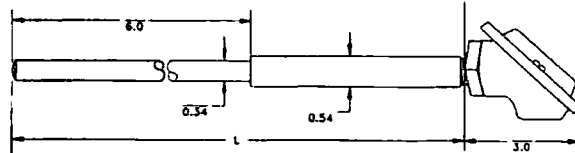
CAPP/USA RESISTANCE THERMOMETER BULBS, NICKEL-A CONTINUED

ORDERING INFORMATION CONTINUED:



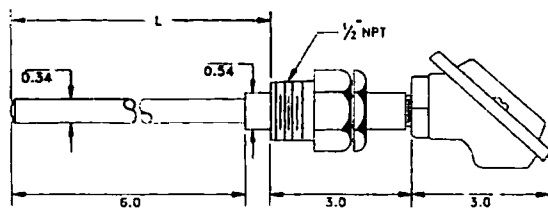
TO FIT HONEYWELL MODEL SERIES 30356314:
BULB WITH HEAD & PLAIN TUBE:

LENGTH	MATERIAL	STOCK NO.
6"	STAINLESS STEEL	277825 \$320.00
12"	STAINLESS STEEL	277826 \$342.00



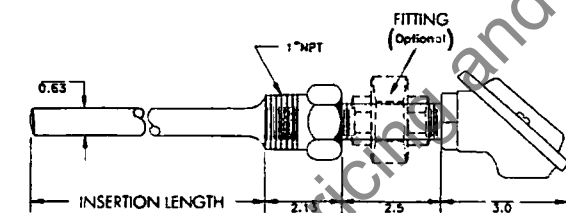
TO FIT HONEYWELL MODEL SERIES 30355817:
**BULB WITH AN EXTENSION
TUBE AND HEAD:**

LENGTH	MATERIAL	STOCK NO.
9"	STAINLESS STEEL	277821 \$359.00
15"	STAINLESS STEEL	277822 \$375.00
21"	STAINLESS STEEL	277823 \$380.00



TO FIT HONEYWELL MODEL SERIES 30355817:
**BULB WITH HEAD, EXTENSION TUBE, &
UNION CONNECTOR:**

LENGTH	MATERIAL	STOCK NO.
6"	STAINLESS STEEL	277816 \$460.00
12"	STAINLESS STEEL	277817 \$484.00
18"	STAINLESS STEEL	277818 \$498.00



TO FIT HONEYWELL MODEL SERIES 30355653:
BULB IN A PIPE-EXTENDED WELL:

- **CAPP STOCK NO.: 277820, \$261.00/**
* NOT INCL. OPTIONS BELOW.
- **WHEN ORDERING STOCK NO. 277820,
MUST SPECIFY THE FOLLOWING:**
 1. **MATL. OF WELL:** SELECT FROM COPPER; BRASS;
STEEL; OR 316 STAINLESS STEEL.
 2. **LAG:** SELECT FROM 0, 1, 2, OR 3" LAGS.
 3. **LENGTH OF ELEMENT:** WHEN SPECIFYING YOUR
ELEMENT LENGTH, PLEASE REMEMBER THAT IT IS
THE "INSERTION LENGTH OF THE WELL + LAG OF THE
WELL + 5.53 INCHES."
 4. **HEADS & OPTION CONNECTOR:** SPECIFY EITHER A
GENERAL - PURPOSE OR SCREW-COVER HEAD; AND
WHETHER YOU WANT A UNION CONNECTOR OR NOT.
ELEMENT LENGTH

EXAMPLE STOCK NO.: 277820-316S.S.-1"-12" ←



*(CONSULT CAPP FOR ALL OPTIONS PRICING).

R.T.D.'S

100 %
CAPP/USA

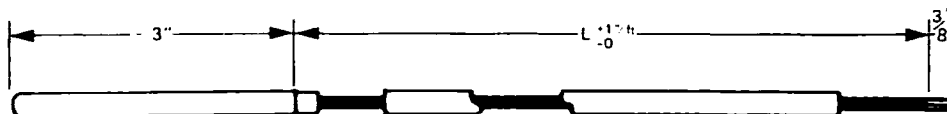


100 %
MADE IN USA

CAPP/USA EXTENDABLE RTD-MDL. E90

MODEL E90

DIMENSIONS



No Welding, No Machining, No Scrap. An economical solution for those needing a variety of RTD probes. This straight 3" RTD is constructed with an tough spring steel joiner embedded in one end for flexibility of use with various sheath lengths. Ideal for spare parts inventory at minimum cost.

Features

No welding, machining or scrap.

1. Determine the required length.
2. Cut a piece of 0.028" wall stainless sheath with a tubing cutter.
3. Deburr the ends, and force the sheath over the end spring, using an arbor press, drill press, or optional tool available from CAPP.

The probe is now permanently integrated at the desired length, suitable for any non-submersed installation. The Model E90 may also be combined with accessory fittings, connection heads and/or thermowells to satisfy a wide variety of applications.

SPECIFICATIONS

Operating temperature range: -320°F (-196°C) to 900°F (480°C)

Sensing element: Strain free, wire wound platinum. Only a wire wound element can provide the reliability, and only a strain free wire wound element can provide the accuracy and stability.

Temp. coefficient or resistance: (Reference) 0.003923 $\Omega/\Omega/^\circ\text{C}$
(DIN 43760) 0.003850 $\Omega/\Omega/^\circ\text{C}$

Pressure rating: 3,000 psi

Resistance: 100.0 \pm 0.1 Ω @ 32°F (°C); 200.0 \pm 0.25 Ω @ 32°F (°C); 500.0 \pm 0.5 Ω @ 32°F (°C)

Stability: Less than 0.05°C shift/year @ °C

Insulation resistance: 500 Megohms (100 Vdc: 70°F)

Time constant: Less than 6 seconds in water flowing @ 3 ft/sec.

Leadwire: AWG #22, stranded nickel plated copper with micatemp insulation.

Accuracy: \pm 0.25°C @ °C

Self heating: 35 mW/°F in water @ 3 ft/sec

Vibration: Sinusoidal 20 Hz to 2K, 25 g's

316 Stainless Steel:		Inconel 600:	
*Stock No.	Each	*Stock No.	Each
ORDER FROM TABLES BELOW:			
315959-10-S-36"	\$47.00	315969-10-I-36"	\$50.00
315960-11-S-36"	\$47.00	315970-11-I-36"	\$50.00
315965-20-S-36"	\$47.00	315971-20-I-36"	\$50.00

316 Stainless Steel:		Inconel 600:	
*Stock No.	Each	*Stock No.	Each
ORDER FROM TABLES BELOW: (cont.)			
315966-21-S-36"	\$47.00	315972-21-I-36"	\$50.00
315967-50-S-36"	\$55.00	315973-50-I-36"	\$58.00
315968-51-S-36"	\$55.00	315974-51-I-36"	\$58.00

Note: *Add an additional \$0.25 for each inch over 36".

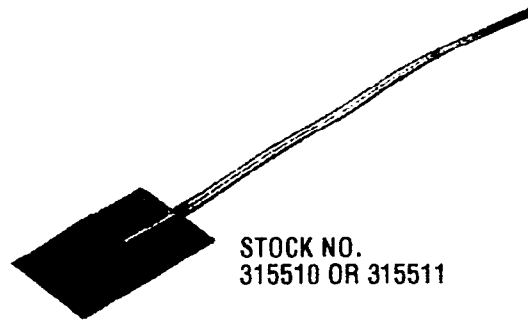
MODEL E90

1 / 4 INCH DIAMETER 3 INCH LONG PROBE ASSEMBLY

OPTIONS		RESISTANCE SPECIFICATION (Ω @ 0°C)
10		100 \pm 0.1 (0.003923 $\Omega/\Omega/^\circ\text{C}$) Reference Standard
11		100 \pm 0.1 (0.003923 $\Omega/\Omega/^\circ\text{C}$) DIN Standard 43 760
20		200 \pm 0.2 (0.003923 $\Omega/\Omega/^\circ\text{C}$) Reference Standard
21		200 \pm 0.2 (0.003923 $\Omega/\Omega/^\circ\text{C}$) DIN Standard 43 760
50		500 \pm 0.5 (0.003923 $\Omega/\Omega/^\circ\text{C}$) Reference Standard
51		500 \pm 0.5 (0.003923 $\Omega/\Omega/^\circ\text{C}$) DIN Standard 43 760
99		Other (Consult CAPP/USA)
OPTIONS		SHEATH MATERIAL
S		316 STAINLESS STEEL
I		INCONEL 600
LEAD LENGTH IN INCHES (36" IS STANDARD)		



CAPP/USA FLEXIBLE RTD STICK-ON SURFACE SENSOR



STOCK NO.
315510 OR 315511

2

CAPP manufactures a polyimide insulated surface sensor designed to provide a practical method for measuring surface temperature. These sensors are small, flexible, and their low mass has minimal thermal effect on the material being measured. They are ideally suited for applications where the device can be permanently mounted using adhesives or other mechanical mounting methods.

SPECIFICATIONS

Operating temperature range: The useful range of operation for CAPP stick-on's is -200 – 288°C (-320 – 550°F) with permissible exposure to 343°C (650°F) for short periods.

Sensing element: The standard sensing element is platinum with a resistance of 100 ohms at $^{\circ}\text{C}$ and temperature coefficient $0.00385\ \Omega/\Omega/^{\circ}\text{C}$ nominal (DIN 43760). Also optionally available on special request are reference grade platinum, nickel and nickel-iron alloy, consult CAPP.

Accuracy: Standard: 315510-1 ± 0.50 ohms 0.50% of temp.

Optional: 315511-2 ± 0.22 ohms 0.25% of temp.

Stability: Less than 0.2°C drift per year at rated service temperature with proper mounting.

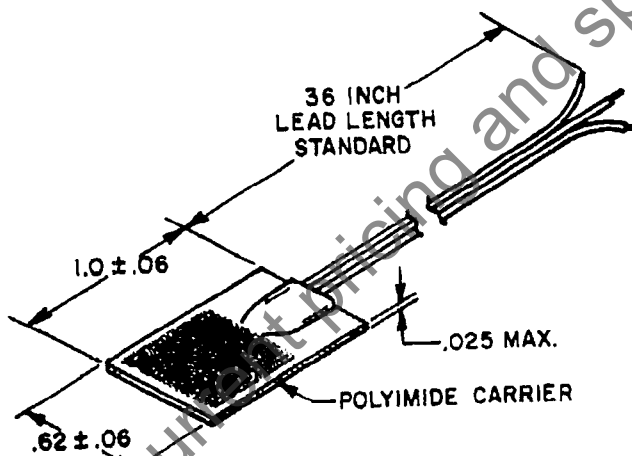
Time response: 70 milliseconds for the sensor to reach 63.2% of a step change in temperature in water flowing at 3 feet per second transverse to the sensor. (ASTM-E-644)

Self heating: The bare sensor will rise less than 1°C while dissipating an I^2R power of 3 milliwatts in still air. (ASTM-E-644)

Insulation resistance: The insulation resistance between outer sensor insulation clamped between two metal plates and the commoned lead wire is 50 megohms minimum with 50 Vdc applied to a dry sensor at room temperature. (ASTM-E-644)

Lead wire: No. 20 AWG stranded copper conductors, TFE Teflon[®] insulated, 3-wire configuration.

Mounting: Will conform to surfaces with radii down to $\frac{3}{16}$ " transverse to element winding and $1\frac{1}{2}$ " radii longitudinal to winding.

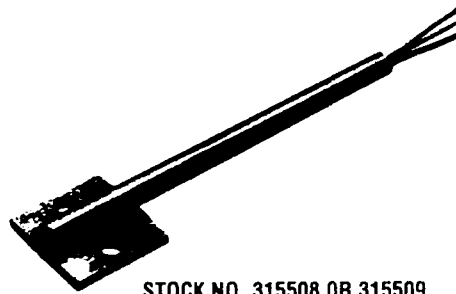


Stock No.	Accuracy	Price
ORDERING INFORMATION:		
315510-1	± 0.50 ohms, 0.50% of temperature.	\$48.20
315511-2	± 0.22 ohms, 0.25% of temperature.	\$59.00

CAPP/USA HEAVY-DUTY INDUSTRIAL RTD SURFACE SENSOR



2



STOCK NO. 315508 OR 315509

CAPP series of HEAVY DUTY surface sensors provides a practical method for measuring surface temperatures in areas where the sensor may be subjected to rugged use during service. These sensors can be bolted or clamped in place on a flat surface. Mounting plates can be formed to mate with specific radii on request.

SPECIFICATIONS

Operating temperature range: Standard -200-260°C (-320-500°F)
High 0-540°C (32-1,000°F)

Sensing element: The standard sensing element is platinum with a resistance of 100 ohms at 0°C and temperature coefficient 0.00385 $\Omega/\Omega/^\circ\text{C}$ nominal (DIN 43760). Also optionally available on special request are reference grade platinum, nickel and nickel-iron alloy.

Accuracy: ± 0.1 ohms ($\pm 0.25^\circ\text{C}$) or 0.4% of temperature, whichever is greater.

Stability: The sensor will have less than 0.05°C drift per year at rated service temperature with proper mounting.

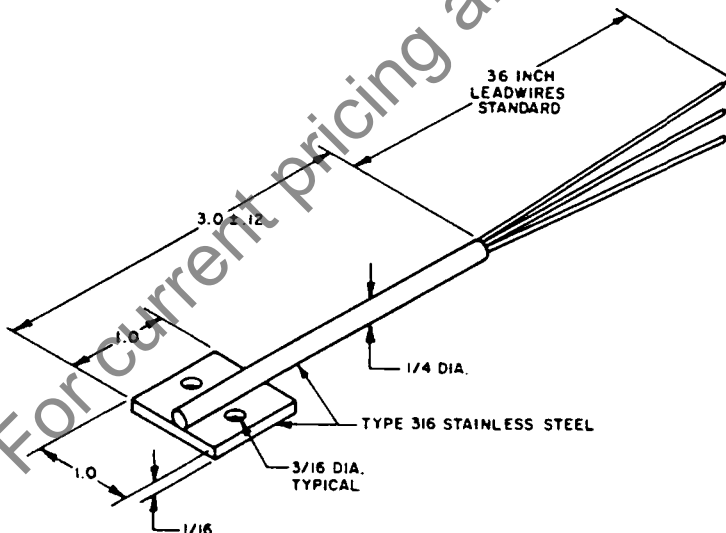
Time response: 8 seconds for the sensor to reach 63.2% of a step change in temperature in water flowing at 3 feet per second transverse to the sensor. (ASTM-E-644)

Self heating: The bare sensor will rise less than 1°C while dissipating an I²R power of 35 milliwatts in still air. (ASTM-E-644)

Insulation Resistance: The insulation resistance between outer sensor housing and commoned leadwires is 50 megohms with 50 Vdc applied to a dry sensor at room temperature. (ASTM-E-644)

Lead wire: #22 AWG stranded nickel plated copper TFE Teflon* insulated, 3-wire configuration, Stk. No. 315508.
#22 AWG stranded nickel plated copper fiberglass insulated, 3-wire configuration, Stk. No. 315509.

Mounting: Sensor can be bolted, clamped or welded into place.



Stock No.	Operating Range	Price
ORDERING INFORMATION:		
315508	-200-260°C	\$86.00
315509	0-540°C	\$86.00

CAPP/USA STRAP-ON RTD SENSORS

CAPP sensors are designed for applications where it is impractical to penetrate a vessel with an immersion sensor—yet a rugged industrial configuration is required. These styles are ideal for use in energy management systems, process plants, refineries, utilities and many other field applications.

Performance Specifications**Operating Temperature Range**

-73°C to 260°C (-100°F to 500°F) continuous. -157°C to 316°C (-250°F to 600°F) for short periods.

Sensing Element

The standard sensing element is platinum with a resistance of 100 ohms at 0°C and temperature coefficient 0.00385 $\Omega/\Omega/^\circ\text{C}$ nominal (DIN 43760). Also optionally available on special request are reference grade platinum, nickel and nickel-iron alloy, consult CAPP.

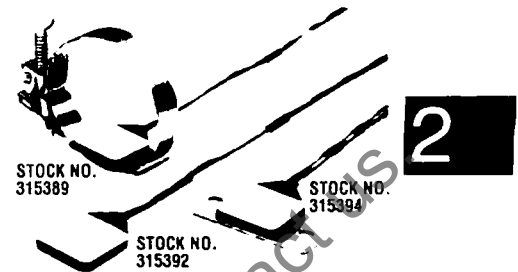
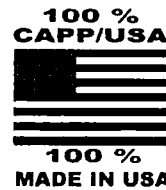
Accuracy (Two Available): (See Stock No.s Below):

(-1) ± 0.50 ohms $\pm 0.50\%$ of temperature, whichever is greater.

(-2) ± 0.22 ohms $\pm 0.25\%$ of temperature, whichever is greater.

Stability

The sensor will have less than 0.2°C drift per year at rated service temperature with proper mounting.

**Self Heating**

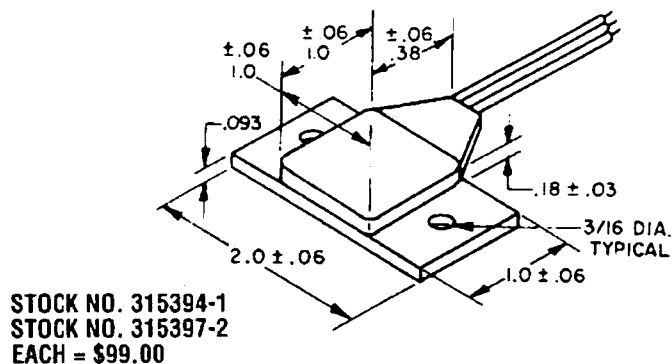
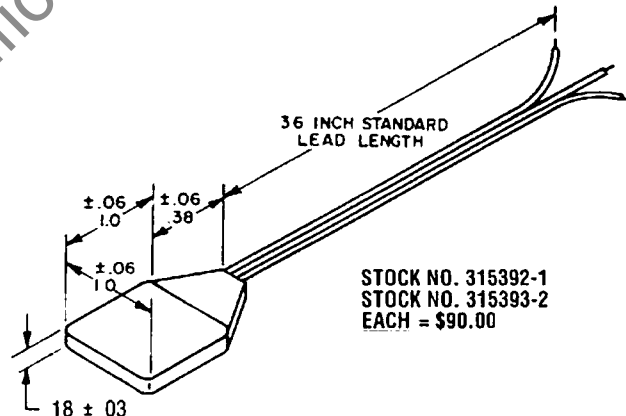
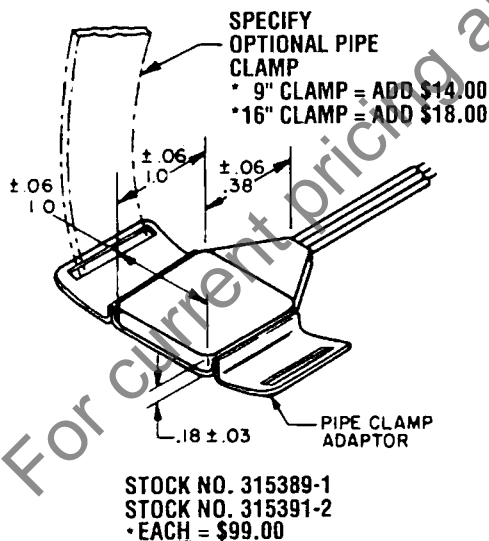
The bare sensor will rise less than 1°C while dissipating an I²R power of 35 milliwatts in still air, 104 milliwatts in 21°C water flowing at 3 feet per second.

Insulation Resistance

The insulation resistance between outer sensor insulation clamped between two metal plates and the commoned leadwire is 50 megohms minimum with 50 Volts DC applied to a dry sensor at room temperature. (ASTM-E-644)

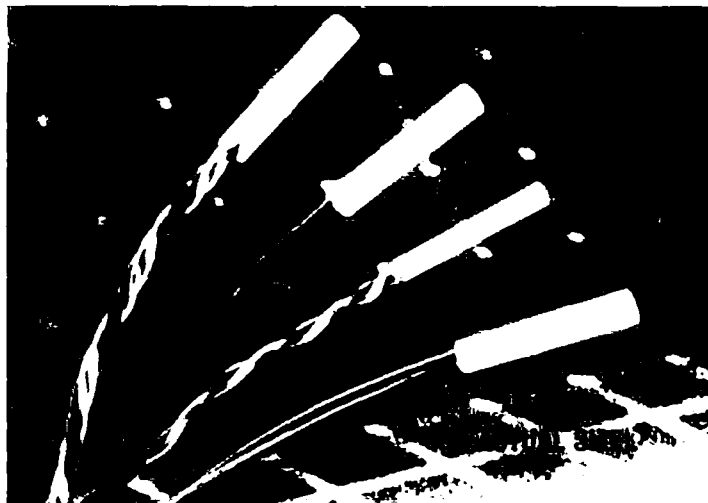
Lead Wire

#22 AWG stranded nickel plated copper silicone insulated, 3 wire configuration.





CAPP/USA PLATINUM RTD CAPSULES



Ready to use platinum RTD Capsules have insulated lead wires welded and anchored internally. No splicing to fragile elements is required. This construction assures reliable rugged embedment, insertion or probe assembly. Fit in precision diameters from 0.0937-0.187". Standard sensors and encapsulation materials rated to 540°C (1,000°F). Choose size and lead wire temperature rating required. Choose the moisture resistant versions for condensation, shallow immersion, and pressure seal or steam sterilization.

SPECIFICATIONS

Temperature range: TFE Teflon® leads: -200-260°C (-320-500°F)
Fiberglass leads: -75-510°C (-100-950°F)

Sensing element: International grade thin film platinum $\alpha=0.00385 \Omega/\Omega/^\circ\text{C}$

Time constant: 0.093 dia. = 0.6 sec.

0.187 dia. = 1.5 sec.

Interchangeability: $\pm 0.3^\circ\text{C}$ or 0.6% of temperature, IEC 751 Class B

Long term stability: Better than 0.05°C (0.02% of resistance) per 5 years, -50-300°C, 0.25°C per year to 540°C

Insulation resistance: >50 MegOhms at 50 Vdc at 25°C

Maximum current: 100 Ω =5 mA, 1,000 Ω =2 mA for limited self heating. Also suitable as self heated sensors

Pressure seal: Moisture resistant 0.187 and 0.125 dia. rated 300 psi, consult CAPP

Case materials: Alumina on 0.187 and 0.125 dia.

Kapton® leads: -200-350°C (-320-660°F)

Moisture resistant: -50-200°C (-60-390°F)

Ice point resistance: 100 $\pm 0.12\Omega$ or 1,000 $\pm 1.2\Omega$; International Class B ($\pm 0.12\%$)

Self heating: >15 mW/ $^\circ\text{C}$

Recommended current: 1 mA maximum for temperature sensing

Lead materials: Nickel coated copper insulated

Polyimide (350°C) on 0.093 dia.

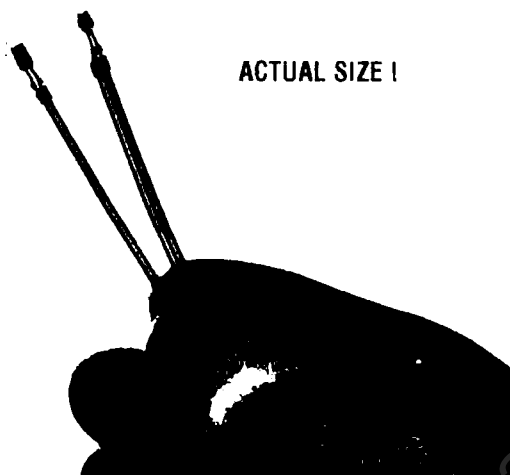
Stock No.	Description	Price
ORDERING INFORMATION:		
315472	<0.187" dia. x 0.6" L Alumina with Teflon® leads, 260°C (500°F)	\$34.80
315473	<0.187" dia. x 0.6" L Alumina with fiberglass leads, 510°C (950°F)	\$38.50
315474	Moisture resistant <0.187" dia. x 0.6" L Alumina with Teflon® leads, 200°C (390°F), 300 psi seal	\$34.80
315475	<0.125" dia. x 0.6" L Alumina with Teflon® leads, 260°C (500°F)	\$34.80
315477	<0.125" dia. x 0.6" L Alumina with fiberglass leads, 510°C (950°F), 3 wire max.	\$38.50

Stock No.	Description	Price
ORDERING INFORMATION: (cont.)		
315478	Moisture resistant <0.125" dia. x 0.6" L Alumina with Teflon® leads, 200°C (390°F), 300 psi seal	\$34.80
315479	<0.093" dia. x 0.5" L Polyimide with Teflon® leads, 260°C (500°F), 3 wire max.	\$34.80
315481	<0.093" dia. x 0.5" L Polyimide with Kapton® leads, 350°C (660°F), 3 wire max.	\$34.80
315482	Moisture resistant <0.093" dia. x 0.6" L Polyimide with Teflon® leads, 200°C (390°F), 3 wire max.	\$34.80

		Resistance Specification		
		T01	100 $\Omega \pm 0.12\Omega$ ($\alpha=0.00385 \Omega/\Omega/^\circ\text{C}$)	
		T10	1000 $\Omega \pm 0.12\Omega$ ($\alpha=0.00385 \Omega/\Omega/^\circ\text{C}$)	No (\$) Adder.
		Number of Leads		
		A	2 wire	No (\$) Adder
		B	3 wire	No (\$) Adder
		C	4 wire	\$3.50
		Lead length in inches (12" standard)		
315472	T01	A	12"	(315472-T01-A-12") = EXAMPLE STOCK NO. = \$34.80



CAPP/USA PLATINUM SURFACE RTD

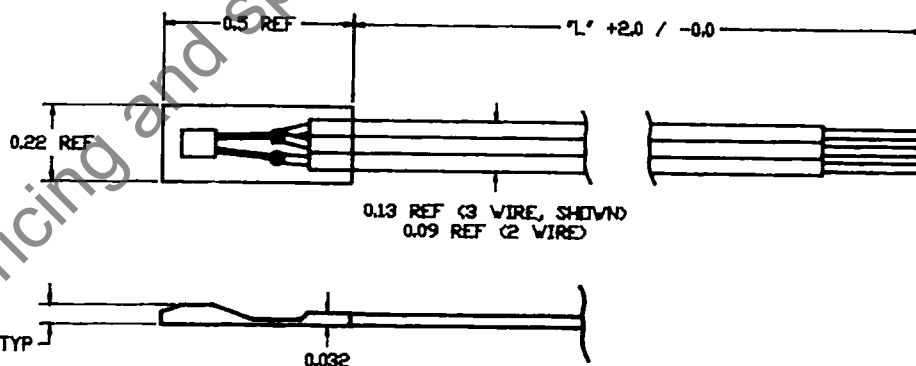


ACTUAL SIZE I

Low cost, sealed platinum RTD is the world's toughest. The IEC 751 sensor is refractory sealed for $\pm 0.05^\circ\text{C}$ stability. Its small strong design allows this package to conform on curved surfaces for accurate response in milliseconds. Toughness is provided by leads welded within the sealed RTD. Moisture resistance for condensing environments, shallow immersion or sterilization is provided by Kapton[®]/Teflon[®] lamination that completely encapsulates the assembly and lead entrance. Standard operating range is -200°C to 260°C . Clamped sensors can withstand 340°C .

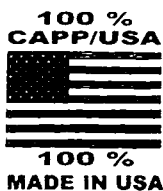
Features:

- Strong welded leads, 30 AWG nickel coated
- Full platinum RTD stability
- Tough and durable
- Strain isolated
- Self heating: $>15 \text{ mW}/^\circ\text{C}$ mounted
- Int'l grade thin film platinum
- Temperature range is -200°C to 260°C (-320 – 500°F)
- Time constant is 0.3 seconds on metal surfaces
- Long term stability better than 0.05°C (0.02%) per 5 years
- Interchangeability: $\pm 0.3^\circ\text{C}$ 0.6% of temperature IEC 751 class

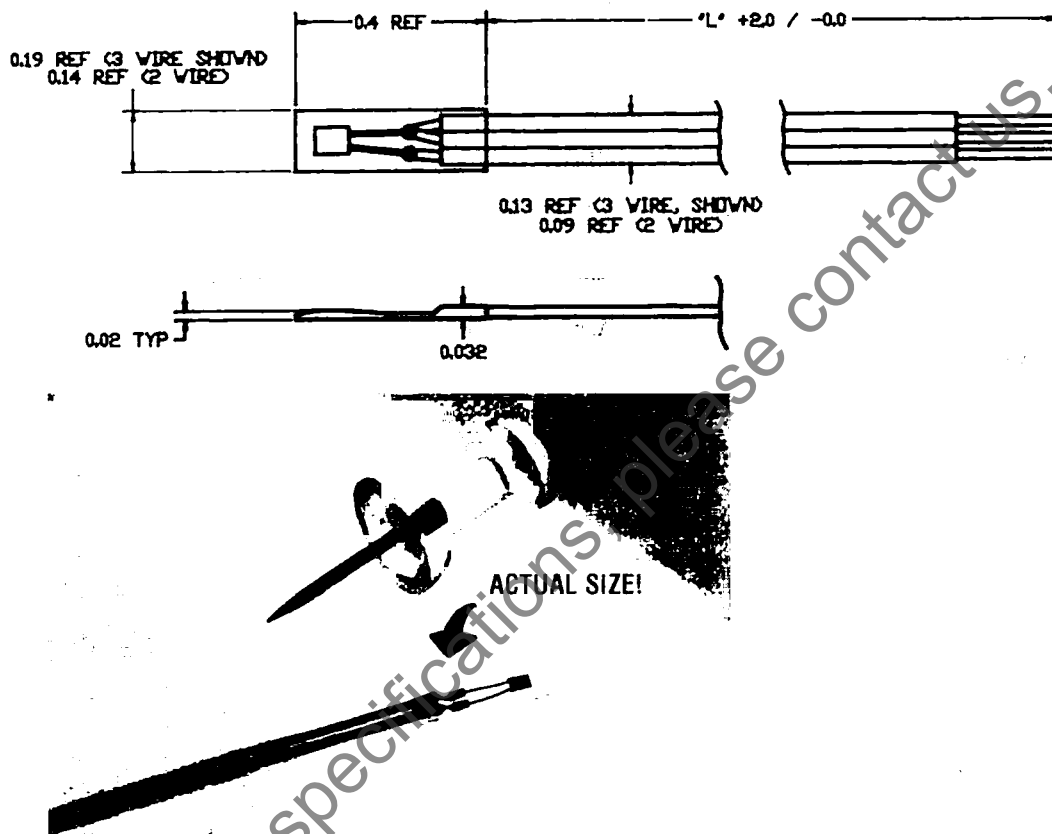


Stock No.	Description	Price
ORDERING INFORMATION:		
314885	100 Ω $\pm 0.12\%$, 0.07" \times 0.1" sensor, 2 lead wires.	\$36.40
314886	100 Ω $\pm 0.12\%$, 0.07" \times 0.1" sensor, 3 lead wires.	\$36.40
314889	1,000 Ω $\pm 1.2\%$, 0.08" \times 0.2" sensor, 2 lead wires.	\$36.40
314890	1,000 Ω $\pm 1.2\%$, 0.08" \times 0.2" sensor, 3 lead wires.	\$36.40

Lead length is 12" unless otherwise specified; add an additional .25¢ per each inch of leads over 12".



CAPP/USA MINI-FLEX PLATINUM RTD (ISO 9001 CERTIFIED)



Low cost, flexible, sealed platinum RTD is the world's smallest and toughest. The 100Ω DIN-IEC sensor is refractory sealed for $\pm 0.05^\circ\text{C}$ stability. Its extremely small and thin design allows this flexible package to easily conform on complex surfaces for accurate response in milliseconds. Flexibility and toughness are provided by platinum ribbons welded within the sealed RTD. Moisture resistance for condensation, shallow immersions and sterilization environments is provided by Kapton®/Teflon® lamination that completely encapsulates the assembly and lead entrance. Standard operating range is -200 – 260°C . Clamped sensors can withstand 340°C . Full platinum RTD stability; flexible, tough and durable; best for small radius surfaces and tubes; fully sealed; recommended for condensing environments; and strain isolated.

SPECIFICATIONS

Leads: 30 AWG nickel coated

Temperature range: -200 – 260°C (-300 – 500°F)Self heating: >15 mW/ $^\circ\text{C}$ mountedInterchangeability: $\pm 0.5^\circ\text{C}$ or 0.8% of temp. at $\pm 0.2\%$ $\pm 0.3^\circ\text{C}$ or 0.6% of temp. at $\pm 0.12\%$ IEC 751 Class B.

Sensing element: 100Ω thin film platinum

Time constant: <0.2 sec. on metal surfacesLong term stability: Better than 0.05°C (0.02%) per 5 years

Stock No.	Description	Price
ORDERING INFORMATION:		
314874	2-wire 100Ω thin film platinum, resistance is: $100\Omega \pm 0.2\Omega = 0.00385 \Omega/\Omega^\circ\text{C}$.	\$35.60
314876	2-wire 100Ω thin film platinum, resistance is: $100\Omega \pm 0.12\Omega = 0.00385 \Omega/\Omega^\circ\text{C}$.	\$35.60
314877	3-wire 100Ω thin film platinum, resistance is: $100\Omega \pm 0.2\Omega = 0.00385 \Omega/\Omega^\circ\text{C}$.	\$54.05
314878	3-wire 100Ω thin film platinum, resistance is: $100\Omega \pm 0.12\Omega = 0.00385 \Omega/\Omega^\circ\text{C}$.	\$54.05

Note: Lead length is 12" unless otherwise specified, add an additional .25¢ per each additional inch over 12" leads.



RTD SIMULATOR

Direct RTD output—11 precise resistance steps simulate the temperatures of a 100 ohm RTD sensor to calibrate data loggers, transmitters, controllers and computers. Accuracy is $\pm 0.05\%$ for platinum sensors.

RTD curve—Built-in calibration tables permit the selection of 11 different temperatures (DIN standard 43760).

Special ranges for other materials and curves are available from the factory.

Hand held—($2\frac{1}{8} \times 4 \times 2\frac{1}{4}$ inches). Replace decade box and tables with a 3 and 4 wire calibration. Weight: 1 lb.

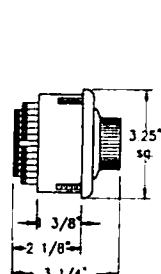


ORDERING INFORMATION:

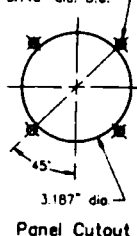
Stock No.	PCN	Series	Price
284106	309251	11PT	\$269.00



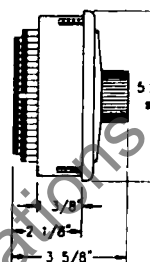
THERMOCOUPLE & RTD SWITCHES



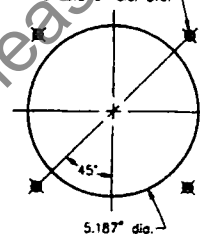
#18 Drill (.1695" dia.)
4 places eq. spaced
on 3.710" dia. B.C.



Panel Cutout



#18 Drill (.1695" dia.)
4 places eq. spaced
on 5.540" dia. B.C.



Panel Cutout

Features:

These two pole (for use with TC's) and three pole (for use with RTD's) selector switches provide low resistance switching for temperature measuring circuits. Both switches are make before break. The TC switch is 3.25" square and the RTD switch is 5.25" square.

Stock No.	Description	Price
312984	12 channels TC	\$185.00
312985	12 channels RTD	\$185.00

ORDERING INFORMATION:

For current pricing and specifications, please contact us

THERMOCOUPLE WIRE

COMPLETE ORDERING GUIDE TO THERMOCOUPLE WIRE

INSULATED EXTENSION WIRE (PRICED-PER-FOOT)



Stock No.	Model	Type	Insulation	Gauge	Pos. Color	Neg. Color	Overall Color	Max. Temp.	Price
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4000	3WZP4	J	Polyvinyl Over	16	White	Red	Black	235°F	\$52
27871	3WZP14	J	Polyvinyl Over	16	White	Red	Black	235°F	\$75
27869	3WZP6	J	Polyvinyl Over	20	White	Red	Black	235°F	\$36
3995	3WZD4	J	Rubber Over	16	White	Red	Black	235°F	\$1.85
279340	3WZT4	J	Teflon	16	White	Red	Black	415°F	\$90
279341	3WZT6	J	Teflon	20	White	Red	Black	415°F	\$63
3999	3WZP36	J	Flexible Polyvinyl	20	White	Red	Black	235°F	\$50
278577	3WZJ36	J	Flexible Fiberglass	20	White	Red	Black	235°F	\$49
278580	5WZP14	K	Polyvinyl Over	16	Yellow	Red	Yellow	235°F	\$74
279342	5WZP14P	K	Polyvinyl Over	16	Yellow	Red	Yellow	235°F	\$74
278581	5WZP16	K	Polyvinyl Over	20	Yellow	Red	Yellow	235°F	\$49
279343	5WZT4	K	Teflon	16	Yellow	Red	Yellow	415°F	\$1023
279344	5WZT6	K	Teflon	20	Yellow	Red	Yellow	415°F	\$77
278586	5WZJ36	K	Flexible Fiberglass	20	Yellow	Red	Yellow	235°F	\$77
278578	8WZP4	E	Polyvinyl Over	16	Purple	Red	Purple	235°F	\$77
279345	8WZP6	E	Polyvinyl Over	20	Purple	Red	Purple	235°F	\$52
279346	8WZT6	E	Teflon	16	Purple	Red	Purple	415°F	\$106
278587	6WZP4	S	Polyvinyl Over	16	Black	Red	Green	235°F	\$59
279349	6WZP6	S	Polyvinyl Over	20	Black	Red	Green	235°F	\$31
278590	6WZD4	S	Rubber Over	16	Black	Red	Black	235°F	\$1.96
279352	6WZT4	S	Teflon	16	Black	Red	Green	415°F	\$98
279353	6WZT6	S	Teflon	20	Black	Red	Green	415°F	\$58
279354	1WZP4	T	Polyvinyl Over	16	Blue	Red	Blue	235°F	\$69
278564	1WZP4P	T	Polyvinyl Over	16	Blue	Red	Blue	235°F	\$62
2398	1WZP6	T	Polyvinyl Over	20	Blue	Red	Blue	235°F	\$50
278565	1WZP36	T	Flexible Polyvinyl	20	Blue	Red	Blue	235°F	\$52
279357	1WZT4	T	Teflon	16	Blue	Red	Blue	415°F	\$89
279358	1WZT6	T	Teflon	20	Blue	Red	Blue	415°F	\$72

1. Premium-Grade Wire.
2. Asstent Indicates Stranded Conductors.
Note: Type J Wire is for Iron-Constantan Thermocouples.
Type K Wire is for Chromel-Alumel Thermocouples.
Type E Wire is for Chromel-Constantan Thermocouples.
Type S Wire is for Type R & S, Platinum-Rhodium Thermocouples.
Type T Wire is for Type T, Copper-Constantan Thermocouples.

OPTIONAL INSULATIONS AVAILABLE: (CONSULT CAPP)

Teflon With Drain and Shield.
TFF Tape and Synthetic Braid.

INSULATED THERMOCOUPLE WIRE: (DOUBLE CONDUCTOR)—PRICED PER FOOT:

Stock No.	Model	Type	Insulation	Gauge	Pos. Color	Neg. Color	Overall Color	Max. Temp.	Price
278486	9B3C2	J	Varnished Fiberglass	20	White	Red	Brown	925°F	\$1.10
278487	9B3C4	J	Varnished Fiberglass	24	White	Red	Brown	800°F	\$3.70

CAPP/USA

1-800-356-8000 PHONE

1-800-356-3262 FAX 131

cont.

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THERMOCOUPLE WIRE



COMPLETE ORDERING GUIDE TO THERMOCOUPLE WIRE (cont.)

INSULATED THERMOCOUPLE WIRE: (DOUBLE CONDUCTOR)—PRICED PER FOOT:

Stock No.	To Fit Honeywell Model	Type	Insulation	Gauge	Pos. Color	Neg. Color	Overall Color	Max. Temp.	Price
278488	9B3C5	J	Varnished Fiberglass	30	White	Red	Brown	800°F	\$4.5
278489	9B3C6	J	High-Temp. Fiberglass	20	—	—	—	950°F	\$3.98
279371	9B3N4P	J	Nylon ¹	24	White	Red	Clear	350°F	\$3.38
278479	9B3N4	J	Nylon	24	White	Red	Clear	350°F	\$3.34
279374	9B3C1	J	Thick Glass Braid	14	White	Red	Brown	925°F	\$1.59
278504	9B2C6	K	High-Temp. Fiberglass	20	Yellow	Red	Brown	1300°F	\$3.98
7161	9B2C2	K	Varnished Fiberglass	20	Yellow	Red	Brown	925°F	\$3.88
278507	9B2N2	K	Refrasil	20	—	—	—	1700°F	\$2.09
279376	9B2A2	K	Ceramic Fiber Braid	20	—	—	—	2250°F	\$2.09
278471	9B1C2	T	Varnished Fiberglass	20	Blue	Red	Brown	500°F	\$7.76
278478	9B1C4	T	Varnished Fiberglass	24	Blue	Red	Brown	450°F	\$5.58
278473	9B1C5	T	Varnished Fiberglass	30	Blue	Red	Brown	450°F	\$3.36
278464	9B1N4	T	Nylon	24	Blue	Red	Clear	350°F	\$3.36
279378	9B1N4P	T	Nylon ¹	24	Blue	Red	Clear	350°F	\$3.36
279387	9B4C7	E	High-Temp. Fiberglass	20	Purple	Red	Brown	1000°F	\$7.79

1. Premium Grade Wire

BARE THERMOCOUPLE WIRE: (INDIVIDUAL WIRES)—PRICED PER POUND:

Stock No.	To Fit Honeywell Model	Type	Gauge	Polarity Of Wire	Price	Stock No.	To Fit Honeywell Model	Type	Gauge	Polarity Of Wire	Price
278525	9A1L1	K	8	Positive	\$51.00	278527	9A1L3	E	20	Positive	\$70.00
278526	6A1L2	K	14	Positive	\$51.00	278528	9A1L5	E	24	Positive	\$81.90
278527	9A1L3	K	20	Positive	\$70.00	278529	9A1E1	E	8	Negative	\$52.50
278533	9A1K1	K	8	Negative	\$39.00	278530	9A1E2	E	14	Negative	\$52.00
278534	9A1K2	K	14	Negative	\$44.00	278531	9A1E3	E	20	Negative	\$69.00
278535	9A1K3	K	20	Negative	\$52.50	278532	9A1E5	E	24	Negative	\$78.00
278525	9A1L1	E	8	Positive	\$51.00	278510	9A1M3	T	20	Positive	\$20.00
278526	9A1L2	E	14	Positive	\$51.00	278514	9A1N3	T	20	Negative	\$69.00

BARE THERMOCOUPLE WIRE: (MATCHED WIRES)—PRICED PER POUND:

Stock No.	To Fit Honeywell Model	Type	Gauge	Grade Of Wire	Price	Stock No.	To Fit Honeywell Model	Type	Gauge	Grade Of Wire	Price
278538	9A1C1	J	8	Standard	\$33.00	278555	9A1A2	K	14	Standard	\$46.00
278539	9A1C2	J	14	Standard	\$36.50	278556	9A1A3	K	20	Standard	\$46.00
278540	9A1C3	J	20	Standard	\$43.00	278548	9A1D1	E	8	Standard	\$61.00
278541	9A1C5	J	24	Standard	\$49.00	278551	9A1D2	E	14	Standard	\$52.00
278544	9A1G1	J	8	Premium	\$39.00	278552	9A1D3	E	20	Standard	\$81.40
278546	9A1G2	J	14	Premium	\$46.50	278553	9A1D5	E	24	Standard	\$71.00
278547	9A1G3	J	20	Premium	\$54.10	278536	9A1B3	T	20	Standard	\$46.00
278554	9A1A1	K	8	Standard	\$46.00	278537	9A1B13	T	20	Premium	\$56.00

BARE THERMOCOUPLE WIRE - HIGH TEMPERATURE: (MATCHED WIRES)

Stock No.	To Fit Honeywell Model	Type	Gauge	Price
278561	309A5B2	Platinum Rhodium (30%) / Platinum Rhodium (6%) ¹	24 (Type B)	\$SPECIAL QUOTE
278560	309A6T2	Tungsten / Tungsten Rhenium (26%) ²	24	\$SPECIAL QUOTE
278558	309A6T5	Tungsten Rhenium (5%) / Tungsten Rhenium (26%) ²	24	\$SPECIAL QUOTE

1. Rated Max. Temperature: 3000°F

2. Rated Max. Temperature: 4000°F

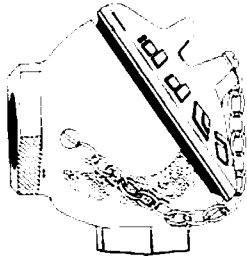
THERMOCOUPLE WIRE

BASIC CHARACTERISTICS OF THERMOCOUPLE WIRE AND EXTENSION WIRE INSULATION

Wire Material	Maximum Temperature		Flexibility	Abrasion Resistance	Solvent Resistance	Acid Resistance	Base Resistance	Flame Resistance	Moisture Resistance
	°F	°C							
(PVC) Polyvinyl Over Polyvinyl	221	105	Excellent	Good	Fair	Good	Good	Good	Good
Nylon	350	177	Good	Excellent	Good	Poor	Good	Poor	Good
Teflon-FEP (Extruded)	400	204	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Teflon-TFE (Wrap)	500	260	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Rubber	500	260	Excellent	Fair	Fair	Poor	Good	Poor	Good
Fiberglass	900	482	Good	Poor	Excellent	Excellent	Excellent	Excellent	Poor
Synthetic Fiber	400	204	Good	Good	Excellent	Excellent	Excellent	Excellent	Fair
Refrasil	1800	982	Good	Poor	Excellent	Excellent	Excellent	Excellent	Poor
Ceramic Fiber	2000	1093	Poor	Poor	Excellent	Excellent	Excellent	Excellent	Poor
Buna-s Rubber	150	60	Good	Good	Good	Poor	Good	Poor	Good
Enamel	225	107	Fair	Poor	Fair	Poor	Good	Poor	Fair
Teflon	392	200	Good	Good	Good	Fair	Good	Good	Good
High-Temp. Fiberglass	1300	704	Good	Good	Good	Good	Good	Good	Good
Thick Glass Braid	900	482	Fair	Good	Good	Good	Good	Good	Good

3

COMPONENTS & ACCESSORIES



THERMOCOUPLE HEADS SCREW-COVER HEAD SELECTION

Standard Stock No.	Each	Explosion-Proof Stock No. ¹	Each	Conduit Outlet Thread	Protection Tube Conn. Thread	To Fit Honeywell Model	Price
163053	\$37.00	—	—	1/2"	1/2"	30356496-1	\$37.00
3557	\$37.00	—	—	1/2"	3/4"	30356496-2	\$37.00
257200	\$37.00	—	—	1/2"	1"	30356496-3	\$37.00
177324	\$37.00	279012 ²	\$91.00	3/4"	1/2"	30356496-4	\$37.00
217343	\$37.00	279013 ²	\$91.00	3/4"	3/4"	30356496-5	\$37.00
139525	\$37.00	—	—	3/4"	1"	30356496-6	\$37.00

1. Explosion-Proof heads are U.L. Listed & CSA approved.
2. Terminal block for expl. proof head is STOCK NO. 279019.

GENERAL-PURPOSE HEAD SELECTION

Standard Stock No.	Each	Polypropylene Stock No. ¹	Each	Conduit Outlet Thread	Protection Tube Conn. Thread	To Fit Honeywell Model	Price
221128	\$24.75	279015 ²	\$62.40	1/2"	1/2"	30366504-1	\$25.00
221127	\$24.75	—	—	1/2"	3/4"	30366504-2	\$25.00
275948	\$24.75	—	—	1/2"	1"	30366504-3	\$25.00
—	—	279016 ²	\$62.40	3/4"	1/2"	30757555-2	\$63.00

1. Polypropylene heads are rated at max. temp. of 235 F. and are excellent in corrosive medias.
2. Terminal blocks for polypropylene heads are STOCK NO. 279017 for single-type and STOCK NO. 279018 for duplex-type.
279017:\$10.40 / 279018:\$17.52.

MINI-ALUMINUM HEAD

Stock No.	Each	Description	To Fit Honeywell Model	Price
5584	\$19.90	1/2" NPT Female Connection Outlet.	30682116-1	\$20.00

THERMOCOUPLE TERMINAL BLOCKS

MINI-TERMINAL BLOCK

Used with mini-aluminum head.

Stock No.	Each	Description	To Fit Honeywell Model	Price
29443	\$9.00	Single	30682117-1	\$9.05
129535	\$13.00	Duplex	30682117-2	\$13.00

SINGLE-ELEMENT TERMINAL BLOCK

Standard terminal block mainly used in the gen. purpose or screwcover heads.

Stock No.	Each	Description	To Fit Honeywell Model	Price
6100	\$11.30	Single Element	30074456-7	\$11.52
3562	\$27.65	Duplex Element	30356503-2	\$28.10

RIGID-TYPE TERMINAL BLOCK

Primarily used in screw-cover and general purpose heads for CAPP-O-PAK assemblies.

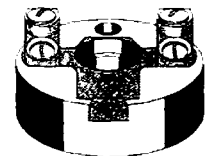
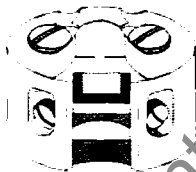
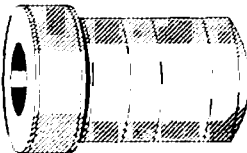
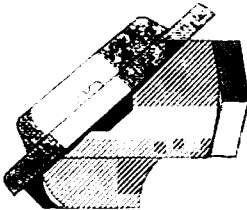
Stock No.	Each	Description	To Fit Honeywell Model	Price
115677	\$26.80	Rigid-Type Terminal Block.	30359804-3	\$27.20

MOUNTING PLATE & BUSHING¹

To adapt terminal blocks to thermocouple assemblies.

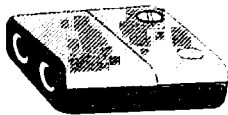
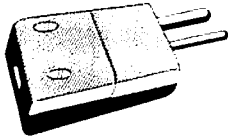
Stock No.	Each	Description	To Fit T/C O.D.	To Fit Honeywell Model	Price
277412	\$19.00	Mounting Bushing & Plate	1/16"	30681513-1	\$19.00
91440	\$19.00	Mounting Bushing & Plate	1/8"	30681513-2	\$19.00
213304	\$18.00	Mounting Bushing & Plated	3/16"	30681513-3	\$19.00
213310	\$19.00	Mounting Bushing & Plate	1/4"	30681513-4	\$19.00

1. Plate or bushing must be soldered to T/C sheath-consult CAPP.



COMPONENTS & ACCESSORIES

QUICK-CONNECT PLUGS & JACKS

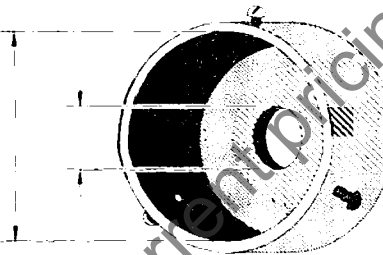
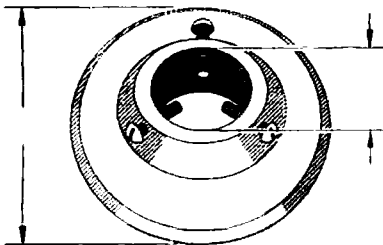


Stock No.	Type	Color	To Fit Honeywell Model	Price
PLUG SELECTION				
5868	J	Black	30728096-1	\$6.50
5871	K	Yellow	30728096-5	\$6.50
5870	T	Blue	30728096-4	\$6.50
5869	R,S	Green	30728096-3	\$6.50
277359	E	Purple	30728096-8	\$6.50
5873	Uncompensated	White	30728096-6	\$6.50
272411	N	Orange	30728096-7	\$6.50
JACK SELECTION				
217691	J	Black	3072809-1	\$8.00
5877	K	Yellow	3072809-5	\$8.00
5876	T	Blue	3072809-4	\$8.00
5875	R,S	Green	3072809-3	\$8.00
277360	E	Purple	3072809-8	\$8.00
5878	Uncompensated	White	3072809-6	\$8.00
279026	N	Orange	3072809-7	\$8.00

MOUNTING ACCESSORIES FOR PLUGS & JACKS

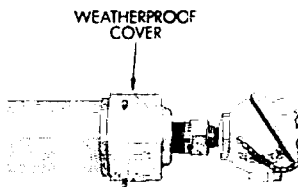
Stock No.	Description	To Fit Honeywell Model	Price
279020	Cable Clamps	30721652	\$3.04
279022	Tube Adaptors To Fit .065" Sizes	3072165-1	\$15.00
279023	Tube Adaptors To Fit .125" Sizes	3072165-2	\$15.00
279024	Tube Adaptors To Fit .191" Sizes	3072165-3	\$15.00
279025	Tube Adaptors To Fit .250" Sizes	3072165-4	\$15.00

COLLAR-TYPE ADJUSTABLE FLANGES



Stock No.	Diameter Of "I"	Diameter Of "O"	Fits Tube Size	To Fit Honeywell Model	Price
FLANGES WITH 3 MOUNTING HOLES					
3417	.9"	3.25"	1/2"	30352055	\$29.15
277351	1.38"	3.5"	1"	30352045	\$32.00
FLANGES WITHOUT MOUNTING HOLES					
277353	.9"	3.25"	1/2"	30000388	\$20.09
41207	1.38"	3.5"	1"	30000236	\$20.09
2640	2.2"	4.5"	2"	30000244	\$20.09

Note: Also Available as curved-type saddle, specify STOCK NO.: 277357.
Diameters are 3.25 x 5.75. and to fit a 3" tube.



WEATHERPROOF COVERS

Stock No.	Thread N.P.T. Of "I"	Diameter Of "O"	Fits Tube Size	To Fit Honeywell Model	Price
277356	3/4"	3.2"	3"	30003967-2	\$49.40

cont.

COMPONENTS & ACCESSORIES

WEATHERPROOF COVERS (cont.)

Stock No.	Thread N.P.T. Of "I"	Diameter Of "O"	Fits Tube Size	To Fit Honeywell Model	Price
272777	1 1/4"	3.2"	3"	30003967	\$55.00
270980	3/4"	2.13"	2"	30003974	\$42.05
91430	3/4"	1.88"	1 3/4"	30004142	\$42.05

COMPRESSION FITTINGS READJUSTABLE TYPE

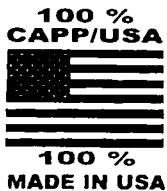
Stock No.	Mounting Thread (NPT)	To Fit These Sheath Sizes	To Fit Honeywell Model	Price
279027	1/8"	1/16" O.D.	3066672-1	\$31.00
211143	1/8"	1/8" O.D.	3066672-2	\$31.00
279029	1/8"	3/16" O.D.	3066672-3	\$31.00
279030	1/4"	1/4" O.D.	3066672-4	\$71.00
279031	1/2"	3/8" O.D.	3066672-5	\$113.15

Note: Material of above fittings is 303 S.S.

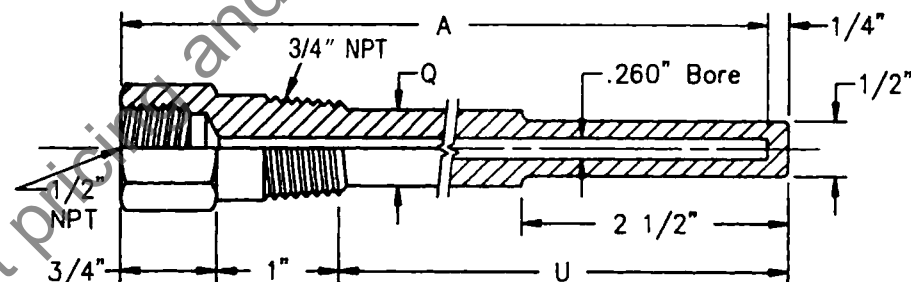
FIXED TYPE-NOT ADJUSTABLE

Stock No.	Mounting Thread (NPT)	To Fit These Sheath Sizes	Material Of Fitting	To Fit Honeywell Model	Price
272662	1/8"	1/16" O.D.	316 S.S.	30363275-2	\$74.00
279033	1/8"	1/8" O.D.	316 S.S.	30363275-3	\$41.00
178227	1/8"	3/16" O.D.	316 S.S.	30363275-4	\$41.00
279035	1/4"	1/4" O.D.	316 S.S.	30363275-5	\$32.00
279036	1/2"	3/4" O.D.	316 S.S.	30363275-6	\$73.05
279037	1/8"	1/16"	Brass	30363275-1	\$31.00
279038	1/8"	1/8"	Brass	30076520-1	\$10.00
279039	1/8"	3/16"	Brass	30076520-2	\$10.00
279040	1/4"	1/4"	Brass	30076520-3	\$10.00
279041	1/2"	3/4"	Brass	30076520-4	\$22.90

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THERMOWELLS



Features: Three sizes of thermowells are stocked in both 304 and 316 stainless steel.
Specifications: Both 1/4" Spring Loaded TC and RTD's.

Order No.	Dimensions			Material	Price
	Stem Lgth. A	Insert Lgth. U	Dia. Q		
312913	4"	2 1/2"	1/2"	304 SST	\$34.00
312914	6"	4 1/2"	3/4"	304 SST	\$39.00
312915	12"	10 1/2"	3/4"	304 SST	\$65.50
312916	4"	2 1/2"	1/2"	316 SST	\$45.00
312918	6"	4 1/2"	3/4"	316 SST	\$49.00
312919	12"	10 1/2"	3/4"	316 SST	\$95.00

THERMOCOUPLE RELATED SENSING

DIGITAL INFRARED TEMPERATURE TESTER



When you need to know how hot your machinery is running, rate of cooling or process temperatures, use the infrared technology of the Dickson IR550. It gives you accurate readings without contact. Non-contact readings are more sanitary and less hazardous. Dickson's IR550, with adjustable emissivity, provides outstanding accuracy with most materials.

Stock No.	Description	Temperature Range	Accuracy	Ambient Operating Temperature	Recommended Distance From Target	Average Response Time	Field Of View	Price
283983	Digital Infrared Temperature Indicator	-50 to +1000°F (-45 to +537°C)	±1% full scale ±1 digit	+32 to +122°F, (0 to +50°C)	7" to 10'	1 second	10° (5 to 1 ratio)	\$497.40

ACCESSORIES:

Stock No.	Description	Price
283984	9V Battery	\$5.00
283986	Wall Transformer/Battery Eliminator	\$27.00
283987	Output Cable 6'	\$24.07
283988	NIST Traceable Calibration 3-Pt.	\$132.25

DIGITAL TEMPERATURE THERMOMETER

For quick temperature checks throughout the workplace, you can't beat the convenience of our pocket-sized digital thermometer.

ORDERING INFORMATION:

Stock No.	Description	Temperature Range	Accuracy	Price
211153	Digital Temperature Indicator	-20 to +220°F, -28 to +105°C	±1°F from +20 to +140°F, ±1°C from -7 to +60°C or ±1% full scale outside these ranges	\$72.10

ACCESSORIES

Stock No.	Description	Price
284481	1.4V Batteries (6 pack)	\$32.30

D152 AND D153 SERIES

The D152 and D153 are the perfect replacement for old bi-metal thermometers. The compact styling, durability and great price make these digital thermometers an excellent value. Data hold freezes readings on display. On/Off button and auto power off. 5" stem, button battery AB13.

ORDERING INFORMATION:

Stock No.	Description	Temperature Range	Accuracy	Price
283978	Digital Thermometer, (-40 to +300°F)	-40 to +300°F, -40 to +150°C	±3.4°F, ±1.9°C	\$28.00

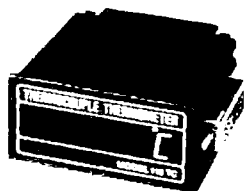
D154 AND D155 SERIES

The D154 and D155 have large easy-to-read LCD displays, are water resistant and rugged enough to withstand 10' drops! A protective cover also acts as an extension for tough to reach areas. On/Off button, auto power off. Data hold and continuous update. 3" stem, button battery AB13.

ORDERING INFORMATION:

Stock No.	Description	Temperature Range	Accuracy	Dimension	Price
283973	Digital Thermometer, (-40 to +300°F)	-40 to +300°F, -40 to +150°C	±2°F, ±1°C	5.75" in length (3" probe)	\$28.00

THERMOCOUPLE RELATED SENSING



CHROMALOX DIGITAL T/C THERMOMETER MODEL 115

RUGGED DIN/NEMA CASE
COLD JUNCTION COMPENSATED
UP TO $\pm 2^{\circ}\text{C}$ ACCURACY
LINEAR ANALOG OUTPUT FOR
CHART RECORDERS
MODEL 115

Features

The Model 115 Digital Thermometers are economical panel-mounted indicators with a standard analog output. Models are available with either J, K, T or E thermocouple input, with Fahrenheit or Celsius display. The 115 features large 0.56" LEDs with 3 1/2 digits. The 115 can operate on either 115 or 230 Vac, and requires only 4.13" panel depth.

Specifications

Cold Junction Compensation:

0.05°F/°F (0.05°C/°C) ambient of 32 to 104°F (0 to 40°C)

Input Impedance: Greater than one megohm

Common Mode Rejection Ratio: 120 dB

Resolution: 1°C or 1°F

Output: Analog, 1 mV/°C or 0.556 mV/°F (0°F = 0 mV). Analog device must have input impedance of 10 k Ω .

Dimensions: H: 1.9" (48 mm) x W: 3.8" (97 mm) x D: 4.13" (105 mm); 6.02" (153 mm) with metal case

Cutout: H: 1.772" (45 mm) x W: 3.622 (92mm)

Output Accuracy: $\pm 0.5\%$ span

Operating Voltage: 117 Vac or 230 Vac $\pm 15\%$, 50 or 60 Hz.

Power Consumption: 1.75 Watts

Operating Temperature: 32 to 104°F

Display: 0.56 inch high LED

ORDERING INFORMATION:

Stock No.	PCN	Series	Input	Range	Accuracy	Price
283515	314990	115TF	T Copper-Constantan	-100 to 750°F	$\pm 3.6^{\circ}\text{F}$	\$241.00

Note: To Order

Bench top models:

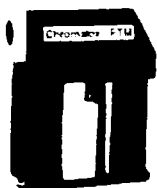
The DS-115 Digital Thermometer incorporates a 115 thermocouple thermometer in a bench top case. This single input unit features a pre-wired 115 Vac power cord, on/off switch and quick-disconnect thermocouple connector.

To order, simply add the prefix "DS" to the stock no. of your choice.

The DSS-115 is a similar unit with the ability to monitor 10 input signals. The desired channel is selected by a 10 position front panel rotary switch. All thermocouple inputs to a DSS-115 are via screw terminals.

To order, simply add the prefix "DSS" to the stock no. of your choice.

5



HAND-HELD PORTABLE NONCONTACT THERMOMETER, MDL PTM

The Chromalox PTM is a portable, battery operated, hand held, non-contact thermometer. Designed for use throughout your plant in any heat critical stage of your process. Carry it in a toolbox or in its handy holster. Use it to check temperatures of electrical components, bearings, insulation, steam traps, roofing materials, concrete, pumps, compressors, as well as product temperatures.

Temperature change often means trouble. The Chromalox PTM line of thermometers uses noncontact temperature measurement to spot problems early, so you can prevent costly downtime and avoid processing problems that lead to rejected product.

A Chromalox PTM weighs about half as much as other noncontact handheld thermometers, so it's easier to lift, easier to aim, and easier to get precise readings.

Operation is easy, too. You simply aim, pull the trigger and read the temperature. There's no need to focus and no need to calibrate.

And the PTM's rugged optical system and electronics are environmentally sealed, so it's built to deliver, day after day, even in the harshest conditions.

A sophisticated microprocessor insures accuracy and repeatability for targets less than 1" (2.5 cm).

For added accuracy most models include adjustments for emissivity and ambient temperature. And for added convenience, certain models provide Min, Max, Differential and Average values as well as audible Hi/Lo alarms.

Most models have analog and digital output for data loggers and recorders. A printer accessory is also available.

The PTM-5 has a built-in data logger that stores up to 64 readings from different sites around your facility, and can transfer the data to a Lotus 1-2-3 spreadsheet.

Compare. no other handheld thermometer delivers this much for the money. And when you consider the thousands of dollars you could save in repairs, rejected product and downtime, a Chromalox PTM could pay for itself the first time you use it.

ORDERING INFORMATION:

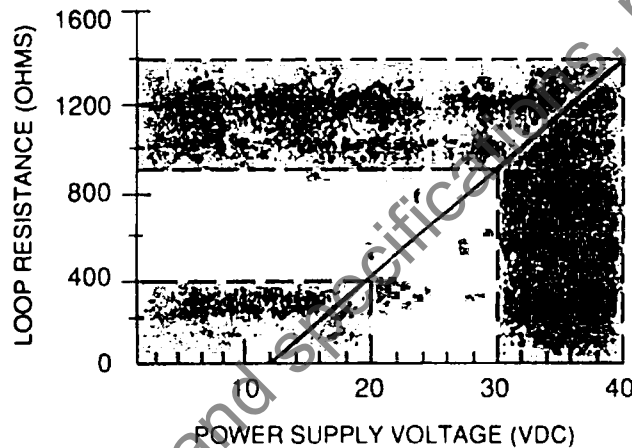
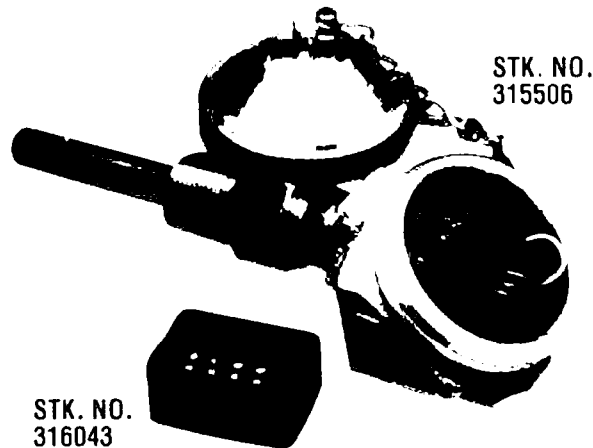
Stock No.	PCN	Description	Price
284118	309614	PTM2 with Carrying Pouch, 0 to 1000°F (-17 to 540°C); 8-14 Spectral Response; 1.0" Spot @ 18". MDL PTM2.	\$320.00
284119	309622	PTM3 with Carrying Pouch, 0 to 1000°F (-17 to 540°C); 8-14 Spectral Response; 1.0" Spot @ 36". MDL PTM3.	\$1,225.00
284120	309630	Same as PTM 3 with 0 to 1600°F (-17 to 870°C; High/Low Set Point Alarm, Multi-Function Display and Reflected Temperature Compensation. MDL PTM4.	\$1,650.00

ACCESSORIES

284128	309673	110 Vac Adaptor	\$40.00
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THERMOCOUPLE RELATED SENSING

CAPP/USA TRANSMITTER/2-WIRE RTD



The CAPP Model STT2000 Two-Wire RTD Temperature Transmitter is accurate to $\pm 0.1\%$ of SPAN or $\pm 0.1^\circ\text{C}$ whichever is greater. It fills the gap between the full featured field mount transmitter and the very limited instruments used for environmental control systems. It is specifically designed for rugged industrial applications where the operating temperature permits the transmitter to be mounted directly in the connection head. FM APPROVED Class I Div. 1 Groups B, C, D; Class II Div. 1 Groups E, F, G & H; and Class III hazardous locations

SPECIFICATIONS

Output: 4–20 mA, 1–5V

Range: Set course zero and SPAN, minimum SPAN is 5°C

Accuracy: $\pm 0.1\%$ of SPAN or $\pm 0.1^\circ\text{C}$, whichever is greater

Ambient Temp.: -20 – 85°C

Resolution: Better than 0.05°C

Sensor break indication: Upscale current limited, less than 30 mA

Model No.	Stock No.	Description	Price
ORDERING INFORMATION:			
STT2000	315506	Transmitter with standard cast-aluminum head.	\$242.00
STT2000E	316042	Transmitter with explosion proof small cast-aluminum head, FM approved.	\$257.00
STT2000W	316043	Transmitter with No connection Head	\$185.00

Note: The CAPP/USA STT2000 is also available in celsius temp.—Consult CAPP/USA.

THERMOCOUPLE RELATED SENSING



TEMPERATURE TRANSMITTERS FOR RTD AND THERMOCOUPLES

ALL TEMPERATURE RANGES
BURNOUT INDICATION
LEAD WIRE COMPENSATION
EXTENDS SIGNALS UP TO

7000 FEET

MODEL 7001

MODEL 7004 (LINEARIZED)

Features

One RTD model and one thermocouple model cover all ranges and inputs. The moisture-sealed housing, easily accessible mounting hardware make the 284017 and 284018 simple to maintain.

Covers all Temperature Ranges (no Range Cards needed)

Selectable Burnout Indication

Perfect Lead Wire Compensation

Optimum Linearization for all Zeros and Spans

Covers all Thermocouple Types and Millivolt Signals

Field Selectable Loss of Input Indication

Linearization Card Provides for linear 4-20 mA Signal (7004 T)

Better than 0.1% of span accuracy

Shipped with J Thermocouple Calibration

SPECIFICATIONS

Output: Stock No. 284017 — 4 to 20 mA DC, non-isolated

Stock No. 284018 — 4 to 20 mA DC, isolated

Accuracy: Stock No. 284017 — 0.1% of calibrated span

Stock No. 284018 — 0.2% of calibrated span

Power Supply: 12 to 48 Vdc

Max. Load Resistance: 1200 Ohms at 48 Vdc

Stability: Stock No. 284017 — 0.1% of calibrated span for one year

Stock No. 284018 — 0.2% of calibrated span for one year

Input/Output Isolation: 500 VRMS

Loss of Input: Field Selectable:

- Upscale for open or shorted sensor
- Downscale for open or shorted sensor
- Upscale for open sensor
- Downscale for open sensor

Span And Zero: Continuously Adjustable, non-interacting

Temperature Limits: Operate within specifications: -25 to +85°C (-13 to +185°F)

Operate without damage: -55 to +100°C (-67 to +212°F)

Intrinsic Safety: Designed to meet U.S. and International Intrinsic Safety requirements

Stock No.	PCN	Model	Input	Rangeability	Potentiometer Adjustment	Ambient Temperature Effects	Price
284017	306085	7001PT	100 Ohm platinum RTD 120 Ohm Nickel RTD	Zero: -100 to 400°C (-148 to 752°F) Span: 25 to 800°C (45 to 1440°F)	Zero: 26°C (-148 to 752°F) Span: 2.25: 1 Turndown	±0.3°C ±0.4% of span for an ambient change of 50°C	\$465.00
284018	306083	7004T/C	T/C Types: J, K, T, E, R, S, & B mV Ranges -30 to 180 mV	Zero: -30 to 80 mV Span Gain: 270 to 1	Zero: -30 to 80 mV Span: 2.25: 1 Turndown	±2.5°C ±0.5% span for an ambient change of 50°C	\$540.00

5

PLANT ENGINEERS
COMPLETE LISTING OF FREQUENTLY USED
ISA ABBREVIATIONS

ISA Letter	USED IN:			
	Circle*	Relay Superscript	Square/Diamond	Elsewhere
A	Analysis; Alarm	Analog		Air Supply
AS				
B	Burner, Combustion			
C	—; Control			
D	—; Differential	Digital	Digital	
d/dt		Derivative		
E	Voltage (emf); Sensor	Voltage		Electric Supply
ES				
F	Flow Rate; Ratio (Fraction)			
FF	Flow Ratio			
FQ	Flow Quantity			
G	—; Glass, Viewing Device			Gas Supply
GS				
H	Hand; High			
HS				Hydraulic Supply
I	Current (electric); Indicate	Current	Interlock	Instrument Air
IA				
IO		On/Off		
J	Power; Scan			
K	Time, Time Schedule; Time Rate-of-Change, Control Station	Proportional		
L	Level; Light, Low	Low		
M	—; Momentary, Middle or Intermediate			
N		Number of analog inputs or value of exponent		Nitrogen Supply
NS				
O	—; Orifice (Restriction)	Electromagnetic; Sonic		
P	Pressure, Vacuum; Point (Test) Connection	Pneumatic	Purge or Flush	Plant Air
PA				
PD	Pressure Differential			
Q	Quantity; Integrate, Totalize			
R	Radiation; Record	Resistance (Elec.)	Reset	
REV		Reverse action	Solenoid	
S	Speed, Frequency; Safety, Switch			Set Point Steam Supply
SP				
SS				
T	Temperature; Transmit	Time	Trap	
TD	Temperature Differential			
U	Multivariable; Multifunction			
V	Vibration, Machinery Analysis; Valve/Damper/Louver			
W	Weight, Force; Well			Water Supply
WD	Weight/Force Differential			
WS				
X	—; X Axis	Multiply, analog input variable		
Y	Event, State or Presence; Y Axis, Relay, Compute			
Z	Position, Dimension; Z Axis, Driver/Actuate/Unclassified			
ZD	Final Control Element Gauging, Deviation			

5

PLANT ENGINEERS

ISA SYMBOLS

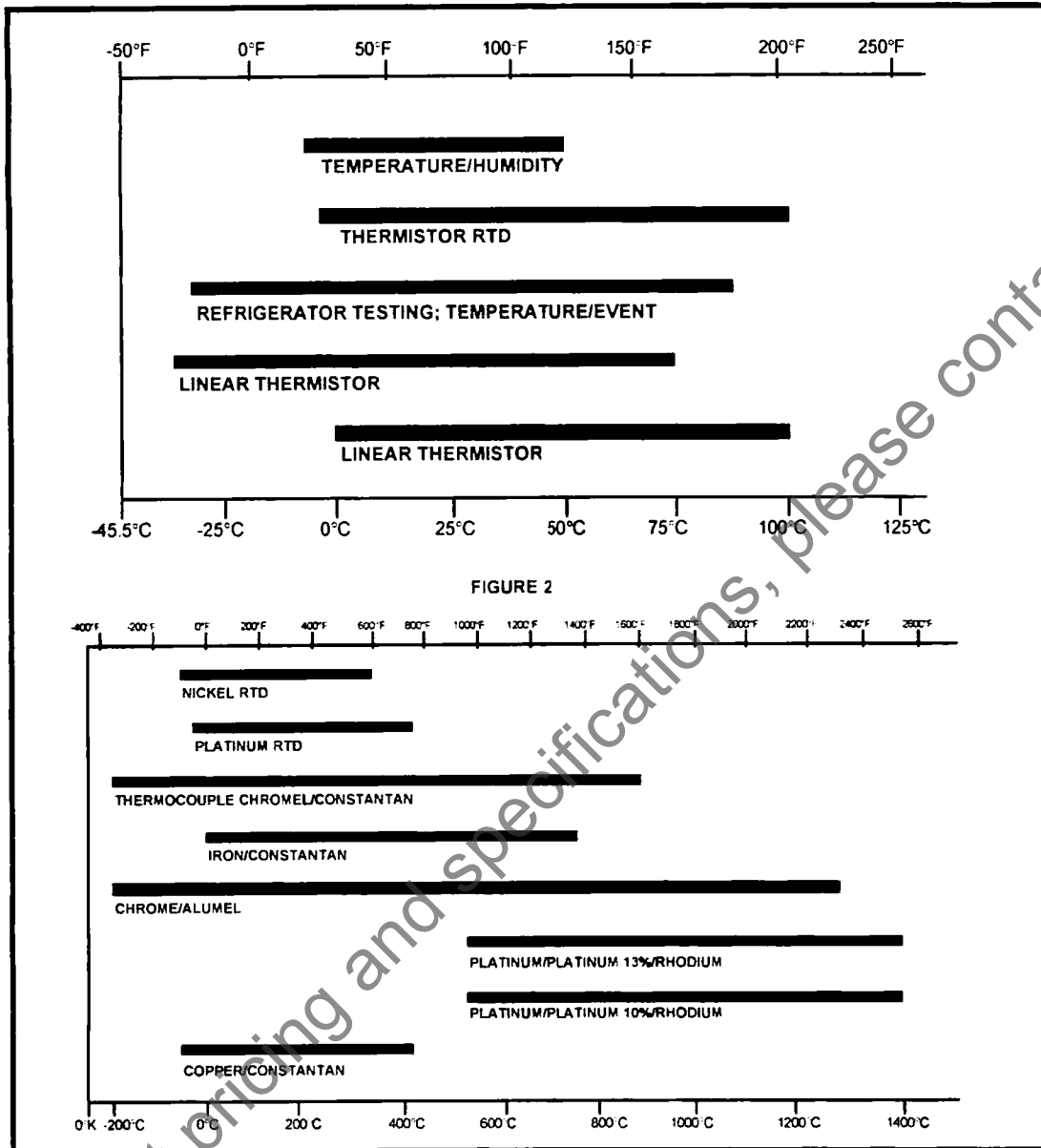
ISA Symbol	USED IN:			
	Circle*	Relay Superscript	Square/Diamond	Elsewhere
\square		summing		
$\square n$		averaging		
Δ		difference		
\square		integral		
\square		dividing		
\square		square-root extraction		
x^n		exponential		
$f(x)$		nonlinear or unspecified function		
$f(t)$		time function		
$>$		high selecting		
$<$		low selecting		
$>$		high limiting		
$<$		low limiting		
$-k$		reverse proportional		
V		velocity limiter		
$+$		bias		
$-$				
\pm				
\cdot / \cdot		convert		

* When used in a circle, meaning before the semicolon generally apply if the letter is in the first position, with meanings after the semi-colon applying to succeeding letters.

NOTE: Letters can be given meanings other than those shown here for user's convenience, but ANY CHANCE IN MEANING MUST BE SPECIFIED ON THE DRAWING.

5

ENGINEER'S GUIDE TO TEMPERATURE, HUMIDITY, and PRESSURE MEASUREMENTS



RECORDERS

HONEYWELL MICROPROCESSOR - BASED

CIRCULAR CHART RECORDERS

HONEYWELL TRULINE® SERIES DR4500A:



FEATURES & OVERVIEW:

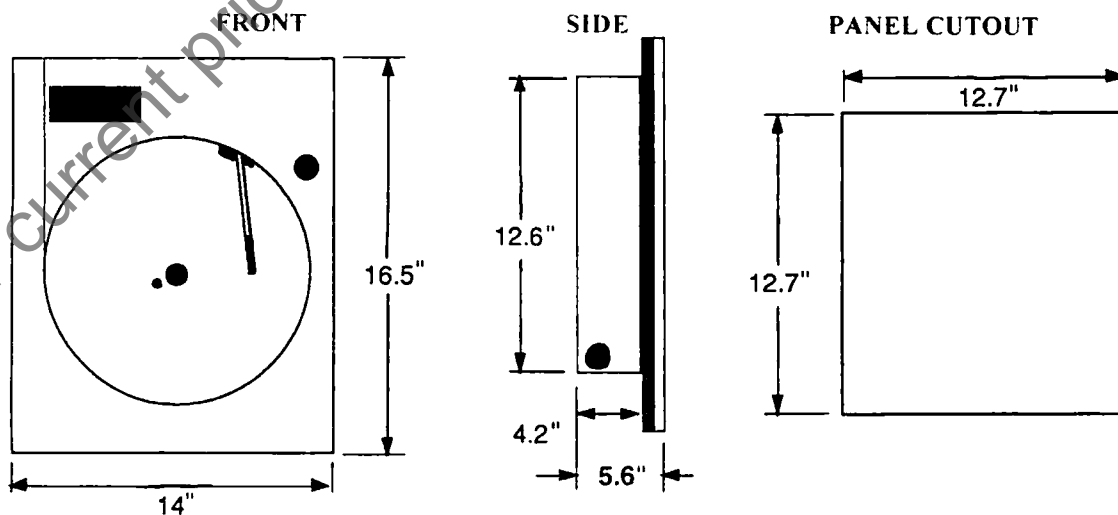
THE TRULINE® SERIES CHART RECORDER UTILIZES A UNIQUE STYLUS-TYPE PRINT HEAD TO PRINT ALL CHART MEASUREMENT DATA ONTO A HEAT-SENSITIVE CHART. THE TRULINE® ALSO PRODUCES AS MANY AS 4 ANALOG TRACES WHICH HAVE THE SAME TIME LINE REFERENCE.

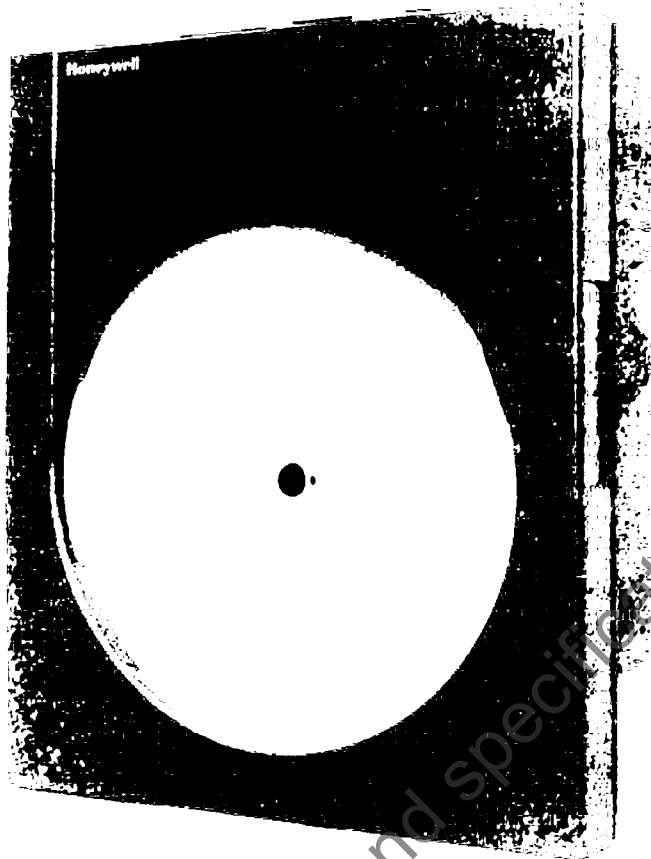
THE TRULINE® IS WIDELY USED FOR MANY PROCESS APPLICATIONS.

FEATURES INCLUDE OPERATOR-INTERFACE; ENGLISH LANGUAGE PROMPTS; UP TO 4 CHANNELS; ONLY ONE ALL-PURPOSE CHART; DIAGNOSTICS; AND OPTIONS WHICH INCLUDE CHART-ILLUMINATION AND ALARM OUTPUT.

6

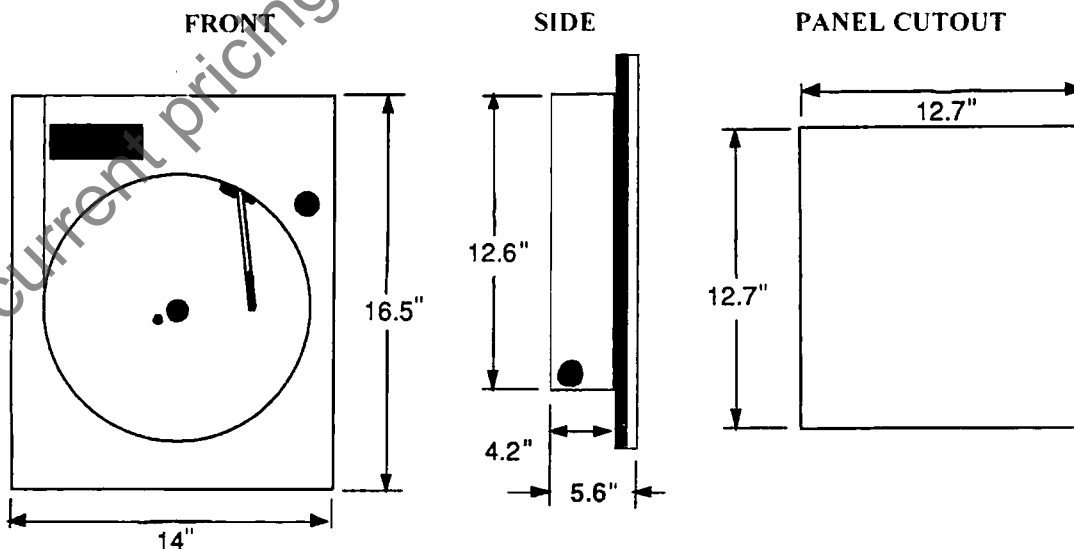
DIMENSIONS: (IN INCHES):



**HONEYWELL MICROPROCESSOR - BASED
CIRCULAR CHART RECORDERS****HONEYWELL CLASSIC® SERIES DR4500A:****FEATURES & OVERVIEW:**

THE CLASSIC® SERIES RECORDER PROVIDES THE END USER BOTH PEN-DRAWN ANALOG TRACES AS WELL AS THE CONVENIENCE OF MICROPROCESSOR CONTROLLED FUNCTIONS. THIS UNIT IS AVAILABLE IN 1-PEN OR 2-PEN, AND IS ALSO AVAILABLE WITH A DIGITAL CONTROLLER WHICH IS USED TO GENERATE OUTPUT SIGNALS TO DAMPERS, VALVES, AND OTHER DEVICES.

FEATURES INCLUDE OPERATOR-INTERFACE; DIAGNOSTICS; INPUT-PROCESSING; AND A GASKETED-TYPE DOOR.

6**DIMENSIONS: (IN INCHES):**

RECORDERS

ORDERING INFORMATION - TRULINE® AND CLASSIC® MODELS

ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 15 TABLES BELOW:

OPTION TABLES

MODEL TYPE:

EXAMPLE PRICE:

1:	TRULINE®	DR45AT	\$1,159.00
	TRULINE® WITH RELAY EXPANSION	DR45AR	\$1,190.00
	TRULINE® - FLOW RECORDER	DR45AW	\$1,190.00
	TRULINE® - HTST	DR45AH	\$2,765.00
	CLASSIC® MODEL WITH 1-PEN	DR45A1	\$1,045.00
	CLASSIC® MODEL WITH 2-PENS	DR45A2	\$1,380.00

INPUTS: (CHANNEL #1)

2:	RTD/TC/mV/4-20mA/0-5Vdc	1	\$0.00
	0-10Vdc	3	\$27.00

INPUTS: (CHANNEL #2)

3:	RTD/TC/mV/4-20mA/0-5 Vdc	1	\$0.00
	RTD/TC/mV/4-20mA/0-5 Vdc	1	\$0.00
	0-10 Vdc	3	\$27.00
	0-10 Vdc	3	\$350.00
	NONE	0	\$0.00

INPUTS: (CHANNEL #3)

4:	RTD/TC/mV/4-20mA/0-5 Vdc	1	\$326.00
	0-10 Vdc	3	\$350.00
	NONE	0	\$0.00

INPUTS: (CHANNEL #4)

5:	RTD/TC/mV/4-20mA/0-5 Vdc	1	\$326.00
	0-10 Vdc	3	\$350.00
	NONE	0	\$0.00

EXTERNAL OUTPUTS:

6:	CONTROL OUTPUT #1	1	\$357.00
	CONTROL OUTPUT #1	1	\$0.00
	CONTROL OUTPUT #1 WITH SETPOINT PROGRAMMING	4	\$357.00
	PULSE OUTPUT	5	\$357.00
	CONTROL OUTPUT #1 WITH FM APPROVALS	6	\$357.00
	NONE	0	\$0.00

EXTERNAL OUTPUTS:

7:	CONTROL OUTPUT #2 WITH FM APPR	6	\$357.00
	CONTROL OUTPUT #2 WITH SETPOINT PROGRAMMING	4	\$357.00
	NONE	0	\$0.00

6

ORDERING INFORMATION - TRULINE® AND CLASSIC® MODELS (CONTINUED)

OPTION TABLES

MODEL TYPE:

COMMUNICATIONS:

8:	NONE.....	0	\$0.00
	DMCS COMMUNICATIONS.....	2	\$269.00

PEN SELECTIONS:

9:	STANDARD PEN.....	0	\$0.00
	TRULINE ABRASION-RESISTANT PEN.....	1	\$31.00

EXTERNAL INTERFACE:

10:	2 ALARMS / 2 DIGITAL INPUTS.....	1	\$147.00
	4 ALARMS / 2 DIGITAL INPUTS.....	2	\$431.00
	6 ALARMS / 2 DIGITAL INPUTS.....	3	\$627.00
	NONE.....	0	\$0.00

OPTIONAL SOFTWARE:

11:	TOTALIZATION ON INPUT #1.....	A	\$225.00
	TOTALIZATION ON INPUTS #1 & 2.....	E	\$382.00
	TOTALIZATION ON INPUTS #1, 2, 3, & 4.....	H	\$485.00
	NONE.....	0	\$0.00

OPTIONAL SELECTIONS:

12:	BLUE DOOR - GLASS WINDOW.....	5	\$0.00
	BLUE DOOR - ACRYLIC WINDOW.....	6	\$36.00
	GRAY DOOR - GLASS WINDOW.....	0	\$0.00
	GRAY DOOR - ACRYLIC WINDOW.....	1	\$36.00
	HEAVY-DUTY ST. STEEL DOOR-GLASS WINDOW.....	2	\$181.00
	HEAVY-DUTY ST. STEEL DOOR-ACRYLIC WINDOW.....	3	\$215.00
	HEAVY-DUTY ST. STEEL DOOR-HTST.....	4	\$0.00
13:	DOOR LOCK.....	K	\$34.00
	HEAVY-DUTY DOOR LATCH.....	M	\$58.00
	NO DOOR LATCH.....	0	\$0.00
14:	CHART ILLUMINATION.....	N	\$98.00
	NONE.....	0	\$0.00
15:	U.L. LISTED.....	P	\$15.00
	U.L. & FM APPROVALS.....	S	\$31.00
	FM APPROVALS - (CLASS 1, DIV. 2, GROUPS A, B, C, & D).....	R	\$15.00
	NO APPROVALS.....	0	\$0.00

EXAMPLE STOCK NO.: DR45AT-1-0-0-0-1-0-0-0-0-0-5-0-N-0.

EXAMPLE PRICE: \$1,614.00

6

cont.



RECORDERS

TRULINE® REPLACEMENT PARTS

<u>STOCK NO.</u>	<u>DESCRIPTION</u>
6264.....\$29.00.....	CHART PAPER, 100 PER BOX, TO FIT HW CHART NO. 755317.
55146.....\$90.00.....	STANDARD TRULINE® PEN.
136128.....\$107.00.....	ABRASION-TIP TRULINE® PEN.

CLASSIC® REPLACEMENT PARTS

<u>STOCK NO.</u>	<u>DESCRIPTION</u>
6014.....\$28.00.....	PURPLE PEN/INK CARTRIDGE, TO FIT HW-735489-001.
6015.....\$28.00.....	RED PEN/INK CARTRIDGE, TO FIT HW-735489-002.
6017.....\$28.00.....	GREEN PEN/INK CARTRIDGE, TO FIT HW-735489-003.
6018.....\$28.00.....	BLUE PEN/INK CARTRIDGE, TO FIT HW-735489-004.
6019.....\$28.00.....	RED PEN/INK CARTRIDGE, TO FIT HW-735489-005, USED AS PEN #2.
6021.....\$28.00.....	GREEN PEN/INK CARTRIDGE, TO FIT HW-735489-006, USED AS PEN #2.
6022.....\$28.00.....	PURPLE PEN/INK CARTRIDGE, TO FIT HW-735489-007, USED AS PEN #2.
6023.....\$28.00.....	BLACK PEN/INK CARTRIDGE, TO FIT HW-735489-008.
213789.....\$27.00.....	PEN ARM, MFG. NO. 756409-002.

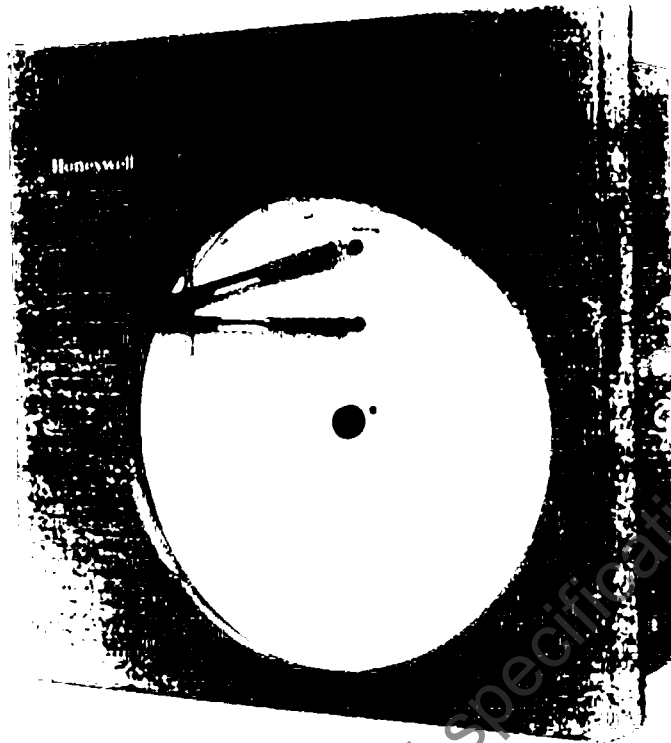
6

**REPLENISH YOUR STOCK OF SPARE
PARTS QUICKLY**

**ORDER FROM CAPP TODAY,
HAVE IT TOMORROW - GUARANTEED!**

HONEYWELL MICROPROCESSOR - BASED CIRCULAR CHART RECORDERS

HONEYWELL SERIES DR4200-GP: GENERAL PURPOSE



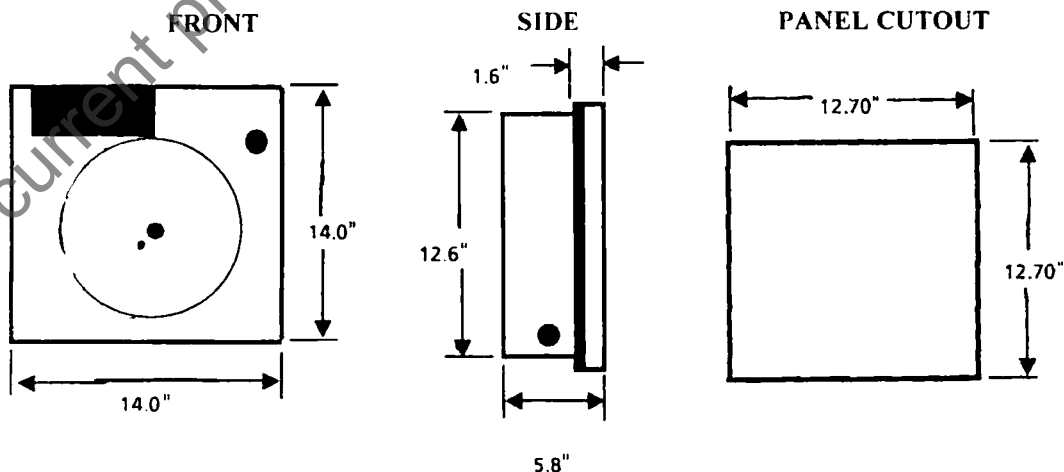
FEATURES & OVERVIEW:

THE HONEYWELL SERIES DR4200 IS WIDELY USED AS A GENERAL PURPOSE RECORDER FOR MANY PROCESS APPLICATIONS WHICH RANGE FROM FOOD PROCESSING, OVENS, FURNACES, INCINERATORS, AND MANY MORE.

FEATURES INCLUDE INPUT-PROCESSING; PROCESS INTERFACE; DIAGNOSTICS; SELECTION OF EITHER 1 OR 2 PENS; AND AN OPTIONAL HOSE-DOWN DOOR.

6

DIMENSIONS: (IN INCHES):



cont.

RECORDERS

ORDERING INFORMATION - SERIES DR4200-GP

ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 7 TABLES BELOW:

OPTION TABLES

NUMBER OF PENS:

1:	ONE-PEN RECORDER.....	DR4200GP1	\$620.00
	TWO-PEN RECORDER.....	DR4200GP2	\$925.00

OUTPUTS: (FOR PEN #1)

2:	NONE.....	0	\$0.00
	1 ALARM RELAY.....	1	\$115.00
	2 ALARM RELAYS.....	2	\$193.00
	LIMIT CONTROL - FM APPROVED.....	F	\$125.00

OUTPUTS: (FOR PEN #2)

3:	NONE.....	0	\$0.00
	1 ALARM RELAY.....	1	\$115.00
	2 ALARM RELAYS.....	2	\$193.00
	LIMIT CONTROL-FM APPROVED.....	F	\$125.00

OPTIONAL SELECTIONS: (4 SELECTIONS)

4:	GRAY DOOR.....	G	\$0.00
	BLUE DOOR.....	B	\$0.00
	HEAVY-DUTY GRAY DOOR.....	J	\$9.00
	HEAVY-DUTY BLUE DOOR.....	H	\$9.00

5:	ACRYLIC WINDOW.....	P	\$19.00
	GLASS WINDOW.....	G	\$0.00

6:	STANDARD DOOR LATCH *.....	O	\$0.00
	DOOR LOCK.....	K	\$29.00
	HEAVY-DUTY DOOR LATCH.....	T	\$58.00

7:	U.L. LISTED.....	U	\$15.00
	C.S.A. CERTIFIED.....	C	\$15.00
	U.L. AND C.S.A.....	B	\$31.00
	NO APPROVALS.....	O	\$0.00

* THIS OPTION IS NOT AVAILABLE
WITH THE HEAVY-DUTY DOOR.

EXAMPLE STOCK NO.: DR4200GP1-0-0-B-G-0-0.

EXAMPLE PRICE: \$620.00

6

HONEYWELL MICROPROCESSOR - BASED CIRCULAR CHART RECORDERS

HONEYWELL SERIES DR4200-EV: ENHANCED VERSION



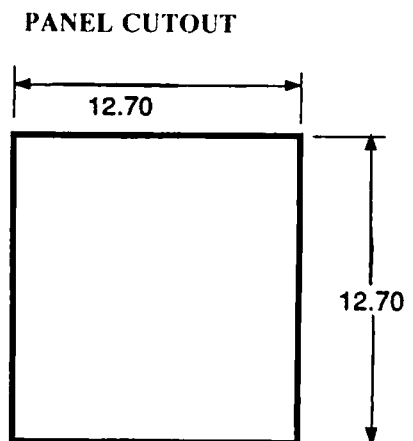
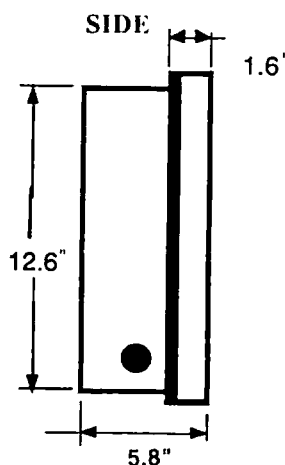
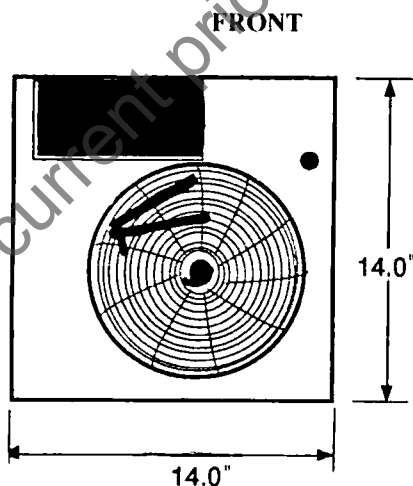
FEATURES & OVERVIEW:
MUCH LIKE AND SIMILAR TO ITS
PREDECESSOR SERIES DR4200-GP,
THE ENHANCED VERSION DR4200-
EV IS ALSO WIDELY USED AMONG
MANY PROCESS APPLICATIONS.

HOWEVER, THIS ENHANCED-
VERSION SERIES RECORDER
COMES WITH AN EASY-TO-READ
DIGITAL DISPLAY ON ITS FRONT
DOOR WHICH DISPLAYS ALL
PROCESS VALUES.

FEATURES INCLUDE INPUT-
PROCESSING; OPERATOR
INTERFACE; DIAGNOSTICS;
PROCESS INTERFACE; 1 OR 2
PENS; AND AN OPTIONAL HEAVY-
DUTY DOOR.

6

DIMENSIONS: (IN INCHES)



cont. ➔

RECORDERS

ORDERING INFORMATION - SERIES DR4200-EV

ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 8 TABLES BELOW:

OPTION TABLES

NUMBER OF PENS:

1:	ONE-PEN RECORDER.....	DR4200EV1	\$770.00
	TWO-PEN RECORDER.....	DR4200EV2	\$1,090.00

OUTPUTS: (FOR PEN #1)

2:	NONE.....	0	\$0.00
	1 CONTROL/INCLUDES 2 RELAYS.....	1	\$290.00
	2 ALARM RELAYS.....	2	\$195.00
	1 POWER SUPPLY (24V).....	3	\$110.00

OUTPUTS: (FOR PEN #2)

3:	NONE.....	0	\$0.00
	1 CONTROL/INCLUDES 2 RELAYS.....	1	\$290.00
	2 ALARM RELAYS.....	2	\$195.00
	1 POWER SUPPLY (24V).....	3	\$110.00

OPTIONAL SELECTIONS: (5 SELECTIONS)

4:	GRAY DOOR.....	G	\$0.00
	BLUE DOOR.....	B	\$0.00
	HEAVY-DUTY GRAY DOOR.....	J	\$10.00
	HEAVY-DUTY BLUE DOOR.....	H	\$10.00

5:	ACRYLIC WINDOW.....	P	\$0.00
	GLASS WINDOW.....	G	\$20.00

6:	STANDARD DOOR LATCH *.....	O	\$0.00
	DOOR LOCK.....	K	\$35.00
	HEAVY-DUTY DOOR LATCH.....	T	\$60.00

7:	U.L. LISTED.....	U	\$20.00
	C.S.A. CERTIFIED.....	C	\$20.00
	U.L. AND C.S.A.....	B	\$40.00
	NO APPROVALS.....	O	\$0.00

8:	1 LOOP TOTALIZATION.....	1	\$160.00
	2 LOOP TOTALIZATION.....	2	\$320.00
	NO TOTALIZATION.....	0	\$0.00

* THIS OPTION IS NOT AVAILABLE WITH THE HEAVY-DUTY DOOR.

EXAMPLE STOCK NO.: DR4200EV2-0-0-B-G-0-0-0

EXAMPLE PRICE.: \$1,110.00



**COMPARE
TO
HONEYWELL
TRULINE**

PARTLOW VersaChart® RECORDER

VersaChart, the only circle chart recorder that prints 1 to 4 color trend lines, scales and alphanumeric data on standard plain-paper charts!

Features a new level of circular chart recording capability. It's brilliant color trend lines, scales and alphanumeric data messages make chart reading fast and easy. Associated trend lines, scales and data messages are also linked by common colors providing for greater accuracy. Printing is accomplished with a four-color marker pen cartridge which prints the information as it glides across your choice of a 10, 11 or 12 inch chart.

The VersaChart uses plain-paper charts, rather than thermal paper, for a more permanent record of your data. Trend data can be scales and zoned to enhance readability, and portions of a scale may be magnified with trend-zoom for better resolution within critical areas. It's easy to read 40 character vacuum fluorescent display can simultaneously or sequentially display process value, units and tag information.

The display, combined with the five Quick-Select keys, make programming the VersaChart easy for users at all skill levels. A number of optional features are available including an Advanced-Math-Capability (with up to 12 Derived Variable), up to four Totalizers and up to 8 Analog inputs.

The new Partlow VersaChart is designed to easily and quickly retrofit existing name-brand circle chart recorders. It is also backed by a comprehensive two year warranty.

RECORDER

One to four pens of trend information recorder on 10, 11, or 12 inch circular charts. Character information such as scales, tags, instrument and operator IDs, and alarm messages can be printed as well.

Item	Description
Charts	10, 11, or 12 inch circular charts
Chart Drive	DC stepper motor
Chart Rotation	6 to 9999 hours per revolution
Pen Type	Disposable 4 pen fiber tip marker assembly
Pen Colors	Red, green, blue, and black
Chart Recording Accuracy	.3% of chart span reference accuracy
Chart Drive Accuracy	± 2 minutes per 24 hours, assuming all backlash removed

DISPLAY AND KEYPAD

Item	Description
Primary Display	2 line, 40 character vacuum fluorescent display with .21 inch (5mm) high characters
Status Indicators	8, user configurable, red LED status indicators
Operator Keypad	15 keys for programming and unit operation

INPUTS

Eight total inputs can be combined in pairs of any of the following available types:

Analog Input Types

Item	Description
Thermocouple	Types J, K, T, R, S, E, B, N, G, D, C, Ni/Ni-Mo and Platinum II.
RTD Types	Platinum 100, 2 or 3 wire .00385 coefficient DIN 43760/IEC 751 .00392 coefficient (USA) .00392 coefficient (SAMA) Nickel 100, 2 or 3 wire
Voltage Inputs	0 to 25mV, 0 to 100 mVDC, 0 to 1 VDC, 0 to 10 VDC
Current Inputs	0 to 20mA, 4 to 20mA
Contact Closure	Open/closed switch sensing without external voltages or resistors
Scan Rate	The input scan rate is programmable and dependent upon the number of active inputs present in the recorder. The overall capability of the instrument is 16 scans/second.

OUTPUTS

A total of eight on/off outputs, either Relay or Solid State Relay Driver, and up to four, 4 to 20ma analog outputs are available.

Item	Description
Relay	SPDT, contacts rated 5 amps resistive at 115 VAC, 2.5 amps resistive at 230 VAC — 1/8 HP at 230 VAC (Single Phase), 250 VA at 115/230 VAC
Solid State Relay Driver	Open collector output, can provide 40mA at 3 VDC or 20mA at 4 VDC. Short circuit current is limited to 100mA.
Analog	0 to 20mA into 0-650 ohm load with 12 bits resolution

6

RECORDERS

ORDERING INFORMATION - VERSACHART

ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 7 TABLES BELOW:

OPTION TABLES

TYPE

Recorder Only.....	\$1,250.00
Controller	\$1,670.00

PENS/COLORS

	One Trend, One Color.....1	NC
	Two Trend, Two Colors.....2	\$245.00
	Three Trend Pens, Three Colors.....3	\$465.00
1:	Four Trend Pens, Four colors.....4	\$710.00
	One Trend Pen, Four Colors.....5	\$147.00
	Two Trend Pens, Four Colors.....6	\$345.00
	Three Trend Pens, Four Colors.....7	\$514.00

ANALOG INPUTS

	One Input.....1	NC
	Two Inputs.....2	\$196.00
2:	Three Inputs.....3	\$400.00
	Four Inputs.....4	\$595.00
	Six Inputs.....6	\$979.00
	Eight Inputs.....8	\$1,388.00

RELAY OUTPUTS*

	None.....0	NC
	Two Relays.....2	\$140.00
3:	Four Relays.....4	\$246.00
	Six Relays.....6	\$381.00
	Eight Relays.....8	\$472.00

SSR OUTPUTS*

	None.....0	NC
	Two SSRDs.....2	\$140.00
4:	Four SSRDs.....4	\$246.00
	Six SSRDs.....6	\$381.00
	Eight SSRDs.....8	\$472.00

4-20mA OUTPUTS

5:	One 4-20 Output.....1	\$177.00
	Two 4-20 Outputs.....2	\$348.00
	None.....0	NC

MATH/TOTALIZER

	None.....0	NC
6:	Math.....1	\$245.00
	Totalizer.....2	\$245.00
	Math & Totalizer.....3	\$497.00

ENCLOSURE OPTIONS

	Glass Window.....1	NC
7:	Glass Window with Door Lock.....2	\$50.00
	Plastic Window.....3	\$36.00
	Plastic Window with Door Lock.....4	\$85.00

*Note: Total quantity of SPDT Relays and SSR Drivers must be less than or equal to eight.
Overall Dimensions: 14.12 inches wide x 16.77 inches high x 7.75 inches deep.

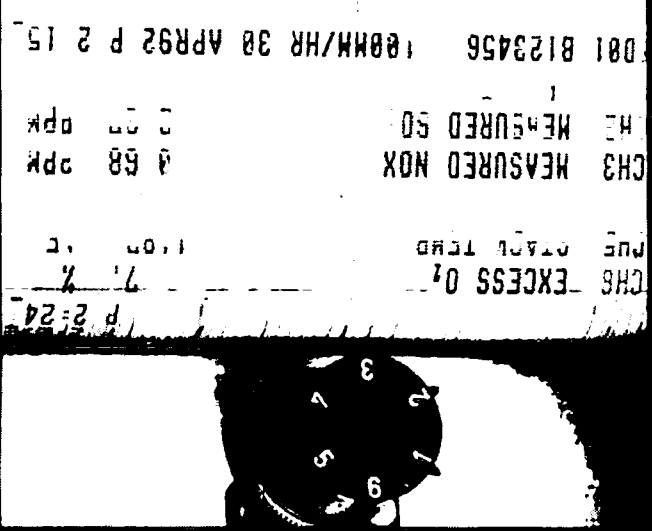
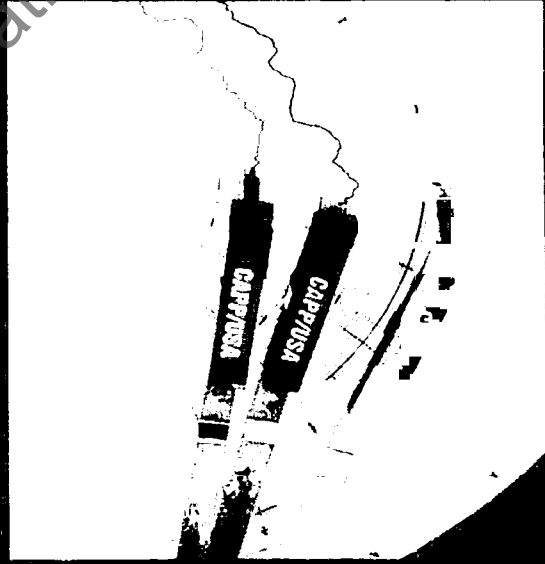
EXAMPLE NO.: 1100103
EXAMPLE PRICE: \$1,493.00

CAPP/USA
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Pens, Inks & Charts for

Manufactured to Fit the Specifications of:

HONEYWELL • FOXBORO • GRAPHIC CONTROLS • LEEDS & NORTHRUP • PARLOW • TAYLOR • OMEGA • FISCHER & PORTER • YOKOGAWA • BAILEY AND MANY MORE



CH3 MEASURED NOX 3.68 PPM
 CH3 MEASURED SO 0.27 PPM
 CH6 EXCESS O₂ 7.1%
 081 8123456 100MM/HR 30 APR92 P 2 15

Exclusive First Time Cross-Reference of GRAPHIC CONTROLS Part Numbers.

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RECORDERS

PROGRAMMABLE CIRCULAR RECORDERS

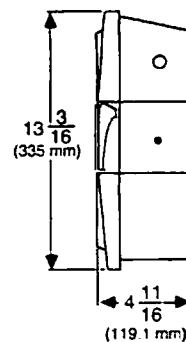
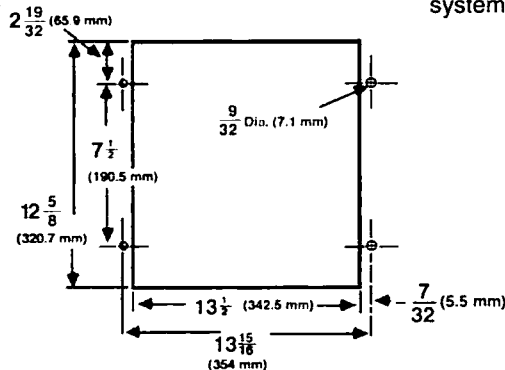
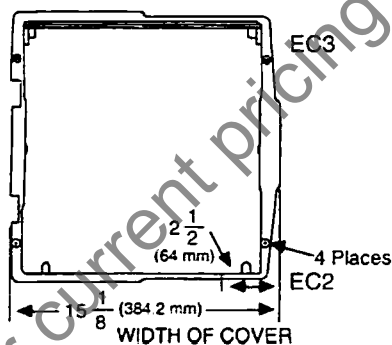
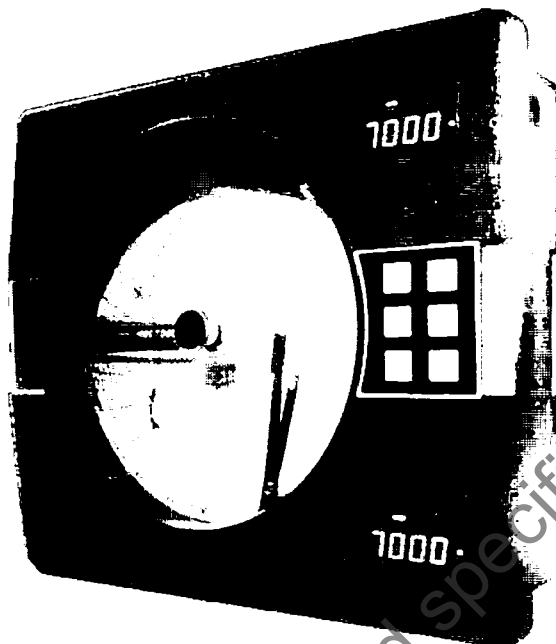
Partlow

MRC 7000 Recording Controller With Programmable Setpoint Profile Capability

MRC 7000 FEATURES:

Input capabilities include thermocouple, RTD, millivolt, volt and milliamp.

Standard features include: isolated process input, process value display for each pen, up to two programmable alarms per pen, automatic linearization for thermocouples and RTD's, sensor break and error fault detection, display/chart and process filtering, 0.56 inch high LED displays, tactile feedback keys on front cover, programmable display, decimal point positioning, proportional control output limits, programmable output action on sensor break/error condition, auto/manual transfer, security access systems and more.



6

RECORDERS

ORDERING INFORMATION — MRC 7000

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 12 TABLES BELOW:

OPTION TABLES

MRC 7000

PEN 1		
1:	Recorder Only.....	71 \$765.00
	Recording Controller.....	72 \$890.00
	Recording Profile Controller.....	73 \$1,205.00
	High or Low Limit.....	74 \$870.00
PEN 2		
2:	None.....	0 \$0.00
	Recorder Only.....	1 \$257.00
	Recording Controller.....	2 \$439.00
*RELAY OUTPUTS		
3:	None.....	0 \$0.00
	One SPST.....	1 \$37.00
	Two SPST.....	2 \$74.00
	Four SPST.....	4 \$148.00
	Six SPST.....	6 \$224.00
	One SPDT.....	7 \$47.00
	Two SPDT.....	8 \$96.00
	Two SPDT & Two SPST.....	9 \$170.00
*SSR DRIVER OUTPUTS		
4:	None.....	0 \$0.00
	One.....	1 \$31.00
	Two.....	2 \$62.00
	Four.....	4 \$125.00
	Six.....	6 \$188.00
	Eight.....	8 \$257.00
4-20 mA OUTPUTS		
5:	None.....	0 \$0.00
	One.....	1 \$37.00
	Two.....	2 \$74.00
	Three.....	3 \$111.00
	Four.....	4 \$148.00
TRANSMITTER POWER SUPPLY		
6:	None.....	0 \$0.00
	24 Vdc Regulated/Isolated.....	1 \$94.00
PEN 1 AUXILIARY INPUT††		
7:	None.....	0 \$0.00
	Position Proportioning.....	1 \$26.00
	Remote Setpoint.....	3 \$26.00

OPTION TABLES CONTINUED ON THE NEXT PAGE

cont.

6

RECORDERS

ORDERING INFORMATION — MRC 7000 (CONTINUED)

OPTION TABLES

MRC 7000

PEN 2 AUXILIARY INPUT††

	None.....	0	\$0.00
8:	Position Proportioning.....	1	\$26.00
	Remote Setpoint	2	\$26.00

COMMUNICATIONS

9:	None.....	0	\$0.00
	RS-485 Total Access.....	2	\$181.00

ENCLOSURE OPTIONS

	Std. Cover (Plastic Windows).....	2	\$0.00
10:	Door Lock**	4	\$51.00
	Sealed Conduit Connectors.....	6	\$51.00
	Door Lock & Sealed Conduit Connectors**	7	\$101.00

VOLTAGE

	115 Vac Input.....	1	\$0.00
	115/230 Vac Input	2	\$57.00

11:

CSA Approved

	115 Vac Input.....	4	\$0.00
	115/230 Vac Input	5	\$0.00
	None.....	0	\$0.00

OPTION SUFFIX

	None.....	0	\$0.00
	NEMA 3†.....	N3	\$77.00
12:	RTD Depression Pen 2	AW	\$103.00
	0/100 mVdc Input	AD	\$0.00
	N3 plus AW	AE	\$181.00

* Total quantity of SPST Relays and SSR Drivers must be no more than (8) eight.

** This option comes with structural foam cover.

*** Applies to Model 73XXXXX3XXXXXX.

† N3 - NEMA 3 Type Spray Resistance Enclosure.

†† Must be 0 when ordering Model 71XXXXXXXXXX.

Note: 4-20 mA inputs are accommodated using the 1-5V input and a 250 ohm Shunt Resistor P/N 64411701 (provided with unit) Stock No. 277549 \$11.00 or the 10-50 mA Input and a 2.5 ohm Shunt Resistor P/N 64411702, Stock No.: 238549. \$11.00

EXAMPLE NO.: 722001000041

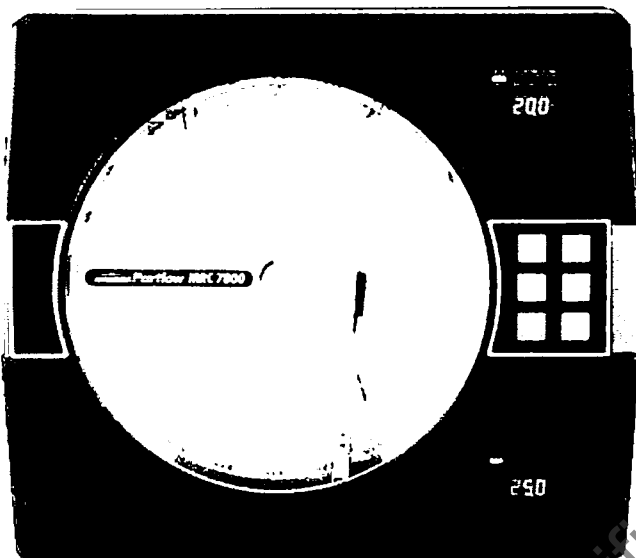
EXAMPLE PRICE: \$1,417.00

6

TOTALIZATION & FLOW RECORDERS



MRC 7800 Recorder For Measuring and Totalizing Flow

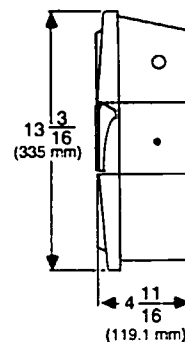
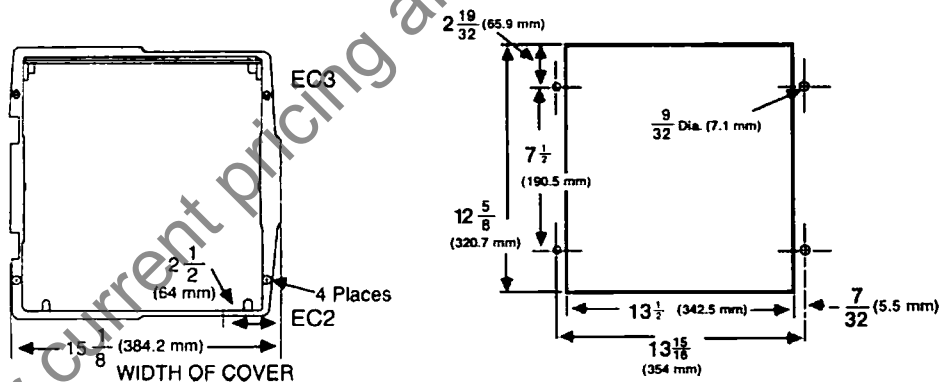


Input capabilities include millivolt, volt and milliamp.

Standard features include: isolated process input, process value display for each pen, up to two programmable alarms per pen, sensor break and error fault detection, display/chart and process filtering, 0.56 inch high LED displays, tactile feedback keys on front cover, programmable display, decimal point positioning,

security access
systems and more.

Offers unique features including flexibility of dampening effects, variety of square root extraction methods, low flow cutoff for totalization, adjustable flow time base, adjustable decimal position for both the flow rate and total, remote setpoint and remote reset options, adjustable scan rate, and widely adjustable proportional band.



RECORDERS

ORDERING INFORMATION — MRC 7800

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 9 TABLES BELOW:

OPTION TABLES

MRC 7800

PEN AND TOTALIZATION SELECTION		
	One Pen Recorder	785 \$1,155.00
	One Pen Recorder with Totalization.....	786 \$1,215.00
1:	Two Pen Recorder.....	787 \$1,490.00
	Two Pen Recorder with Totalization	788 \$1,550.00
	One Pen Recorder with Totalization and Second Display	789 \$1,339.00
*RELAY OUTPUTS		
	None.....	0 \$0.00
	One SPST	1 \$37.00
	Two SPST.....	2 \$74.00
2:	Four SPST.....	4 \$149.00
	Six SPST.....	6 \$224.00
	One SPDT	7 \$47.00
	Two SPDT.....	8 \$96.00
	Two SPDT & Two SPST	9 \$170.00
*SSR DRIVER OUTPUTS		
	None.....	0 \$0.00
	One.....	1 \$32.00
3:	Two.....	2 \$64.00
	Four.....	4 \$129.00
	Six.....	6 \$195.00
	Eight.....	8 \$257.00
4-20 mA OUTPUTS		
	None.....	0 \$0.00
	One.....	1 \$37.00
4:	Two.....	2 \$74.00
	Three.....	3 \$111.00
	Four.....	4 \$149.00
TRANSMITTER POWER SUPPLY		
5:	None.....	0 \$0.00
	24 Vdc Regulated/Isolated.....	1 \$94.00
DATALOGGING OPTIONS		
6:	None.....	0 \$0.00
	Data logged memory**	1 \$283.00
FIXED CHARACTER		
	Fixed.....	0 \$0.00
COMMUNICATIONS		
	None.....	0 \$0.00
ENCLOSURE OPTIONS		
	Std. Cover (Plastic Windows)	2 \$0.00
7:	Door Lock	4 \$51.00
	Sealed Conduit Connectors	6 \$51.00
	Door Lock & Sealed Conduit Connectors**	7 \$101.00

OPTION TABLES CONTINUED ON THE NEXT PAGE

ORDERING INFORMATION—MRC 7800 (CONTINUED)

OPTION TABLES

MRC 7800

VOLTAGE

115 Vac, 60 Hz	1	\$0.00
230 Vac, 60 Hz	2	\$57.00

8:

CSA Approved

115 Vac, 60 Hz	5	\$9.00
230 Vac, 60 Hz	6	\$67.00
None	0	\$0.00

OPTION SUFFIX

9: None	0	\$0.00
NEMA 3†	N3	\$77.00

- * Total quantity of SPST Relays and SSR Drivers must no more than (8) eight. When SPDT Relays are included, the total must be less than or equal to six.
- ** Available only on units with totalization.
- *** This option comes with structural foam cover.
- † N3 - NEMA 3 Type Spray Resistance Enclosure.

NOTE: 4-20 mA inputs are accommodated using the 1-5V input and a 250 ohm Shunt Resistor, Stock No. 277549 (provided with unit) or the 10-50 mA Input and a 2.5 ohm Shunt Resistor, Stock No.: 238549. \$11.00

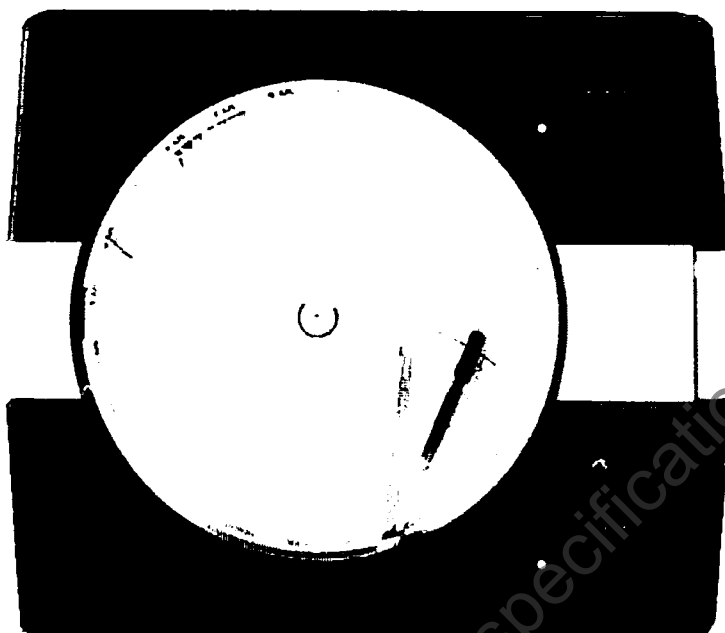
EXAMPLE NO.: 78500100002100
EXAMPLE PRICE: \$1,192.00

RECORDERS

ANALOG RECORDERS



ARC 4100 Analog Circle Chart Recorder and Recording Controller



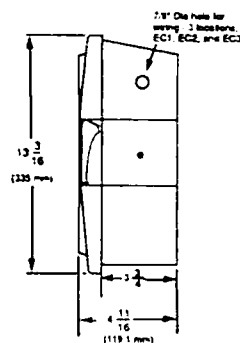
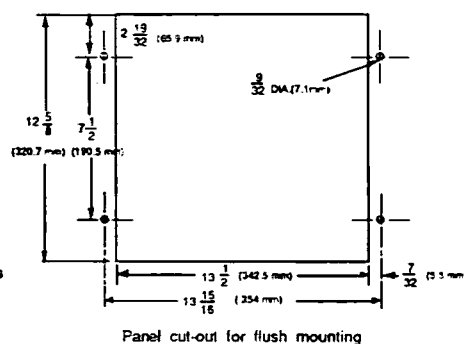
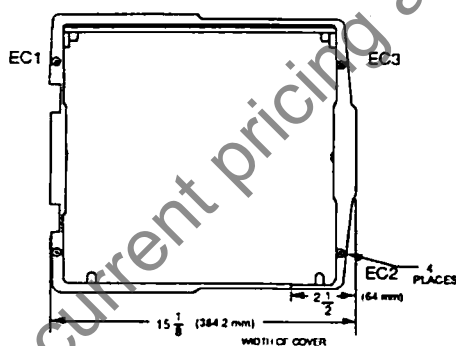
ARC 4100 FEATURES:

Can be ordered with inputs of RTD, thermocouple, milliamp, and volt. Outputs include on-off, time proportioning, and 4-20 mA with full PID.

Setpoint change easily accomplished through front access thumbwheel.

Analog design provides a degree of protection from electronic noise interference.

6



ORDERING INFORMATION — ARC 4100

ORDERING IS EASY — JUST SELECT AN OPTION
FROM THE 11 TABLES BELOW:

OPTION TABLES ARC 4100

PEN 1 TYPE/OUTPUT		
	Recorder Only.....	411 \$635.00
	High Limit (Latching).....	412 \$820.00
	On-Off Controller Relay.....	413 \$730.00
1:	On-Off Controller SSR Driver.....	414 \$730.00
	Time Prop. Relay.....	415 \$925.00
	Time Prop. SSR Driver.....	416 \$925.00
	4-20 mA.....	417 \$955.00
PEN 2 SETPOINT		
	Recorder Only.....	0 \$0.00
	Local 3 Digit Pos. Only*.....	1 \$0.00
2:	Local 3 Digits Pos./Neg.*.....	2 \$0.00
	Local 4 Digit Pos. Only*.....	3 \$0.00
	Remote Setpoint**.....	4 \$0.00
PEN 1 SECOND OUTPUT		
	None.....	0 \$0.00
3:	On-Off/Alarm Relay.....	1 \$68.00
	On-Off/Alarm SSR Driver.....	2 \$68.00
PEN 2 TYPE/OUTPUT		
	None.....	0 \$0.00
	Recorder Only.....	1 \$400.00
	High Limit.....	2 \$585.00
4:	On-Off Controller Relay.....	3 \$490.00
	On-Off Controller SSR Driver.....	4 \$490.00
	Time Proportioning Relay.....	5 \$690.00
	Time Prop. SSR Driver.....	6 \$690.00
	4-20 mA.....	7 \$724.00
PEN 2 SETPOINT		
	None or Recorder Only.....	0 \$0.00
	Local 3 Digit Pos. Only*.....	1 \$0.00
5:	Local 3 Digit Pos./Neg.*.....	2 \$0.00
	Local 4 Digit Pos. Only*.....	3 \$0.00
	Remote Setpoint**.....	4 \$0.00
PEN 2 SECOND OUTPUT		
	None.....	0 \$0.00
6:	On-Off/Alarm Relay.....	1 \$68.00
	On-Off/Alarm SSR Driver.....	2 \$68.00
INTERNAL OPTIONS		
	None.....	0 \$0.00
	Chart Pin in Chart Flange.....	1 \$17.00
	Event Pen (115 volts only).....	2 \$140.00
7:	Tamperproof Platen.....	3 \$24.00
	Combination 1 & 2.....	4 \$155.00
	Combination 1 & 3.....	5 \$40.00
	Combination 2 & 3.....	6 \$161.00
	Combination 1, 2, 3.....	7 \$180.00

OPTION TABLES CONTINUED ON THE NEXT PAGE

cont.

RECORDERS

ORDERING INFORMATION — ARC 4100 (CONTINUED)

OPTION TABLES

ARC 4100

ENCLOSURE OPTIONS

	Std Cover (Plastic Windows).....	2	\$0.00
8:	Door Lock**	4	\$52.00
	Sealed Conduit Connectors	6	\$52.00
	Door Lock & Sealed Conduit Connectors**	7	\$105.00

CHART ROTATION

	24 Hour	1	\$0.00
	7 Day	2	\$4.00
9:	12 Hour	3	\$35.00
	48 Hour	4	\$48.00
	72 Hour	5	\$113.00

VOLTAGE

	115 Vac, 60 Hz	1	\$0.00
	230 Vac, 60 Hz	2	\$37.00
	115 Vac, 50 Hz	3	\$0.00
	230 Vac, 50 Hz	4	\$37.00

10:

CSA Approved

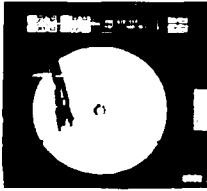
	115 Vac, 60 Hz	5	\$33.00
	230 Vac, 60 Hz	6	\$68.00
	115 Vac, 50 Hz	7	\$33.00
	230 Vac, 50 Hz	8	\$68.00
	None	0	\$0.00

OPTION SUFFIX

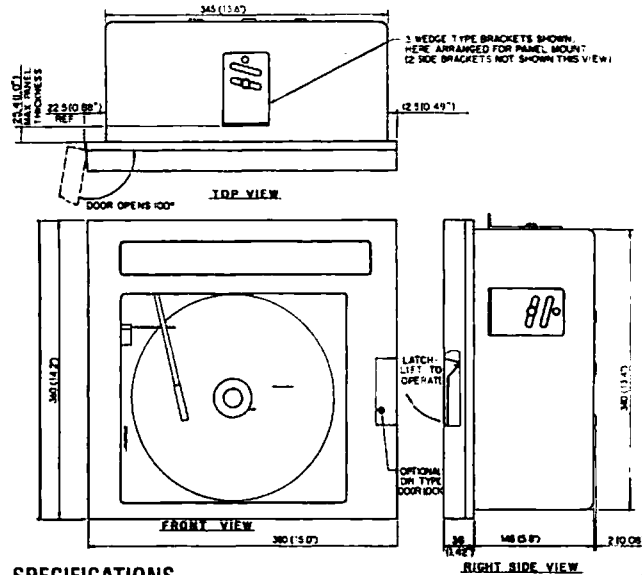
	None	0	\$0.00
	NEMA 3†	N3	\$77.00
	Remote Thumbwheel Only	AV	\$0.00
	RTD Depression Pen 2	AW	\$105.00
11:	Reverse Range Pen 1	HA	\$0.00
	Reverse Range Pen 2	HB	\$0.00
	Reverse Range Pen 1 & 2	HC	\$0.00
	N3 plus Reverse Pen 1	NA	\$77.00
	N3 plus Reverse Pen 2	NB	\$77.00
	N3 plus Reverse Pen 1 & 2	NC	\$77.00

- * Ranges with top span of 1000 are three digit ranges with the setpoint maximum of 999.
- ** If remote Setpoint is selected, Local Setpoint is not available. This is a 1-5 Vdc or 4/20 mA DC Remote Setpoint input type.
- *** Options 6 or 7 shouldn't be ordered without the N3 suffix.
- † N3 NEMA type protection for wet environments.

EXAMPLE NO.: 411000002211
EXAMPLE PRICE: \$775.00



CHESSELL CIRCULAR CHART RECORDER MODEL 392: PROGRAMMABLE CIRCULAR RECORDERS



SPECIFICATIONS

General:

Number of Inputs: 1, 2, 3, or 4
Configuration: Digital display and integral keypad
Writing System: Blue, red, green and black disposable markers-1500% of line (approx. 500m)
Chart Type: Circular, 100mm calibrated width
Chart Speeds: 1 to 4096 hours per revolution
Display: 40-character, vacuum fluorescent digital display

Power: 90-260 Vac, 25 VA (115 W/heater) 24 Vdc, 25W

Performance:

Input Resolution: 0.01% of operating gain span
Pen Response: 1 sec. full scale
Channel Update: Each channel scanned every 250msec
Pen Position Resolution: $0 \pm 1\%$ of chart change
Display Accuracy: 0.02% of operating gain span
CJC Rejection: $\pm 0.5^\circ\text{C}$ from 25°C
Input Impedance: $>20 \text{ Meg}\Omega$

Rejection:

Common Mode: 120dB @ 50/60 Hz.
Normal Mode: 60dB @ 50/60 Hz.

Physical:

Panel Space: $380 \times 360 \text{ mm}$ ($15.0 \times 14.2"$)
Panel Cutout: $345 \times 340 \text{ mm}$ ($13.6 \times 13.4"$)
Depth Behind panel: 148mm (5.8")
Weight: 7 kg (15 lb) typical

Order No.	Description
392	Features: Choice of 1, 2, 3, or 4 pens; 40 character vacuum fluorescent digital display; universal inputs: TCs, RTDs, mA, mV, & Volts; digital accuracy .02% of span; four alarms per channel; EEPROM memory for security; simple on-site configuration using front panel keypad; derived variable for math or special calculated values; built-in 3/2, 5/2, linear, square root, Log 10, linearizations, four totalizers with nine digit readout; two single- or dual-output controllers.

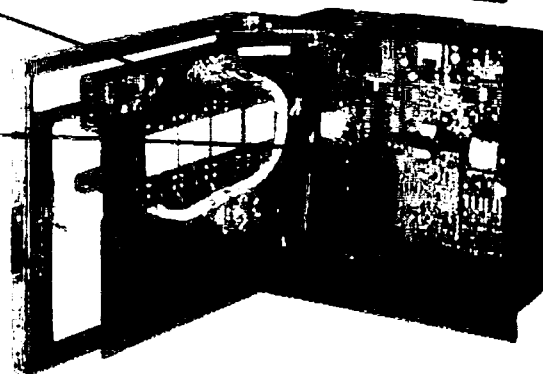
6

**CAPP/USA GIVES BOTH YOU & YOUR PLANT THE FREEDOM,
FLEXIBILITY, & CONVENIENCE OF USING
OUR UNIQUE "BUILD-YOUR-OWN" THERMOCOUPLE & RTD OPTION TABLES.
CAPP = CONVENIENCE**

RECORDERS

EXPLODED VIEW OF CHESSELL MODEL 392

- Two available single- or dual-output controllers provide 3-mode PID control, with a cutback control feature to ease process startups. Cascade or ratio/bias, feedforward, and an internal setpoint generator are available. Outputs include 4-20 mA continuous or relay.
- During configuration, Model 392 prompts the operator to choose from standard process high/low, deadband, or rate-of-change alarms with hysteresis and relay outputs. The Model 392 offers choice of linearizations including TC, RTD, square root, 3/2 and 5/2 power, Log, and custom curve.
- Each pen is individually configured at the touch-panel keypad for a variety of inputs, including standard thermocouples, RTDs, (ANSI/DIN-types), voltage, current, and special ranges. Model 392's four-pen capability saves space, reduces installed cost, and permits at-a-glance monitoring of up to four variables.
- The model 392's available NEMA 4X enclosure is perfect for outdoor locations, standing up to dust, rain, and elements. And it's sized as a direct replacement for our Model 390.
- A new chart pindown method assures positive timing and makes replacing chart paper easier and faster ever.
- Our exclusive new unified servomotor system drives from one to four pens with unprecedented accuracy and reliability. It's based on technologies developed in manufacturing and supporting more than 250,000 recorders — worldwide.
- Extensive use of surface-mount technology (SMT) keeps Model 392 at the leading edge of electronic reliability and performance. Motor drive and display control functions are now integrated on a single board, as part of our efforts to pack higher functionality into minimum space.
- Larger than ever, the Model 392's 40-character vacuum-fluorescent display is highly visible under all lighting conditions and designed to communicate valuable information to the operator — instantly. It displays process variables in engineering units tagging them with meaningful channel identifiers. Menu-driven programming is in plain English, and a scroll routine shows the status of each channel in use.
- Dedicated auto/manual and remote/local keypads let the operator switch easily between control modes, and simultaneously see how the process is affected via the continuously updating display. The internal setpoint generator can provide remote setpoints for each PID controller.
- All functions — including chart speed and ranging, pen and instrument calibration, input type, controller and steeping generator — are configured from the touch-panel keypad. Channel and totalizer tags can be up to 16 characters long for easy recognition.



6

ORDERING INFORMATION — MODEL 392

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 11 TABLES BELOW:

OPTION TABLES

392

NUMBER OF CHANNELS

1:	One	1	\$1,150.00
	Two	2	\$1,605.00
	Three	3	\$2,000.00
	Four	4	\$2,535.00

OPERATING VOLTAGE

2:	110/120 Vac	1	NC
	220/240 Vac	3	NC
	24 Vdc	5	\$156.00

INPUT TYPE

3:	None	0	NC
	Universal V, mV, TC, RTD, mA - requires shunt	1	NC
	>5-100 Vdc (1MW, 100:1 attenuator)	2	\$21.00
	4 to 20 mA (250W shunt)	3	\$21.00

INPUT ISOLATION (see Note 1)

4:	None	0	NC
	2 Pen Isolated	2	\$63.00
	3 Pen Isolated	3	\$83.00
	4 Pen Isolated	4	\$102.00

OUTPUT RELAYS - Maximum 8 Relays

5:	None	0	NC
	Two (one card)	2	\$140.00
	Four (one card)	4	\$235.00
	Six (two cards)	6	\$365.00
	Eight (two cards)	8	\$465.00

CONTROL LOOPS

6:	None	0	NC
	Current Adjusting Type (CAT), 4-20 mA	1	\$480.00
	Duration Adjusting Type (DAT), Relay Output	2	\$480.00
	Duplex (1 loop, 2 outputs) CAT	3	\$590.00
	Duplex (1 loop, 2 relays) DAT	4	\$590.00

SETPOINT GENERATOR - 4 Recipes of 20 Segments Each

7:	None	0	NC
	Yes	1	\$308.00

CASE & MOUNTING

8:	NEMA 3 Panel	0	NC
	NEMA 3 Pipe, 2"	1	NC
	NEMA 4 Panel	2	\$127.00
	NEMA 4 Pipe, 2"	3	\$127.00
	NEMA 4X Panel	4	\$161.00
	NEMA 4X Pipe, 2"	5	\$161.00

OPTION TABLES CONTINUED ON THE NEXT PAGE

6

cont.



RECORDERS

ORDERING INFORMATION — MODEL 392 (CONTINUED)

OPTION TABLES 392

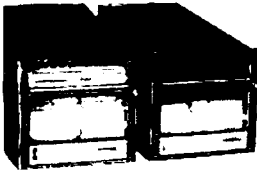
Door Lock			
9:	None	0	NC
	Yes	1	\$46.00
Transducer Power Supply - Specify Inputs to be Powered			
10:	None	0	NC
	Yes	1	\$181.00
Totalizers (Integrators)			
	None	0	NC
	One	1	\$220.00
11:	Two	2	\$400.00
	Three	3	\$590.00
	Four	4	\$775.00

NOTE 1 - All 1-channel recorders are inherently isolated (no other channel and common is not grounded). Two channel input cards cannot be split into one non-isolated. Recorders cannot be split into part isolated and part non-isolated. Isolated cards have 250V isolation between adjacent channels and ground. All non-isolated inputs share a common negative terminal which is recorder common, NOT ground.

NOTE 2 - There are three Option Card positions. 4 Output Relays take one and 8 Output Relays take two positions. Two Retransmission/Control Outputs and 8 Event Inputs share a common card and take only one position.

EXAMPLE NO.: 392-1-1-1-0-0-0-0-1-0-0
EXAMPLE PRICE: \$1,196.00

CHELSELL MULTIPOINT STRIP CHART RECORDERS SERIES 344, 345, 346 100MM RECORDER/LOGGER



344 & 345 SERIES

The power of full programmability. Fully user-programmable, continuous, strip chart recorders with an unrivalled range of annotation, math processing and hardware options.

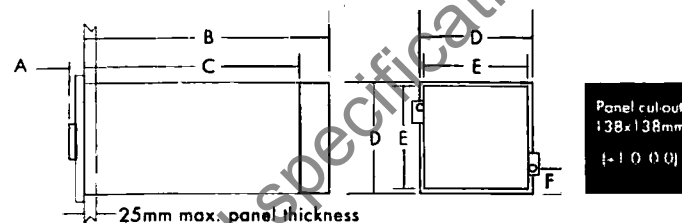
Features: Up to 3 input channels; Universal inputs; Standard user linearisation selections; High visibility tracing and optional annotation for logging, scale and event message printing; Fully user-selectable chart speed in range 10-36000 mm/hr (0.5-900 in/hr) manually or event triggered; and Choice of manual/auto take-up roll or Z-fold cassettes.

Order No.	Description
344	Offers ribbon indication for instant comprehension of fast moving signals and easy viewing at a distance; high visibility coloured tape indication. Operator access to chart on/off, alternate chart speed, start log, alarm adjustment and totalizer reset. Menu-driven configuration with plain English prompts using a rugged handheld terminal.
345	Offers high resolution digital display of process variables and related tags with provision for full configuration from the front panel. 2 x 20 character high resolution display for process variables and user interaction. Full interactive access to chart speed, batch number and much more. Menu-driven configuration with plain English prompts using a integral keypad.

Installation

Maximum wire size 1mm²

Terminal type Screw



Dimensions (mm)

A	B	C	D	E	F
17	375 (long cover)	345 (short cover)	144	137	32

346 SERIES

Features: Up to 6 input channels; Universal inputs; Standard user linearisation selections; High density tracing with multi-colour annotation for logging, scale and event message printing as standard; Fully user-selectable chart speed in range 10-36000 mm/hr (0.5-900 in/hr) manually or event triggered;

Choice of manual/auto take-up roll or Z-fold cassettes; 2 x 20 character high resolution display; Full interactive access to chart speed; Menu-driven configuration with plain English prompts. Reconfigure from front of instrument.

Order No.	Description
346	The most fully featured dotting, strip chart recorder of its class, offering high clarity, 6-colour tracing and printing of inputs with the option of three derived channels to give a total of nine recorded values. Easy-to-operate-and-program user interface for simple, front panel configuration to your process together with exceptionally wide range of application oriented math processing features.

ORDERING INFORMATION — MODEL 344

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 13 TABLES BELOW:

OPTION TABLES

344

NUMBER OF CHANNELS

1:	One.....	1	\$1,670.00
	Two.....	2	\$1,800.00
	Three.....	3	\$2,460.00

OPERATING VOLTAGE

2:	110/120 Vac.....	1	N/C
	220/240 Vac.....	3	N/C
	24 Vdc.....	5	N/C

INPUTS (Specify Channel Position and Scale Range - See Note 3)

	None.....	0	N/C
	4-20 mA.....	4	\$15.00
	Universal (TC, RTD, mV, V).....	6	N/C
	>5-100 Vdc.....	7	\$22.00
3:	4-2 mA without pen.....	1	N/C
	Universal without pen.....	2	N/C
	>5-100 Vdc without pen.....	3	N/C
	Pen without input.....	5	N/C

RELAY OUTPUTS

	None.....	0	N/C
4:	Two Relay Card.....specify up to.....	2	\$240.00
	Four Relay Card.....THREE cards.....	3	\$240.00
	Six Relay Card.....(max 2) See note 1.....	5	\$395.00
	for restrictions		

CHART ILLUMINATION

5:	None.....	0	N/C
	Yes.....	1	\$125.00

CHART & PENS (See Note 2)

6:	Roll, Standard Pens.....	0	\$60.00
	Z-Fold, Standard Pens.....	1	N/C
	Roll, Extended Pens.....	2	\$60.00
	Z-Fold, Extended Pens.....	3	N/C

CHART SPEED

	1mm/hr to 1 cm/sec Configurable.....	6	N/C
--	--------------------------------------	---	-----

DOOR OPTIONS

	Standard, Glass.....	0	N/C
	Standard, Glass, Lock.....	1	\$50.00
	Standard, Polycarb.....	2	\$50.00
7:	Standard, Polycarb, Lock.....	3	\$100.00
	Full View, Glass.....	4	\$50.00
	Full View, Glass, Lock.....	5	\$95.00
	Full View, Polycarb.....	6	\$95.00
	Full View, Polycarb, Lock.....	7	\$150.00

OPTION TABLES CONTINUED ON THE NEXT PAGE

RECORDERS

ORDERING INFORMATION — MODEL 344 (CONTINUED)

**OPTION
TABLES**

344

TRANSDUCER POWER SUPPLY (includes Extended Terminal Cover and Flange)		
8:	None.....	0 N/C
	Three Channel.....	1 \$200.00
CONDUIT MOUNTING FLANGE (with Extended Terminal Cover)		
9:	None.....	0 N/C
	Yes.....	1 \$100.00
ANNOTATION (Printing) and CLOCK		
10:	None.....	0 N/C
	Yes.....	1 \$200.00
CUSTOM MESSAGE (User Defined Messages - Requires Annotation Option)		
11:	None.....	0 N/C
	Yes.....	1 \$65.00
TOTALIZER (Requires Annotation Option)		
	None.....	0 N/C
	One.....	1 \$195.00
12:	Two.....	2 \$400.00
	Three.....	3 \$630.00
	Four.....	4 \$770.00
	Five.....	5 \$895.00
	Six.....	6 \$1,170.00
TOTALIZER OUTPUT (Requires Relay Option)		
	None.....	0 N/C
	One.....	1 \$80.00
13:	Two.....	2 \$120.00
	Three.....	3 \$190.00
	Four.....	4 \$217.00
	Five.....	5 \$280.00
	Six.....	6 \$330.00

NOTE 1 - Each recorder has THREE OPTION SLOTS. EACH relay card takes a slot. Retransmission takes a slot. Communications and Event Inputs share a common slot. The 6-relay card CANNOT go into bottom slot 5. Slot 3 relays are numbered 1 thru 6, slot 4 are 7 thru 12 and slot 5 are 13 thru 16 — no matter how many relays in each slot.

NOTE 2 - With chart illumination, extended pens available on one and two channel recorders only.

NOTE 3 - AC and DC inputs cannot be mixed on same recorder. AC inputs are between 0-1.7 Vac at 50 or 60 Hq. Accuracy is + 2%.

Each recorder is shipped with: two mounting clamps, one roll or Z-fold chart, one marker for each ordered pen and one installation and operation manual.

EXAMPLE NO.: 344-1-0-0-1-0-6-0-0-0-0-0

EXAMPLE PRICE: \$1,795.00

6

RECORDERS

ORDERING INFORMATION — SERIES 346

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 11 TABLES BELOW:

OPTION TABLES

346

NUMBER OF CHANNELS

	None.....	0	\$2,410.00
	One.....	1	\$3,550.00
	Two.....	2	\$2,550.00
1:	Three.....	3	\$2,620.00
	Four.....	4	\$2,700.00
	Five.....	5	\$2,805.00
	Six.....	6	\$2,955.00

OPERATING VOLTAGE

	110/120 Vac.....	1	N/C
2:	220/240 Vac.....	3	N/C
	24 Vdc.....	5	N/C

INPUTS (Specify Channel Position - See Note 2)

	None.....	0	N/C
	4-20 mA.....	4	\$15.00
3:	Universal (TC, RTD, mV, V).....	6	N/C
	>5-100 Vdc.....	7	\$22.00

RELAY OUTPUTS (See Note 1)

	None.....	0	N/C
4:	Two Relay Card..... specify	2	\$140.00
	Four Relay Card..... up to	3	\$260.00
	Six Relay Card..... THREE cards	5	\$380.00

FIXED DIGIT

.....	0	N/C
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CHART TYPE

5:	Roll	0	\$60.00
	Z-fold	1	N/C

CHART SPEED

1mm/hr to 1 cm/sec Configurable.....	6	N/C
--------------------------------------	---	-----

DOOR OPTIONS

	Standard, Glass.....	0	N/C
	Standard, Glass, Lock.....	1	\$50.00
	Standard, Polycarb.....	2	\$50.00
6:	Standard, Polycarb, Lock.....	3	\$100.00
	Full View, Glass.....	4	\$50.00
	Full View, Glass, Lock.....	5	\$100.00
	Full View, Polycarb.....	6	\$100.00
	Full View, Polycarb, Lock.....	7	\$150.00

OPTION TABLES CONTINUED ON THE NEXT PAGE

ORDERING INFORMATION — SERIES 346 (CONTINUED)

OPTION TABLES

346

TRANSDUCER POWER SUPPLY (includes Extended Terminal Cover and Flange)

7:	None.....	0	N/C
	Three Channel.....	1	\$190.00
	Six Channel.....	2	\$375.00

CONDUIT MOUNTING FLANGE (with Extended Terminal Cover)

8:	None.....	0	N/C
	Yes.....	1	\$55.00

STANDARD ANNOTATION AND CLOCK

.....	1	N/C
-------	---	-----

CUSTOM MESSAGES (User Defined Messages)

9:	None.....	0	N/C
	Yes.....	1	\$60.00

TOTALIZER

	None.....	0	N/C
	One.....	1	\$225.00
	Two.....	2	\$430.00
10:	Three.....	3	\$615.00
	Four.....	4	\$780.00
	Five.....	5	\$880.00
	Six.....	6	\$1,145.00

TOTALIZER OUTPUT (Requires Relay Option)

	None.....	0	N/C
	One.....	1	\$80.00
	Two.....	2	\$115.00
11:	Three.....	3	\$200.00
	Four.....	4	\$225.00
	Five.....	5	\$300.00
	Six.....	6	\$350.00

NOTE 1 - Each recorder has THREE OPTION SLOTS. EACH relay card takes a slot. Retransmission takes a lot. Communications and Event Inputs share a common slot. The 6-relay card CANNOT go into bottom slot 5. Slot 3 relays are numbered 1 thru 6, slot 4 are 7 thru 12 and slot 5 are 13 thru 16 — no matter how many relays in each slot.

NOTE 2 - AC and DC inputs cannot be mixed on same input card. Channels 1, 2 & 3 or 4, 5 & 6 must be all AC or all DC. AC inputs are between 0-1.7 Vac and 0-5 Vac at 50 or 60 Hz. Accuracy is +2%.

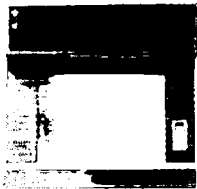
Each recorder is shipped with: two mounting clamps, one roll or one Z-fold chart, one multicolor printhead and one installation and operation manual.

EXAMPLE NO.: 346-0-1-4-0-0-0-6-1-0-0-1-0-0-0

EXAMPLE PRICE: \$2,475.00

6

RECORDERS



CHESELL MULTIPOINT STRIP CHART RECORDERS SERIES 4180 180mm RECORDERS

The most advanced, versatile and robust 180mm recorders available today; unrivalled for cost effective recording. Up to 24 channels can be recorded on the 4180M high speed multipoint dotter, with 6 continuous traces on the 4180C. The 80 character VFD dot matrix display provides both bar graph and digital display of channel tags, values and engineering units.

Availability of options, ease of configuration and low cost mean these recorders meet the most demanding of applications.

Optional memory card stores configurations and archives up to 2 Mb of data on a standard PCMCIA card. Data is stored in standard DOS format for ease of analysis using standard spreadsheet software packages.

Comprehensive alarms package allows up to 4 alarms per channel to be used with relays, for external alarming or as triggers to initiate jobs such as changing print colour on alarm, initiating messages, changing range etc.

Quick and easy password protected configuration via front panel keys gives access to all recorder variables. An optional PC package allows even faster configuration.

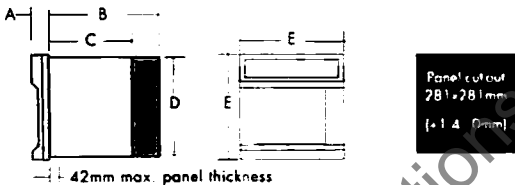
180mm recording width-giving increased readability at very reasonable cost.

80 character VFD dot matrix display provides simultaneous high resolution digital and analogue bar graph indication of both calculated and input channel values.

8 Channel universal input card accepts signals from all analogue and digital measurements including TCs, RTDs, mVs, Volts, mA, ohms and contact closures.

Cost effective, 16 channel DC input card accepts all analogue and digital inputs except RTDs.

Full colour text annotation of time, data, scales, alarm messages and logs providing exceptionally clear and complete records.



Dimensions (mm)

A	B	C	D	E
46	304	275	278	288

SERIES 4180C

Order No.	Description
4180M	Features: 6 colour dot printing provides high quality and exceptionally fast trending of up to 24 channels in just 3 seconds. All inputs are scanned and updated every second to permit fast response to alarms and changes in channel values.
4180C	Unique Trace-Lock software produces continuous recording without the expense associated with individual pens and provides the added clarity of multicolour annotation. Up to 6 channels can be continuously traced in different colours for maximum readability. The high speed, 8 channel universal input card provides 0.25 second updating of data to ensure that changes in values are never missed.

ORDERING INFORMATION — SERIES 4180C

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 9 TABLES BELOW:

OPTION TABLES

4180C

Number of Traces			
1:	Two.....	2	\$2,750.00
	Four.....	4	\$3,430.00
	Six.....	6	\$4,110.00
Additional Universal Inputs (see Note 2)			
2:	None.....	0	NC
	Eights (second card).....	1	\$390.00
	Sixteen (second & third cards).....	2	\$735.00
250 Ohm Shunt (4-20 mA) two digits,			
3:	00 to 08 (see Note 1) 00.....		\$10.00
100 Ohm Shunt (4-20 mA) specify two digits,			
4:	00 to 08 (see Note 1) 00.....		\$10.00
Door Type			
5:	Glass Window.....	2	NC
	Polycarbonate Window.....	3	\$45.00
Operating Volts			
6:	90-130 Vac, 50/60 Hz.....	1	NC
	190-260 Vac, 50/60 Hz.....	2	NC
Relay Outputs (see Note 2)			
7:	None.....	0	NC
	Eight Relays (one card).....	1	\$500.00
	Sixteen Relays (two cards).....	2	\$950.00
	Twenty-four Relays (three cards).....	3	\$1,400.00
Mounting			
8:	Panel.....	0	NC
	Bench Stand/Handle.....	1	\$55.00
Communications - RS232/422			
9:	None.....	0	NC
	Yes.....	1	\$350.00

NOTE 1 - 16 Channel card input terminal spacing does not permit mounting shunt or attenuator on adjacent channels.

NOTE 2 - There are a maximum of three (3) input/relay card positions. One 8-channel Universal input card is included as standard. Each 8 Universal inputs take one position, each 16 dc inputs take one position, each 8 relays take one position. The sum of input and relay cards selected cannot exceed three (3) cards.

EXAMPLE NO.: 4180C-2-0-00-00-3-1-0-0-0
EXAMPLE PRICE: \$2,795.00

RECORDERS

ORDERING INFORMATION — SERIES 4180G

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 17 TABLES BELOW:

OPTION TABLES

4180G.....\$6,980.00

Universal Inputs (see Note 3)

	None.....0	\$0.00
1:	Eights (one card).....1	\$355.00
	Sixteen (two cards).....2	\$710.00
	Twenty-four (three cards).....3	\$1,063.00

Two-wire DC Inputs (see Notes 2&3)

	None.....0	\$0.00
2:	Sixteen (one card).....1	\$485.00
	Thirty-two (two cards).....2	\$945.00
	Forty-eight (three cards).....3	\$1,411.00

3:	250 Ohm Shunt (4-20 mA) two digits, 00 to 08 (see Note 2) 00.....	\$10.00
----	--	---------

4:	100 Ohm Shunt (4-20 mA) specify two digits, 00 to 08 (see Note 2) 00.....	\$10.00
----	--	---------

5:	100:1 Attenuator (1 M Ohm) specify two digits, 00 to 08 (see Note 2) 00.....	\$20.00
----	---	---------

Operating Volts

6:	90-130 Vac, 50/60 Hz.....1	\$0.00
	190-260 Vac, 50/60 Hz.....2	\$0.00

Chart Type

7:	None.....0	\$0.00
	Z-fold, 22 meters.....1	\$0.00

Relay Outputs (see Note 3)

	None.....0	\$0.00
8:	Eights (one card).....1	\$480.00
	Sixteen (two cards).....2	\$926.00
	Twenty-four (three cards).....3	\$1,386.00

Mounting

9:	Panel.....0	\$0.00
	Bench Stand/Handle.....1	\$50.00

Communications - RS232/422

10:	None.....0	\$0.00
	Yes.....1	\$318.00

OPTION TABLES CONTINUED ON THE NEXT PAGE

ORDERING INFORMATION — SERIES 4180G (CONTINUED)

OPTION TABLES

4180G

Memory Card Drive (See Note 1)		
11:	None.....0	\$0.00
	Yes.....1	\$0.00
Memory Card Size		
	None.....0	\$0.00
12:	128K.....1	\$98.00
	512K.....2	\$196.00
	2 Meg.....3	\$343.00
Archiving Software (See Note 1)		
	Configuration Save/Restore.....0	\$0.00
13:	ASCII Data Logging.....1	\$315.00
	ASCII plus Packed Data.....3	\$411.00
Math Calculations - Derived Variable (DV) Calculations		
	None.....0	\$0.00
14:	Level I (32 DV's, basic math: +, -, *, /, constant, copy).....1	\$130.00
	Level II (32 DV's, basic and advanced math).....2	\$392.00
	CEM (Level II with 96 DV's & 12 ea. Totalizers, Timers and Counters).....3	\$686.00
12 Totalizers, 12 Timers & 12 Counters		
15:	None.....0	\$0.00
	Yes.....1	\$460.00
PC Configuration Software		
16:	None.....0	\$0.00
	Yes.....1	\$160.00
Factory Configuration		
	None.....0	\$0.00
	Channel & Group Configuration Only.....1	\$102.00
17:	With Any Other Standard Functions (i.e., alarms, messages, events, custom scales, etc.).....2	\$284.00
	With Optional Functions (Totalizers, Timers, Counters, etc.).....3	\$347.00
	With Options and Derived Channel Calculations.....4	\$445.00

NOTE 1 -Memory Card Reader REQUIRED to have the facility to save and restore configurations. ASCII Logging is in comma delimited (spreadsheet) format and includes optional storage For direct recorder chart playback. Packed Logging includes ASCII logging and two levels of data compression. A DOS disk is supplied to uncompress to ASCII format.

NOTE 2 -16 Channel card input terminal spacing does not permit mounting shunt or attenuator on adjacent channels.

NOTE 3 -There are a maximum of three (3) input/relay card positions. There are no input cards included as standard. Each 8 Universal inputs take one position, each 16 dc inputs take one position, each 8 relays take one position. The sum of input and relay cards selected cannot exceed three (3) cards.

EXAMPLE NO.: 4180G-1-0-00-00-00-1-1-1-1-0-0-0-1-0-1-0-0
EXAMPLE PRICE: \$8,770.00

RECORDERS

ORDERING INFORMATION — SERIES 4180M

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 9 TABLES BELOW:

OPTION TABLES

4180M \$3,795.00

Universal Inputs (see Note 2)			
	None.....0	NC	
1:	Eights (one card).....1	\$365.00	
	Sixteen (two cards).....2	\$715.00	
	Twenty-four (three cards).....3	\$1,070.00	
Two-wire DC Inputs (see Notes 1&2)			
	None.....0	NC	
2:	Sixteen (one card).....1	\$475.00	
	Thirty-two (two cards).....2	\$946.00	
250 Ohm Shunt (4-20 mA) two digits,			
3:	00 to 24 (see Note 1) 00.....	\$10.00	
100 Ohm Shunt (4-20 mA) specify two digits,			
4:	00 to 24 (see Note 1) 00.....	\$10.00	
Door Type			
5:	Glass Window.....2	NC	
	Polycarbonate Window.....3	\$45.00	
Operating Volts			
6:	90-130 Vac, 50/60 Hz.....1	NC	
	190-260 Vac, 50/60 Hz.....2	NC	
Relay Outputs (see Note 4)			
	None.....0	NC	
7:	Eight Relays (one card).....1	\$475.00	
	Sixteen Relays (two cards).....2	\$935.00	
	Twenty-four Relays (three cards).....3	\$1,400.00	
Mounting			
8:	Panel.....0	NC	
	Bench Stand/Handle.....1	\$55.00	
Communications - RS232/422			
9:	None.....0	NC	
	Yes.....1	\$325.00	

NOTE 1 - 16 Channel card input terminal spacing does not permit mounting shunt or attenuator on adjacent channels.

NOTE 2 There are a maximum of three (3) input/relay card positions. There are no input cards included as standard. Each 8 Universal inputs take one position, each 16 dc inputs take one position, each 8 relays take one position. The sum of input and relay cards selected cannot exceed three (3) cards.

EXAMPLE NO.: 4180M-0-0-00-00-3-1-0-0-0
EXAMPLE PRICE: \$3,840.00



CHESELL MULTIPOINT STRIP CHART RECORDERS SERIES 4250 250mm RECORDERS

4250c—250mm CONTINUOUS RECORDER; HIGH SPEED PROCESSING, EASE OF CONFIGURATION

Features:

Up to 4 continuous colour writing pens for clarity of recording. Full scale pen speed <0.5 seconds over 90% of 250mm chart width.

High speed annotation of text, scales and logs giving information over the full chart width for maximum understanding of recorded data.

A multi-colour, 80 character VFD display provides both analogue bar graphs and digital values of all channels. Information displayed includes channel descriptors, tags, engineering units and alarms for all input and calculated channels.

All inputs are converted to digital values using high accuracy, state-of-the-art A/D converters ensuring maximum performance and accuracy. Rapid response updates all inputs, alarms and calculations up to 4 times per second.

Optional memory card stores configurations and archives up to 2 Mb of data on a PCMCIA SRAM card in DOS format for ease of analysis using standard spreadsheet software packages. Packed format can increase storage capacity by up to 70%.

Pen offset compensation eliminates time differential between the traces in 2, 3 and 4 pen recorders, greatly enhancing the readability of the chart record.

Maths pack option gives powerful calculating capability permitting advanced calculations and enabling all calculated channels to be recorded and/or indicated.

Host communications, using selectable RS232 or RS485, give real time access to data.

Sophisticated alarm strategies can be implemented with 4 fully configurable alarms per channel.

Order No.	Description
4250C	All new 250mm continuous trace recorder combining the latest technology with high speed processing and ease of configuration—the most flexible recorder of its type available today. Extensive options make it the ideal recorder for the toughest process or laboratory applications.

4250M—250mm MULTIPOINT RECORDER; POWERFUL YET PRACTICAL

Features:

Provision for up to 96 inputs with high performance 8-channel universal input cards for all analogue and digital measurements, including mV, Volts, mA, TC, RTD, resistance and volt free contact closures or with cost-effective 16-channel DC input cards.

Excellent clarity with high definition tracing and annotation. Up to 45 traces updates per sec.

Fully configurable message and log formats for report generation.

Roll or Z-fold cassette.

Colour bar graphs and alarm annunciation for clear indication.

Operator configurable key-board built into chart window that remains Secret-Til-Lit.

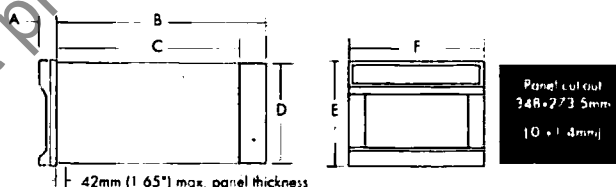
Almost limitless external control of instrument operation for process driven applications. Actions can be triggered by alarms, totalizer and counter thresholds, timers, events.

Simple yet powerful alarm strategies—truly an alarm monitor in its own right.

Memory card option stores instrument configurations and archives process data. Stored data can be transferred to a PC for more detailed analysis or used to produce identical chart copies on the recorder.

Built-in CEM (Continuous Emissions Monitoring) functions provide cost-effective solutions for recording and logging emissions data as required by current legislation.

Trace generator can provide visible process limits for quality monitoring and sterilizer validation.



Dimensions mm (inches)

A	B	C	D	E	F
53	450	410	271	288	360
(2.1")	(17.7")	(16.1")	(10.7")	(11.3")	(14.2")

Order No.	Description
4250M	The most advanced programmable chart recorder in any class. State-of-the-art chart display and unique features, such as Secret-Til-Lit keyboard with interactive operator interface, offer the user a powerful array of practical enhancements to traditional recorder functions. Applications-oriented to meet both your simplest and most demanding processing and monitoring needs.

RECORDERS

ORDERING INFORMATION — SERIES 4250C

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 10 TABLES BELOW:

OPTION TABLES

4250C

Number of Pens (with 8 inputs)			
1:	One	1	\$3,500.00
	Two	2	\$4,500.00
	Three	3	\$5,500.00
	Four	4	\$6,500.00
Additional Universal Inputs (see Note1)			
2:	None	0	NC
	Eights (second card)	1	\$365.00
	Sixteen (second & third cards)	2	\$710.00
250 Ohm Shunt (4-20 mA) two digits,			
3:	00 to 16 00		\$10.00
100 Ohm Shunt (4-20 mA) specify two digits,			
4:	00 to 16 00		\$10.00
Operating Volts			
5:	90-130 Vac, 50/60 Hz	1	NC
	190-260 Vac, 50/60 Hz	2	NC
Chart Type			
6:	Z-fold, 22 meters	1	NC
	Roll, 32 meters	2	\$130.00
Relay Outputs (see Note 1)			
7:	None	0	NC
	Eights (one card)	1	\$475.00
	Sixteen (two cards)	2	\$935.00
	Twenty-four (three cards)	3	\$1,400.00
Mounting			
8:	Panel	0	NC
	Bench Stand/Handle	1	\$55.00
Communications - RS232/422			
9:	None	0	NC
	Yes	1	\$325.00
Annotation			
10:	None	0	NC
	Yes	1	\$270.00

NOTE 1 - There are a maximum of seven (7) input/relay card positions. There are no input cards included as standard. Each 8 Universal inputs take one position, each 16 dc inputs take one position, each 8 relays take one position. The sum of input and relay cards selected cannot exceed seven (7) cards.

EXAMPLE NO.: 4250C-1-0-00-00-1-2-0-0-0-0
EXAMPLE PRICE: \$3,630.00

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RECORDERS

ORDERING INFORMATION — SERIES 4250G

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 20 TABLES BELOW:

OPTION TABLES4250G\$8,885.00

Universal Inputs (see Note 3)		
	None	0 \$0.00
	Eights (one card).....	1 \$360.00
	Sixteen (two cards).....	2 \$710.00
1:	Twenty-four (three cards).....	3 \$1,065.00
	Thirty-two (four cards).....	4 \$1,411.00
	Forty (five cards).....	5 \$1,764.00
	Forty-eight (six cards).....	6 \$2,116.00
	Fifty-six (seven cards).....	7 \$2,469.00
Two-wire DC Inputs (see Notes 2&3)		
	None	0 \$0.00
	Sixteen (one card).....	1 \$485.00
	Thirty-two (two cards)	2 \$945.00
2:	Forty-eight (three cards).....	3 \$1,416.00
	Sixty-four (four cards).....	4 \$1,886.00
	Eighty (five cards)	5 \$2,356.00
	Ninety-six (six cards).....	6 \$2,827.00
250 Ohm Shunt (4-20 mA) two digits,		
3:	00 to 24 (see Note 2) 00	\$10.00
100 Ohm Shunt (4-20 mA) specify two digits,		
4:	00 to 24 (see Note 2) 00.....	\$10.00
100:1 Attenuator (1 M Ohm) specify two digits,		
5:	00 to 24 (see Note 2) 00.....	\$20.00
Operating Volts		
6:	90-130 Vac, 50/60 Hz	1 \$0.00
	190-260 Vac, 50/60 Hz	2 \$0.00
Chart Type		
7:	Z-fold, 22 meters.....	1 \$0.00
	Roll, 32 meters.....	2 \$127.00
Relay Outputs (see Note 3)		
	None	0 \$0.00
	Eights (one card).....	1 \$475.00
	Sixteen (two cards).....	2 \$926.00
8:	Twenty-four (three cards).....	3 \$1,386.00
	Thirty-two (four cards).....	4 \$1,847.00
	Forty (five cards).....	5 \$2,307.00
	Forty-eight (six cards).....	6 \$2,768.00
	Fifty-six (seven cards).....	7 \$3,229.00
Mounting		
9:	Panel	0 \$0.00
	Bench Stand/Handle	1 \$51.00
Communications - RS232/422		
10:	None	0 \$0.00
	Yes.....	1 \$318.00

OPTION TABLES CONTINUED ON THE NEXT PAGE

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cont.

RECORDERS

ORDERING INFORMATION — SERIES 4250G (CONTINUED)

OPTION TABLES

4250G

Memory Card Drive (See Note 1)		
11:	None	0 \$0.00
	Yes	1 \$0.00
Memory Card Size		
12:	None	0 \$0.00
	128K	1 \$98.00
	512K	2 \$196.00
	2 Meg	3 \$343.00
Archiving Software (See Note 1)		
13:	Configuration Save/Restore	0 \$0.00
	ASCII Data Logging	1 \$308.00
	ASCII plus Packed Data	3 \$411.00
Math Calculations - Derived Variable (DV) Calculations		
14:	None	0 \$0.00
	Level I (32 DV's, basic math: +, -, *, /, constant, copy)	1 \$147.00
	Level II (32 DV's, basic and advanced math)	2 \$416.00
	CEM (Level II with 96 DV's & 12 ea. Totalizers, Timers and Counters	3 \$833.00
	00 to 24 (see Note 2)	4 \$833.00
Rolling Memory		
15:	None	0 \$0.00
	Yes	1 \$308.00
12 Totalizers & 12 Counters		
16:	None	0 \$0.00
	Yes	1 \$259.00
12 Counters & 12 Timers		
17:	None	0 \$0.00
	Yes	1 \$259.00
12 Totalizers, 12 Timers & 12 Counters		
18:	None	0 \$0.00
	Yes	1 \$460.00
PC Configuration Software		
19:	None	0 \$0.00
	Yes	1 \$156.00
Factory Configuration		
20:	None	0 \$0.00
	Channel & Group Configuration Only	1 \$102.00
	With Any Other Standard Functions (i.e., alarms, messages, events, custom scales, etc.)	2 \$284.00
	With Optional Functions (Totalizers, Timers, Counters, etc.)	3 \$347.00
	With Options and Derived Channel Calculations	4 \$445.00

NOTE 1 - Memory Card Reader REQUIRED to have the facility to save and restore configurations. ASCII Logging is in comma delimited (spreadsheet) format and includes optional storage for direct recorder chart playback. Packed Logging includes ASCII logging and two levels of data compression. A DOS disk is supplied to uncompress to ASCII format.

NOTE 2 - 16 Channel card input terminal spacing does not permit mounting shunt or attenuator on adjacent channels.

NOTE 3 - There are a maximum of seven (7) input/relay card positions. There are no input cards included as standard. Each 8 Universal inputs take one position, each 16 dc inputs take one position, each 8 relays take one position. The sum of input and relay cards selected cannot exceed seven (7) cards.

EXAMPLE NO.: 4250G-3-0-00-00-1-1-3-1-1-0-0-1-0-1-0-0-0-1-1
EXAMPLE PRICE: \$12,579.00

ORDERING INFORMATION — SERIES 4250M

ORDERING IS **EASY** — JUST SELECT AN OPTION
FROM THE 11 TABLES BELOW:

OPTION TABLES

4250M\$4,755.00

Universal Inputs (see Note 2)

	None	0	NC
	Eights (one card)	1	\$365.00
	Sixteen (two cards)	2	\$715.00
1:	Twenty-four (three cards)	3	\$1,070.00
	Thirty-two (four cards)	4	\$1,415.00
	Forty (five cards)	5	\$1,764.00
	Forty-eight (six cards)	6	\$2,116.00
	Fifty-six (seven cards)	7	\$2,477.00

Two-wire DC Inputs (see Notes 1&2)

	None	0	NC
	Sixteen (one card)	1	\$480.00
	Thirty-two (two cards)	2	\$960.00
2:	Forty-eight (three cards)	3	\$1,420.00
	Sixty-four (four cards)	4	\$1,890.00
	Eighty (five cards)	5	\$2,360.00
	Ninety-six (six cards)	6	\$2,781.00

3:	250 Ohm Shunt (4-20 mA) two digits, 00 to 24 (see Note 1) 00	\$10.00
----	---	---------

4:	100 Ohm Shunt (4-20 mA) specify two digits, 00 to 24 (see Note 1) 00	\$10.00
----	---	---------

5:	100:1 Attenuator (1 M Ohm) specify two digits, 00 to 24 (see Note 1) 00	\$20.00
----	--	---------

Secret-til-lit Keyboard			
6:	None	0	NC
	Yes	1	\$156.00

Operating Volts			
7:	90-130 Vac, 50/60 Hz	1	NC
	190-260 Vac, 50/60 Hz	2	NC

Chart Type			
8:	Z-fold, 22 meters	1	NC
	Roll, 32 meters	2	\$130.00

Relay Outputs (see Note 2)			
	None	0	NC
	Eights (one card)	1	\$480.00
	Sixteen (two cards)	2	\$930.00
9:	Twenty-four (three cards)	3	\$1,390.00
	Thirty-two (four cards)	4	\$1,850.00
	Forty (five cards)	5	\$2,307.00
	Forty-eight (six cards)	6	\$2,768.00
	Fifty-six (seven cards)	7	\$3,230.00

OPTION TABLES CONTINUED ON THE NEXT PAGE

cont.

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RECORDERS

ORDERING INFORMATION — SERIES 4250M (CONTINUED)

OPTION
TABLES

4250M

Mounting

10: Panel0 NC

Bench Stand/Handle1 \$55.00

Communications - RS232/422

11: None0 NC

Yes1 \$325.00

NOTE 1 - 16 Channel card input terminal spacing does not permit mounting shunt or attenuator on adjacent channels.

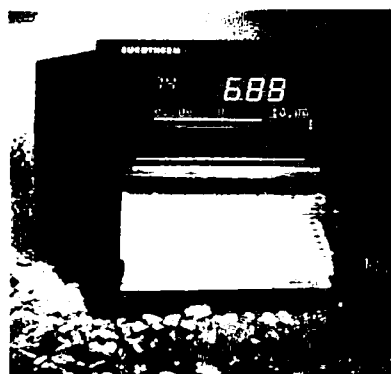
NOTE 2 - There are a maximum of seven (7) input/relay card positions. There are no input cards included as standard. Each 8 Universal inputs take one position, each 16 dc inputs take one position, each 8 relays take one position. The sum of input and relay cards selected cannot exceed seven (7) cards.

EXAMPLE NO.: 4250M-2-1-00-00-00-1-1-1-2-0-1

EXAMPLE PRICE: \$7,361.00

For current pricing and specifications, please contact us.

CHESELL 4103C RECORDER



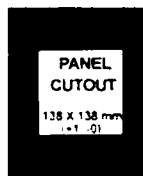
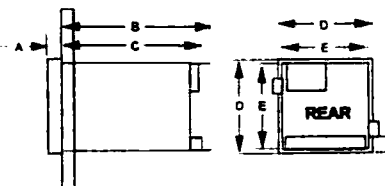
Physical

Panel mounting
Bezel size
Weight
Panel mounting

5.7" x 5.7"

DIN43700
144 x 144 mm.
3.5 kg (7.75 lb.)
Vertical $\pm 30^\circ$

A	B	C
27	236 (with cover)	220 (w/o cover)
1.06	9.29	8.66



D	E	F
144	137	35
5.67	5.39	1.38

- 4-Pen, 4-color continuous trace recorder
- Vivid 4-color display with bargraphs
- Universal isolated inputs
- Only 236mm depth behind panel
- Front panel or PC configuration

- Math, timers, counters and totalizers
- PCMCIA memory card drive
- Up to 16 relay outputs
- Up to 4 analog outputs
- Up to 16 contact inputs

TECHNICAL SPECIFICATIONS:

GENERAL

Max. number of inputs	Four
Input ranges	$\pm 38\text{mV}$, $\pm 150\text{mV}$, $\pm 1\text{ Volt}$, $\pm 10\text{V}$ (0-10 for Ch. 1), $\pm 100\text{V}$ with voltage divider
Input types	DC volts, dc millivolts, dc milliamps (with shunt), thermocouple, 2/3-wire RTD (not channel 1 if any other channel is a thermocouple input)
Input type mix	Freely configurable
Noise rejection (48 to 62 Hz)	Common mode: $>140\text{dB}$ (channel-to- channel & channel-to-ground) Series mode: $>60\text{dB}$
Max. Comm mode voltage	250V continuous
Max. Series mode voltage	45mV at lowest range; 12 Volts peak at highest range

Isolation (dc to 65 Hz: EN61010)	250V (channel-to-channel and channel-to-ground)
Dielectric strength	Channel-to-ground=1350 Vac for 1 min; Channel-to-channel=2300 Vac for 1 min.
Insulation resistance	$>10\text{M}\Omega$ at 500V dc
Input impedance	150mV & 1V range: $>10\text{M}\Omega$; 10V range; 245K Ω
Overvoltage protection	50 Volts peak
Open circuit detection	$\pm 57\text{nA}$ max. 125ms recognition time. $10\text{M}\Omega$ min break

The Model 4103C is a full-featured 4-pen continuous trace recorder. Its die cast door and rugged steel case are designed to meet the requirements of tough industrial environments.

Vivid Color Display: The 4103 boasts a high resolution four-color vacuum fluorescent display (VFD) with five 12-mm characters for process value, twenty 4-mm characters for text and three 1-mm bargraphs. It displays the measured value of each channel with its associated descriptor or scale. It also gives bargraph indication of three channels' values.

Input Technology: The recorder uses a new proprietary input card technology based on a custom chip set and second order Δ/Σ converters. This plus Surface Mount Technology (SMT) gives the 4103 input circuitry high accuracy and stability. Inputs are fully universal with V, mV, TC, RTD and contact inputs.

Easy to Configure: The recorder is fully configurable from the front panel, using push-button keys and text prompts. This allows access both to operator changes and, via a password, to the more complex input and instrument configuration. The recorder can also be configured using a PC and software, allowing configuration setup off-site for later downloading to the recorder.

Math, Timers, Totalizers & Counters: These options offer integrating and counting facilities and the ability to carry out calculations ranging from simple arithmetic to complex application specific functions such as gas flow compensation and environmental parameter monitoring.

Memory Card Archiving: With a standard Type 1 PCMCIA card, data can be stored in a format compatible with standard spreadsheet packages. Also the recorder's configuration can be stored for transfer to another recorder or to a PC.

Serial Communications: The communications option offers Modbus® to ensure compatibility with standard SCADA software and other industrial equipment. Also permits multiple instruments on a single communications link.

Retransmission Outputs: Up to four input or math channels can be output as a linearized current or voltage signal to other instruments.

Event & Contact Inputs: Recorder inputs can be used as contact inputs to trigger internal recorder actions. Also available is a dedicated 16-contact input card.

RECORDERS

MODEL 4103C ORDERING INFORMATION

BUILD-YOUR-OWN STOCK NO.:

4103C-

Option Field				Option Field			
1	Channels			13	Operating Language		
	One Channel	1	\$1,320.00		English	E	—
	Two Channels	2	\$1,670.00		French	F	—
	Three Channels	3	\$1,995.00		German	G	—
	Four Channels	4	\$2,420.00	14	Manual Language		
	One Channel with Annotation	A	\$1,500.00		None	0	—
	Two Channels with Annotation	B	\$1,741.00		English	E	—
	Three Channels with Annotation	C	\$2,300.00		French	F	—
	Four Channels with Annotation	D	\$2,770.00		German	G	—
2	Field Not Used (see Note 1)	0	—	15	Chart Illumination		
3	Power				None	0	—
	90-264 Vac	1	—		Yes	1	\$105.00
	24/48 Vdc	2	\$45.00	16	Field Not Used (see Note 1)	0	—
4	Chart Cassette			17	Field Not Used (see Note 1)	0	—
	Z-fold	Z	—	18	Transmitter Power Supply		
	Roll	R	\$75.00		None	0	—
5	Field Not Used (see Note 1)	0	—		Three Channels, 120 Vac	1	\$150.00
6	Chart Divisions				Three Channels, 240 Vac	2	\$150.00
	No Chart Shipped with Recorder	00	—		Six Channels, 120 Vac	6	\$300.00
	40	40	—		Six Channels, 240 Vac	7	\$300.00
	45	45	—	19	Door/Case Color		
	50	50	—		Green	0	—
	60	60	—		Gray	1	—
	70	70	—		Black	2	—
	75	75	—				
7	Quantity of Shunts						
	None	0	—				
	One	1	\$10.00				
	Two	2	\$20.00				
	Three	3	\$30.00				
	Four	4	\$40.00				
8	Shunt Value						
	None	0	—				
	100 Ohm	1	—				
	250 Ohm	2	—				
9	Quantity of 100:1,1Meg Attenuators						
	None	0	—				
	One	1	\$20.00				
	Two	2	\$40.00				
	Three	3	\$60.00				
	Four	4	\$80.00				
10	Field Not Used (see Note 1)	0	—				
11	Annotation (see Note 2)						
	None	0	—				
	Yes	A	—				
12	Field Not Used (see Note 1)	0	—				

Notes:

Note 1: Fields not currently used for available features.

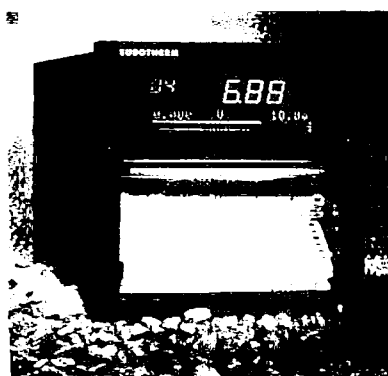
Note 2: If any "With Annotation" is chosen in Field 1, this entry must be "A", otherwise "0".

FOR ADD'L OPTIONS NOT SHOWN, PLEASE CONSULT CAPP/USA.

EXAMPLE STOCK NO.: 4103C-1-0-1-Z-0-40-0-0-0-0-0-E-E-1-0-0-2

EXAMPLE PRICE: \$1,425.00

CHESSELL 4103M RECORDER

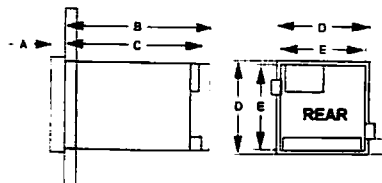


Physical

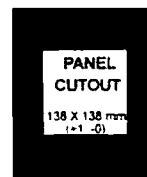
Panel mounting
 Bezel size
 Weight
 Panel mounting

5.7" x 5.7"

DIN43700
 144 x 144 mm.
 3.5 kg (7.75 lb.)
 Vertical $\pm 30^\circ$



A	B	C
27	236 (with cover)	220 (w/o cover)
1.06	9.29	8.66



D	E	F
144	137	35
5.67	5.39	1.38

- Six color fiber tip dotting system for clear traces
- Vivid 4-color display with bargraphs
- One to six universal isolated inputs
- Only 236mm depth behind panel
- Front panel or PC configuration
- Math, timers, counters and totalizers
- PCMCIA memory card drive
- Up to 16 relay outputs
- Up to 4 analog outputs
- Up to 16 contact inputs

TECHNICAL SPECIFICATIONS:

GENERAL

Max. Number of inputs	Six	Isolation (dc to 65 Hz, EN61010)	250V (channel-to-channel and channel-to-ground)
Input ranges	$\pm 38\text{mV}$, $\pm 150\text{mV}$, $\pm 1\text{ Volt}$, $\pm 10\text{V}$ (0-10 for Ch. 1), $\pm 100\text{V}$ with voltage divider	Dielectric strength	Channel-to-ground=1350 Vac for 1 min; Channel-to-channel=2300 Vac for 1 min.
Input types	DC volts, dc millivolts, dc milliamps (with shunt), thermocouple, 2/3-wire RTD (not channel 1 if any other channel is a thermocouple input)	Insulation resistance	>10M Ω at 500V dc
Input type mix	Freely configurable	Input impedance	150mV & 1V range: >10M Ω ; 10V range: 245K Ω
Noise rejection (48 to 62 Hz)	Common mode: >140dB (channel-to-channel & channel-to-ground) Series mode: >60dB	Overvoltage protection	50 Volts peak
Max. Comm. mode voltage	250V continuous	Open circuit detection	$\pm 57\text{nA}$ max. 125ms recognition time, 10M Ω min break
Max. Series mode voltage	45mV at lowest range, 12 Volts peak at highest range		

The Model 4103M is a full-featured 6-trace multipoint recorder. Its die cast door and rugged steel case are designed to meet the requirements of tough industrial environments.

Vivid Color Display: The 4103 boasts a high resolution four-color vacuum fluorescent display (VFD) with five 12-mm characters for process value, twenty 4-mm characters for text and three 14-mm bargraphs. It displays the measured value of each channel with its associated descriptor or scale. It also gives bargraph indication of three channels' values.

Input Technology: The recorder uses a new proprietary input card technology based on a custom chip set and second order $\Delta\Sigma$ converters. This plus Surface Mount Technology (SMT) gives the 4103 input circuitry high accuracy and stability. Inputs are fully universal with V, mV, TC, RTD and contact inputs.

Easy to Configure: The recorder is fully configurable from the front panel, using push-button keys and text prompts. This allows access both to operator changes and, via a password, to the more complex input and instrument configuration. The recorder can also be configured using a PC and software, allowing configuration setup off-site for later downloading to the recorder.

Math, Timers, Totalizers & Counters: These options offer integrating and counting facilities and the ability to carry out calculations ranging from simple arithmetic to complex application specific functions such as gas flow compensation and environmental parameter monitoring.

Memory Card Archiving: With a standard Type 1 PCMCIA card, data can be stored in a format compatible with standard spreadsheet packages. Also the recorder's configuration can be stored for transfer to another recorder or to a PC.

Serial Communications: The communications option offers Modbus® to ensure compatibility with standard SCADA software and other industrial equipment. Also permits multiple instruments on a single communications link.

Retransmission Outputs: Up to four input or math channels can be output as a linearized current or voltage signal to other instruments.

Event & Contact Inputs: Recorder inputs can be used as contact inputs to trigger internal recorder actions. Also available is a dedicated 16-contact input card.

RECORDERS

MODEL 4103M ORDERING INFORMATION BUILD-YOUR-OWN STOCK NO.: 4103M-

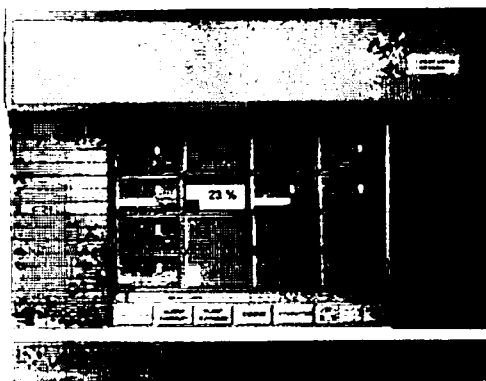
Option Field				Option Field			
1	Channels			13	Operating Language		
	Two Channels	2	\$1,895.00		English	E	—
	Three Channels	3	\$1,940.00		French	F	—
	Six Channels	6	\$2,095.00		German	G	—
				14	Manual Language		
					None	0	—
					English	E	—
					French	F	—
					German	G	—
2	Field Not Used (see Note 1)	0	—	15	Chart Illumination		
3	Power				None	0	—
	90-264 Vac	1	—		Yes	1	\$103.00
	24/48 Vdc	2	\$45.00	16	Field Not Used (see Note 1)	0	—
4	Chart Cassette			17	Field Not Used (see Note 1)	0	—
	Z-fold	Z	—	18	Transmitter Power Supply		
	Roll	R	\$75.00		None	0	—
					Three Channels	3	\$142.00
5	Field Not Used (see Note 1)	0	—		Six Channels	6	\$294.00
6	Chart Divisions			19	Field Not Used (see Note 1)	00	—
	None	00	—				
	40	40	—	20	Door/Case Color		
	45	45	—		Green	0	—
	50	50	—		Gray	1	—
	60	60	—		Black	2	—
	70	70	—				
	75	75	—				
7	Quantity of Shunts						
	None	0	—				
	One	1	\$9.00				
	Two	2	\$19.00				
	Three	3	\$29.00				
	Four	4	\$38.00				
	Five	5	\$48.00				
	Six	6	\$58.00				
8	Shunt Value						
	None	0	—				
	100 Ohm	1	—				
	250 Ohm	2	—				
9	Quantity of 100:1, 1 Meg Attenuators	0	—				
	None	0	—				
	One	1	\$19.00				
	Two	2	\$38.00				
	Three	3	\$58.00				
	Four	4	\$78.00				
	Five	5	\$98.00				
	Six	6	\$117.00				
10	Field Not Used (see Note 1)	0	—				
11	Field Not Used (see Note 1)	0	—				
12	Field Not Used (see Note 1)	0	—				

Notes:
Note 1: Fields not currently used for available features.

**FOR ADD'L OPTIONS NOT SHOWN,
PLEASE CONSULT CAPP/USA.**

EXAMPLE STOCK NO.: 4103M-2-0-1-Z-0-40-0-0-0-0-0-0-E-E-1-0-0-1
EXAMPLE PRICE: \$1,895.00

CHESSELL VIDEO CHART RECORDERS (VCR's)



4250G & 4180G Video Chart Recorders (VCRs).

The first products that integrate the versatility of a high resolution colour display with the proven reliability of the chart recorder to provide the user with a "personal" view of the process.

Combining the ease of configuration and use of the chart recorder with the flexibility of the PC, the VCR provides the best of both while avoiding the complexity of computer-based data acquisition systems

VCRs provide you with the choice, not the complexity. You choose a range of colour displays to provide the exact process information you want, presented in the way you want to see it. You choose when and what to record as colour trends, texts logs or data files.

Displays

The VCRs provide a menu of preconfigured display pages from which to choose. Based on a hierarchical strategy which begins with the Plant Summary display, the instrument supports up to 16 Group pages of 16 channels each

Plant Summary display

The plant Summary display gives top level view of its constituent groups and indicates points in alarm in each group. Also included, as it is in all displays, is the alarm status window.



Group displays

Each group can be displayed in any of three formats: panel, bar graph or trend - the choice of the primary display is yours. Movement from one display type to the next is a simple matter of touching the Cycle Screen Key.



Group bar graph display

All points in the selected group are displayed in colour bar graph form for clarity and quick comparison. Each bar graph contains a tag name, scale information and current value with engineering units. Alarms are also on display.

Group trend display

This display simulates a standard strip chart recorder with up to 16 continuous colour trends shown on a common time basis.



Powerful features such as time and range magnification, X or Y cursor movement, and dynamic history replay provide total flexibility in data presentation.

Alarm summary display

This display can be accessed from any other display simply by touching the ALARM SUMMARY fixed key. It comprises up to 16 records per page, providing a chronological history of alarms up to the present time. A line for each record indicates the time an alarm occurred, when it was acknowledged and when it cleared.

Operation

The VCRs have been designed to minimize the number of key strokes necessary to move between displays. Confusion is eliminated through the use of hierarchical displays that keep the operator fully informed about plant operation.

Process data is presented in ways familiar to the operator, such as indicator face plates, contact status graphics and the use of simulated chart recorder traces.

Display selection

The ease and rapidity with which the data display can be operated keeps training requirements to a minimum. Any Group or Point on the display can be selected by simply touching that part of the screen, causing the selection to be highlighted. Touching the Go To key will then change the displays to the corresponding group or point display.

Alarm Strategy

A sophisticated alarm package offers four fully configurable alarms per point. The Status Window shown on every page will show any group that has an active alarm, while the alarm summary screen will show records of up to 256 alarms

Configuration

Touching the CONFIG key calls up the password-protected configuration menu. This provides a simple, user-friendly method of setting up the instrument. A PC-based software package running under DOS is also available for off-line configuration.

LCD Display

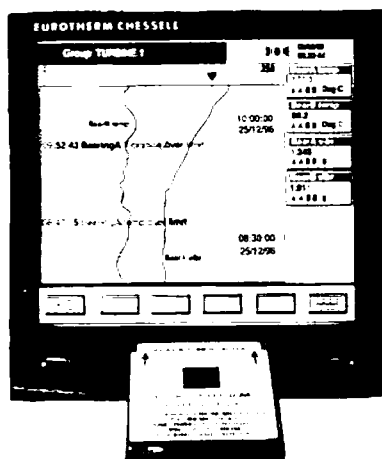
A back-lit VGA liquid crystal display uses TFT (thin film transistor) technology to give exceptionally vivid colour and clarity, unmatched by conventional CRT displays

Touch screen

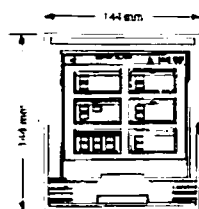
Resistive Touch Screen technology, combining fixed and soft keys, permits quick and easy and positive selection and movement between display.

RECORDERS

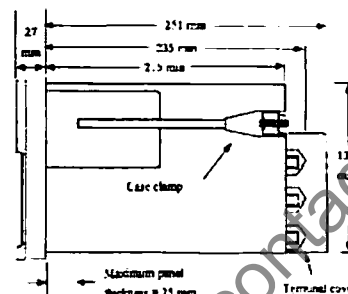
CHESSELL 4100G GRAPHICAL DISPLAY RECORDER



Dimensions



Front View



View of right hand side



Advanced Product Technology

Mass Storage: Type I cards use SRAM technology—used on other Chessel recorders - giving up to 2Mbyte of storage. Type III can give over 300Mbyte of data storage on a rugged hard disk. The floppy disc unit is the 1.44Mbyte disc used on all PCs.

Rugged Mechanical Design: IP65 environmental protection ensures reliable operation in hostile environments. The unique clamp down handle secures the electronics into a case that conforms to standard DIN bezel size of 144x144mm. Upgrades from classical paper recorders are therefore easy.

Man Machine Interface: The high resolution TFT color display gives exceptional viewing angle and clarity. Rugged construction is assured by utilizing a display designed for the automotive industry. The touch screen offers an easy to understand operator interface as proved in large screen modules of Chessel graphics recorders.

Features:

- Full-color VGA display
- Touch screen convenience
- Up to 12 universal input channels
- 8 pre-configured displays for data the way you want to see it
- Vertical Recorder Trend Display
- Versatile Alarm Summary Display
- 3.5" floppy disk or optional high capacity Type 3 PCMCIA data card
- RS-485, MODBUS® RTU Communications
- Up to 12 calculated channels
- Available with PC Configuration Software

MODEL 4100G ORDERING INFORMATION: ORDERING IS EASY — JUST SELECT AN OPTION FROM THE 40 TABLES BELOW

Option				Option			
1	Channels (see Notes 1 & 2)				English	E	0
	No Channels (specify comms option)	00	\$3,145.00		French	F	0
	Two Channels	02	\$3,240.00		German	G	0
	Three Channels	03	\$3,340.00	15	Field Not Used (see note 3)	0	0
	Six Channels	06	\$3,540.00	16	Field Not Used (see note 3)	0	0
	Eight Channels	08	\$4,340.00	17	Field Not Used (see Note 3)	0	0
	Nine Channels	09	\$4,650.00	18	Transmitter Power Supply		
	Twelve Channels	12	\$4,750.00		None	0	0
2	Video Memory (see Note 7)				Three Channels, 120 Vac	1	\$150.00
	1 Meg	0	0		Three Channels, 240 Vac	2	\$150.00
	3 Meg (std 1 Meg plus add'l 2)	2	\$310.00		Six Channels, 120 Vac	6	\$300.00
3	Power				Six Channels, 240 Vac	7	\$300.00
	90-264 Vac	1	0	19	Logo		
	24/48 Vdc	2	\$45.00		Eurotherm Chessell	00	0
4	Field Not Used (see Note 3)	0	0		Other	99	CC
5	Archive Type (see Note 6)			20	Door/Case Color		
	None (Price deduction)	0	0		Green	0	0
	1 44 Meg Floppy Disk	1	0		Gray	1	0
	PCMCIA Card	2	0		Black	2	0
6	Card/Disk Security Lock			21	Field Not Used (see note 3)		
	None	0	0	22	Certifications		
	Yes	1	\$45.00		CE (European Certification)	0	0
7	Quantity of Shunts				CSA (Canadian Standards)	5	CC
	None	0		23	Field Not Used (see note 3)	000	0
	To specify the number of input shunts, enter a two-digit number from "01 thru 12"		See 10.00	24	Hardware Options (see note 5)		
	Pricing is per shunt				None		
8	Shunt Value				One or More Choices in Fields 18, 25-33	1	0
	None	0	0	25	Normally Closed Relays (see note 4)		
	100 Ohm	1	0		None	0	0
	250 Ohm	2	0		Four (one card)	1	\$205.00
9	Qty of 100:1.1Meg Attenuators (0 to 12)	0			Eight (two cards)	2	\$410.00
	None	00			Twelve (three cards)	3	\$615.00
	To specify the number of attenuators, enter a two-digit number from "01 thru 12"		See 20.00		Sixteen (four cards)	4	\$820.00
10	Additional Applications (see note 3)	0	0	26	Normally Open Relays (see note 4)		
11	Field Not Used (see note 3)	0	0		None	0	0
12	Field Not Used (see note 3)	0	0		Four (one card)	1	\$205.00
13	Operating Language				Eight (two cards)	2	\$410.00
	English	E			Twelve (three cards)	3	\$615.00
	French	F			Sixteen (four cards)	4	\$820.00
	German	G		27	Form C, (SPDT) Relays (see note 4)		
14	Manual Language				None	0	0
	None	0			Three (one card)	1	\$205.00
					Six (two cards)	2	\$410.00
					Nine (three cards)	3	\$615.00
					Twelve (four cards)	4	\$820.00
				28	Analog Retransmission (see note 4)-		
					C		
					None	0	0
					Two Outputs (one card)	2	\$250.00

cont.

6

RECORDERS

MODEL 4100G ORDERING INFORMATION: (CONTINUED)

Four Outputs (two cards)			4	\$500.00	NOTES CC = Consult CAPP before specifying (800) 356-8000 Note 1 If "00" input channels are chosen in Field 1. Serial Communications (Field 32) <u>must</u> be specified. Note 2 Math Level I (16 DV's, basic math, + - x +, const) and Floppy Disk or PCMCIA Card Drive are standard. Choose "U" for a price deduct if neither is required. An Archive Drive (Field 5) choice <u>must</u> be made, even if an archive drive is not required ("0" is a price deduction). A Math Calculations (Field 37) choice <u>must</u> be made even if only the standard Level I is needed. Note 3 Fields not currently used for available features. Note 4 With up to 6 inputs there are four option card positions in two horizontal card slots. With 7 to 12 inputs, there are two option card positions in one horizontal card slot. 3 or 4 Relays, 2 Retransmission outputs, Event inputs and Serial Communications each take one card position. The total option card positions cannot exceed the above limits. Note 5 These entries are required as an aid to order processing. Enter "1" if any hardware options (Field 18 and/or Fields 25 thru 33) are chosen. In Field 34, a "1" is always entered since Math Level I or II is always present. Note 6 Enter the 3 floppy disk drive or a PCMCIA card drive. for Type I or Type III cards (up to 340Meg) can be specified in Field 5. The data storage option for the chosen archive drive is selected in Field 30. Choose "0" only if "0" (no archive drive) is chosen in Field 5. An archive drive <u>must</u> be chosen in Field 5 if any data storage option other than "0" is chosen in Field 30. Configuration save/restore is included with all three data storage option. A DOS disk comes with the packed data option to unpack files into ASCII comma delimited format. Note 7 Larger video memory enables longer trace history time. With 3 Meg, the approximate stored history for 6 points at 1 sec. Scan interval is 26.6 hrs. At 30 second scan intervals, it is 500 hrs. (33 days) Storage times are 1/3 of above at standard 1 Meg memory size and proportional at other points and scan intervals.
29	Contact (Event) inputs (see note 4)-CF				
	None		0	0	
	Six contact inputs (one card)	E		\$155.00	
30	Data Storage (see note 6)				
	None		0	0	
	With Config. Save/Restore	C		0	
	With ASCII Archiving	A		\$200.00	
	With Packed Data Archiving	P		\$250.00	
31	Memory Card Size (see note 6)				
	None		0	0	
	126K	1		\$100.00	
	512K	2		\$175.00	
	2Meg	3		\$275.00	
32	Serial Communications (see notes 1 & 4)				
	None		0	0	
	RS485 Modbus (one card)	1		\$250.00	
33	Field Not Used (see note 3)				
34	Software Options (fields 30A, 30P, 35-40) (see note 5)				
	One or More Choices in Fields 35-40	1			
35	Field Not used (see note 3)		0		
36	Custom Messages				
	None		0	0	
	Twenty Custom Messages	M		\$60.00	
37	Math Calculations				
	Level I (12 DV's, basis, + - x +, const)	1		0	
	Level II (Level I plus advanced math)	2		\$125.00	
38	Totalizers, Timers & Counters				
	None		0	0	
	2 Totalizers	2		\$60.00	
	4 Totalizers	4		\$120.00	
	6 Totalizers	6		\$180.00	
	6 each Timers and Counters	C		\$50.00	
	6 each Totalizers, Timers & Counters	T		\$225.00	
39	Custom Curve				
	None		0	0	
	32 point curve	1		\$100.00	
40	Field Not Used (see note 1)		0	0	

EXAMPLE STOCK NO.: 4100G-0201000000000-E-00000-00-2-0-000-000000000000

EXAMPLE PRICE: \$3,240.00

PROGRAMMABLE PRINT-YOUR-OWN-CHART CIRCULAR CHART RECORDER

RUSTRAK SERIES RT-8000: DESIGNED FOR TODAY'S DEMANDS

Industry demands increasingly precise and accurate records. The RT-8000 represents a quantum leap forward in circular chart recorder technology to meet this demand. This unique recorder is ideally suited to applications in food, pharmaceuticals, environmental testing and metal working — wherever process variables must be documented on a single chart and retained to meet industry requirements.

Functionality of the RT-800 can be expanded by available options including control capability, alarm and totalization. Microprocessor-based and field configurable, the RT-8000 is industry proven for use in plant and factory.

NO MORE PREPRINTED CHARTS

The RT-8000 chart recorder draws its own chart as it records your data. This technological innovation pays off in user benefits which make it the most convenient and the most accurate circular chart recorder on the market today.

A box of blank charts is all you need to have a virtually infinite selection of charts at your disposal. You create the chart design when you input the operating parameters. The RT-8000 puts an end to reprinted circular chart ordering, storage and inventory.

SPECIFICATIONS

Number of Channels: 1, 2, 3 or 4

Digital Indication: 1 digit

Accuracy: Temperature $\leq \pm 1^\circ\text{F}$; Voltage 0.1% or better

Minimum Input Span: Range is fully configurable within span limitation of the operating range selected.

Input Impedance:

: 4–20 mA dc: 250 ohms

0–10 Vdc: 200 K ohms

All others: 10 Megohms

Source Impedance: RTD - 100 ohms per lead maximum

Span Step Response Time: 6 seconds maximum with no filtering

Sampling Rate: Input sampled 3 times a second for 2 inputs and once every $\frac{2}{3}$ second for 3 and 4 inputs.

Input Filter: Software selectable - Singel pole low pass - time constants up to 120 seconds.

Digital Displays: Vacuum fluorescent, alphanumeric. A six-digit display dedicated to the process variable.

Alternate information displayed during configuration mode.

An eight-digit display shows key selected operating parameters and provides guidance during configuration.

Indicators: Channel PV display

Alarm status

Controller output

Remote Set Point

Temperature unit or Engineering units

Controllers mode

Deviation Bargraph: 21 segment, color coded deviation bargraph—Green = On Control; Red = Deviation to $\pm 10\%$ of PV

Controller: Manual Operation

Modes of Operation: Automatic with local set point

Automatic with remote set point

Transmitter: 22 to 26 Vdc at input terminals

Supply Voltage: (1.2 watts at 24 Vdc)

Case: Molded, foamed-Noryl with gasketed door to meet NEMA 3 enclosure requirements.

Chart: 12 inch (304.8mm) diameter chart. Plain thermal-sensitive paper.

CAPP STOCK No. 6264

Approval Bodies: UL, CSA and FM approval pending.

Weight: 13.2 lbs (6 kg)

Mounting: Panel or surface mounted—SEE DIMENSIONS BELOW.

**COMPARE RT8000
TO HONEYWELL'S®
TRULINE®
MODEL**

Types of Input	Range	
	$^{\circ}\text{F}$	$^{\circ}\text{C}$
THERMOCOUPLES		
B	105 to 3300	41 to 1816
	105 to 150	41 to 66
	150 to 500	66 to 260
	500 to 1000	260 to 538
	1000 to 3300	538 to 1815
E	-454 to 1832	-270 to 1000
	-454 to -202	-270 to -130
	-202 to 1832	-130 to 1000
E (low)	-200 to 1100	-129 to 593
J	0 to 1600	-18 to 871
J (low)	20 to 770	-7 to 410
K	-320 to 2500	-196 to 1371
	-320 to 0	-196 to -18
	0 to 2500	-18 to 1371
K (low)	-20 to 1000	-29 to 538
N (Ni/Ni MoLy)	32 to 2500	0 to 1371

6

cont.

RECORDERS

PROGRAMMABLE PRINT-YOUR-OWN-CHART CIRCULAR CHART RECORDER

(cont.)

Types of Input	Range	
	°F	°C
THERMOCOUPLES (cont.)		
	32 to 500	0 to 260
	500 to 2500	260 to 1371
N (Ni/Ni Moly, low)	32 to 1260	0 to 682
	32 to 500	0 to 260
	500 to 1260	260 to 682
R	0 to 3100	-18 to 1704
	0 to 500	-18 to 260
	500 to 3100	260 to 1704
S	0 to 3100	-18 to 1704
	0 to 500	-18 to 260
	500 to 3100	260 to 1704
T	-300 to 700	-184 to 371
T (low)	-200 to 600	-129 to 316
W5W26	0 to 4200	-18 to 2315
	0 to 600	-18 to 316
	600 to 3600	316 to 1982
	3600 to 4200	1982 to 2316
W5W26 (low)	0 to 2240	-18 to 1227
	0 to 600	-18 to 316
	600 to 2200	316 to 1982
RTDs		
Platinum		-184 to 482
100 ohms	-300 to 900	-184 to 482
500 ohms	-300 to 900	
Linear		
Milliamperes dc	4 to 20	
Millivolts dc	0 to 10	
	10 to 50	
Volts dc	1 to 5 (can be calibrated 0 to 5)	
	0 to 10	

RELATIVE HUMIDITY:

Platinum	-130 to 392	-90 to 200
100 ohm		
Wet/Dry % RH		
Bulb		
Measured	-130 to 392	-90 to 200
% RH	35 to 40	2 to 4
0 to 1Ld20	>40 to 100	>4 to 38
20 to 100	100 to 212	38 to 100

1. Wet/Dry Input.

ENVIRONMENTAL & OPERATING CONDITIONS

Parameter	Rated	Extreme
Ambient Temperature	58 to 131°F	32 to 131°F
	15 to 55°C	0 to 55°C
Relative Humidity (%RH)	10 to 90*	5 to 90*

VIBRATION

Frequency (Hz)	0 to 70	0 to 200
Acceleration (g)	0.1	0.2

MECHANICAL SHOCK

Acceleration (g)	1	5
Duration (ms)	30	30

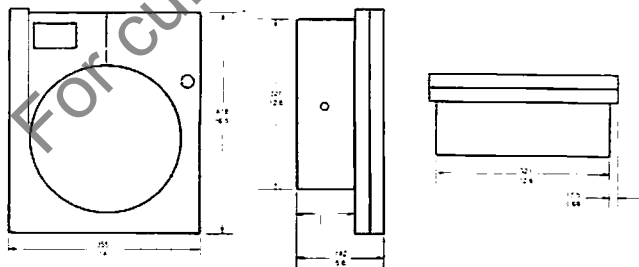
MOUNTING POSITION FROM VERTICAL

Tilted forward	5°	5°
Tilted backward	30°	90°
Tilted to side (pm)	10°	20°

POWER REQUIREMENTS

Voltage (VRMS)	102 to 132	102 to 132
	204 to 264	204 to 264
Frequency (Hz)	49 to 51	48 to 52
	59 to 61	58 to 62
Power Consumption	9 watts maximum	

* The maximum rating only applies up to 40°C (104°F). For higher temperature the RH specification is derated to maintain constant moisture content.



6

RECORDERS

PROGRAMMABLE PRINT-YOUR-OWN-CHART CIRCULAR CHART RECORDER

(cont.)

ORDERING INFORMATION:

Rustrak Model No.	CAPP Stock No.	Description	Price
RT-8000-1	267432	One-Input Recorder	Call
RT-8000-2	267433	Two-Input Recorder	Call
RT-8000-3	267434	Three-Input Recorder	Call
RT-8000-4	267435	Four-Input Recorder	Call

PLEASE SPECIFY CAPP STOCK NO. & ONE OR MORE OF THE FOLLOWING OPTIONS WHEN ORDERING:

Option Code	Option
-A	Alarm/Digital
-S1	Control Output #1 W/Setpoint Programming
-S2	Control Output #2 W/Setpoint Programming
-T1	Totalization - Input 1

Option Code	Option
-T2	Totalization - Inputs 1 + 2
-PW	Plastic Window
-DL	Door Lock
-CL	Chart Illumination

EXAMPLE STOCK NO.: 267433-A-T2-DL.

ADDITIONAL ACCESSORIES:

Stock No.	Description	Price
267436	Humidity Probe	Call
267437	Temperature/Humidity Probe	Call
267438	RTD Probe, 100 Ω	Call
6264	Chart Paper for RT-8000, (100/box)	Call



RUSTRAK COMPACT THERMOCOUPLE RECORDER

Very narrow spans with large offsets are possible due to the accuracy and stability of the amplifier and cold junction compensation circuits.

Expanded scales covering temperatures of interest rather than conventional wide spans beginning at zero degrees are now available.

The cold junction compensation circuit is unique in that calibration is accomplished without resorting to complicated thermocouple simulators or the need to actually measure and correct for the junction temperature. A simple uncomplicated millivolt source is all that is required.

Accuracy of non-standard ranges is effected by thermocouple linearity at temperatures chosen.

The most versatile temperature transducer.

SPECIFICATIONS

Dimensions: 3 1/8" (W) x 5 1/2" (H) x 4 1/8" (D)

Weight: 3 1/4 lbs.

Sensor Type: B, C, E, G, J, K, N, R, S, T (J, K = Standard)

System Accuracy: $\pm 2\%$ of Span¹

Stability Per Year (Sensor & Electronics): $\pm 5\%$ of Span

Maximum Thermocouple Loop Resistance: 1000 Ω

Thermocouple Break Protection: Upscale Standard

Thermocouple Types Available: J (Model 1551), K (Model 1552)

Temperature Limits For Each Type: See Table 3 Below

Maximum Offset Available: Up to ± 5 times Span

Input Connections: Binding Posts: Fixed Line Cord

Maximum Cable Extensions: Extension Grade Thermocouple Wire up to 150' Specify Type J or K

Primary Power Requirements²: 100-130V, 60 Hz

100-130V, 50 Hz

200-260V, 60 Hz

200-260V, 50 Hz

10-14 Vdc @ 15 mA + dc Motor Current

Stock No.	Model No.	Min. Span	Max. Span	Ambient Temperature Limits	Cold Junction Compensation Accuracy	Price
266793	Z55	25°C 50°F	500°C 1000°F	-10 to 60°C 14 to 140°F	$\pm 1^\circ\text{C}$ (2°F) -10 to 60°C	\$525.00
266794	Z55(DC)	25°C 50°F	500°C 1000°F	-10 to 60°C 14 to 140°F	$\pm 1^\circ\text{C}$ (2°F) -10 to 60°C	\$525.00

1. Based on standard ranges meeting minimum and maximum spans within the temperature limits 0-1000°C (0-2000°F) T/C J and K are standard.

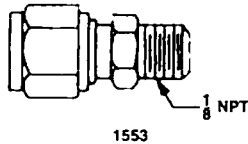
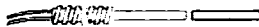
2. Sensors and electronics are transformer isolated from the primary source and floating with respect to ground. AC models have 1000V withstand, from common to frame. Current consumption of DC models is low.

6

cont.

RECORDERS

RUSTRAK COMPACT THERMOCOUPLE RECORDER (cont.) PROBE CONFIGURATION AND TIME CONSTANT



Stock No.	Model No.	Description	Price
266795	1551	Type J (Iron Constantan)—Have Stainless Steel Sheath and 5 Seconds Time Constant. Shaft: 7/16" Dia. x 6" Long, 6' Armored Cable. Maximum Continuous Temperature 900°F (482°C).	\$50.00
266796	1552	Type K (Chromel Alumel)—Have Stainless Steel Sheath and 5 Seconds Time Constant. Shaft: 7/16" Dia. x 6" Long, 6' Armored Cable. Maximum Continuous Temperature 900°F (482°C).	\$55.00
266798	1553	300 PSI Maximum Pressure Fitting. For Models 1551 and 1552. 304 Stainless Steel.	\$35.00

TEMPERATURE LIMITS AND ACCURACY OF THERMOCOUPLES

Thermocouple	Useful Limits		
	Interchangeability Accuracy % Of °C or °F		
TYPE E	-250 to 870°C	-400 to 1600°F	0 to 870°C (1600°F) ±1%
TYPE J	-18 to 750°C	0 to 1350°F	0 to 750°C (1350°F) ±1%
TYPE K	-250 to 1260°C	-400 to 2300°F	0 to 1260°C (2300°F) ±1%
TYPE R	500 to 1400°C	900 to 2500°F	0 to 1400°C (2500°F) ±5%
TYPE S	500 to 1400°C	900 to 2500°F	500 to 1400°C (2500°F) ±5%
TYPE T	-184 to 371°C	-300 to 700°F	0 to 350°C (572°F) ±1%



4 EVENTS (CHANNELS)

RUSTRAK COMPLETE SELECTION OF EVENT RECORDERS

Rustrak event recorders are capable of monitoring from one to sixteen channels of on-off operations at a repetition rate as fast as ten events per second. The number, duration, chronological time and relation of all occurrences can easily be recorded. Compact and economical, Rustrak event recorders are perfect for industry, lab or office. Common applications include monitoring machinery downtime, worktime, productivity and continuity; need for maintenance; security control, time studies and cost analysis. For even greater versatility, a totalizer is built into model 292-4T.

292-4C = four channel

292-8C = eight channel

Built-in power supply.

Operates from switch closure.

292-4T

Features totalizer with light indicators for each channel.

Built-in power supply.

Operates from switch closure.

292-TTL OR HIV-4, 8 CHANNELS AND 392-TTL OR 392-HIV-16 CHANNELS

TTL and HIV VERSIONS

Compatible with most digital logic and low-level analog signals.

Optically coupled, high impedance inputs with 2500V isolation.

Built-in power supply - no external power supplies, step-down transformers or power converters required for operation.

TTL and HIV voltages can be mixed within the same unit.

292-(+DC INPUT)-4, 8 CHANNELS OR 392-(DC INPUT)-16 CHANNELS FIXED DC VOLTAGE

UL approved for 6, 12 and 24 Vdc actuation.

DC input choices: 6, 12, 24 or 48 Vdc.

Can operate from switch closure with 24V event actuator and Model 921-8 power supply, Stock No. 266799.

EVENT ACTUATOR POWER UNITS

Will supply power for eight 24 Vdc or 100 TTL actuators.

Available for recorders with 24 Vdc event, or TTL actuators.

Specify as follows:

MODEL 921-8 / STOCK NO. 266799 (Primary power: 115V, 50/60 Hz)

MODEL 921A-8 / STOCK NO. 266800 (Primary power: 240V, 50/60 Hz)

ORDERING INFORMATION—ALL EVENT RECORDERS

SPECIFICATIONS

Repetition Rate: As fast as 10 events per second

Operating Temperature: 0 to 50°C, 32 to 122°F

Chart Speed Accuracy: Synchronous with line frequency

Power Cord: Fixed line cord

Environment: Indoor/Outdoor with enclosure

Storage Temperature: -40 to 70°C, -40 to 158°F

Input Connections: Barrier strips

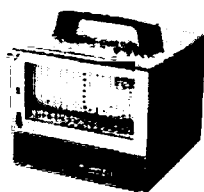
Primary Power: 100-130V, 50 Hz; 100-130V, 60 Hz
200-260V, 50 Hz; 200-260V, 60 Hz



8 EVENTS (CHANNELS)

Stock No.	Model No.	Number Channels	Input	Input Tolerance	Current/Channel	Input Resistance	Price
266802	292-TTL-4	4	3-50 Vac/Vdc	3-50V	.5-10 mA	6 kΩ	\$699.17

RUSTRAK COMPLETE SELECTION OF EVENT RECORDERS (cont.)



16 EVENTS
(CHANNELS)



EVENT ACTUATOR
POWER UNITS

Stock No.	Model No.	Number Channels	Input	Input Tolerance	Current/Channel	Input Resistance	Price
266803	292-TTL-8	8	3-50 Vac/Vdc	3-50V	.5-10 mA	6 kΩ	\$945.00
266805	292-HIV-4	4	50-500 Vac/Vdc	50-500V	.5-5 mA	100 kΩ	\$730.00
266806	292-HIV-8	8	50-500 Vac/Vdc	50-500V	.5-5 mA	100 kΩ	\$922.00
266808	292-6V-4	4	6 Vdc	±20%	300 mA	20Ω	\$1,097.00
266809	292-12V-4	4	12 Vdc	±20%	150 mA	80Ω	\$1,077.00
266810	292-24V-4	4	24 Vdc	±20%	70 mA	350Ω	\$1,124.00
266812	292-6V-8	8	6 Vdc	±20%	300 mA	20Ω	\$1,308.00
266813	292-12V-8	8	12 Vdc	±20%	150 mA	80Ω	\$1,289.00
266814	292-24V-8	8	24 Vdc	±20%	70 mA	350Ω	\$1,330.00

OVERALL SPECIFICATIONS

Stock No.	Model No.	Nominal Dimensions (W x H x D)	Nominal Weight	Recording Width	Chart Paper	Package
266802	292-TTL-4	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 6"	4.4 lbs.	2 ⁵ / ₁₆ "	EE	Sheet Aluminum
266803	292-TTL-8	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 6"	4.8 lbs.	2 ⁵ / ₁₆ "	EE	Sheet Aluminum
266804	392-TTL-16	6 ⁵ / ₈ " x 5 ⁵ / ₈ " x 6 ³ / ₄ "	6 lbs.	2 ⁵ / ₁₆ " / 8 CH's	16-E	Sheet Aluminum
266805	292-HIV-4	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 6"	4.4 lbs.	2 ⁵ / ₁₆ "	EE	Sheet Aluminum
266806	292-HIV-8	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 6"	4.8 lbs.	2 ⁵ / ₁₆ "	EE	Sheet Aluminum
266807	392-HIV-16	6 ⁵ / ₈ " x 5 ⁵ / ₈ " x 6 ³ / ₄ "	6 lbs.	2 ⁵ / ₁₆ " / 8 CH's	16-E	Sheet Aluminum
266808	292-6V-4	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 4 ⁵ / ₁₆ "	3.6 lbs.	2 ⁵ / ₁₆ "	EE	Cast Aluminum
266809	292-12V-4	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 4 ⁵ / ₁₆ "	3.6 lbs.	2 ⁵ / ₁₆ "	EE	Cast Aluminum
266810	292-24V-4	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 4 ⁵ / ₁₆ "	3.6 lbs.	2 ⁵ / ₁₆ "	EE	Cast Aluminum
266811	292-48V-4	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 4 ⁵ / ₁₆ "	3.6 lbs.	2 ⁵ / ₁₆ "	EE	Cast Aluminum
266812	292-6V-8	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 4 ⁵ / ₁₆ "	4 lbs.	2 ⁵ / ₁₆ "	EE	Cast Aluminum
266813	292-12V-8	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 4 ⁵ / ₁₆ "	4 lbs.	2 ⁵ / ₁₆ "	EE	Cast Aluminum
266814	292-24V-8	3 ⁵ / ₈ " x 5 ⁵ / ₈ " x 4 ⁵ / ₁₆ "	4 lbs.	2 ⁵ / ₁₆ "	EE	Cast Aluminum

! NOBODY MAKES IT EASIER THAN CAPP/USA TO SELECT & ORDER RECORDERS & CONTROLLERS BY USING OUR UNIQUE "BUILD-YOUR-OWN" OPTION TABLES

**HONEYWELL - PARTLOW - AMPROBE - CHESSELL - DICKSON - RUSTRAK
ALL OF THE NATIONAL BRANDS OF RECORDERS & CONTROLLERS
FEATURED IN THIS CATALOG - CAPP/USA GIVES YOU FREEDOM
OF CHOICE & FLEXIBILITY**

RECORDERS

ENGINEER'S QUICK OVERVIEW OF EVENT RECORDERS

Each channel of the event recorder is energized by the application of an external voltage. A simple contact-making/contact-breaking device with an external power supply may be used to actuate and deactuate each event. When an event occurs, the stylus is deflected to the right forming a pulse $1/16''$ high. The trace is rectangular; pulse width is determined by event duration.

The Rustrak records a clean black line, indicating the

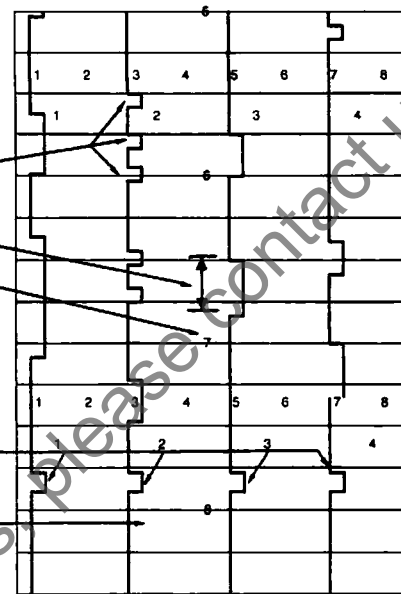
NUMBER

DURATION

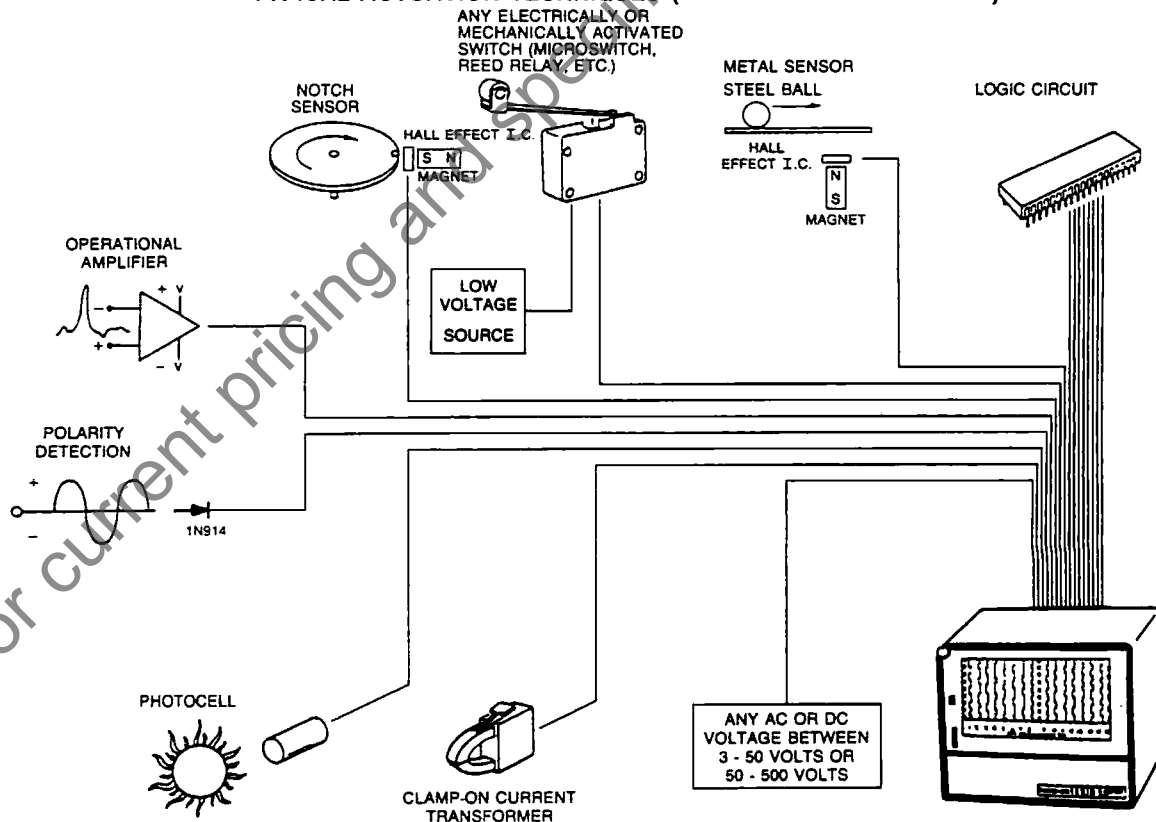
CHRONOLOGICAL TIME

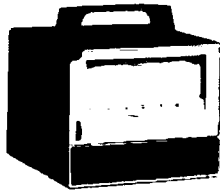
and the RELATION
of all on-off operations.

NOTATIONS
can be made through an
access window provided on
all units.



TYPICAL ACTUATION TECHNIQUES (RUSTRAK MDLS. TTL & HIV)





6425
(STOCK NO. 266828)

GUIDE TO RUSTRAK SERVO RECORDERS

• HIGH SPEED SERVO FAMILY

In the field of recorders, Rustrak miniature direct writing servo recorders are unique. They offer the operator a virtually unlimited recording capability. For example, with a single recorder and appropriate quick change plug-in signal conditioner, you can measure and record:

DC volts from .001V to 500V.

DC currents from 50 μ A to 1000A.

Temperature as detected by thermocouples, nickel wire resistance bulbs and thermistors.

AC volts from 10V to 600V

AC currents from 1A to 1000A.

• WHY BUY A SERVO?

Galvanometric and servo recorders can be used in the same applications, however, many people prefer the servo for the following reasons:

Versatility—unlimited recording capability.

Inkless, long-term, unattended operation.

Neat, continuous trace on pressure sensitive paper.

Fast response time - .25 second.

Rugged stylus.

Instant viewing capability.

Low cost.

• DON'T LIMIT YOUR THINKING!

Servo recorders can be used in any application requiring the monitoring of AC, DC, and temperature (with or without events) within the realms of its specifications. The following are extremely broad categories of typical applications where servos are used with hundreds more within each grouping not listed.

Agriculture

Air pollution

Chromatography

Communications

Food processing

Medical

Meteorology

Oceanography

Petroleum research

Power monitoring

Process monitoring

Transportation

Water pollution

Indoor/Outdoor with enclosure

• HIGH-SPEED SERVO

SPECIFICATIONS

Sensitivity: 100 mV full scale

Accuracy: $\pm 1\%$ of span (including linearity and dead band at 25°C)

Full scale response time: .25 second maximum

Frequency response: Full scale dc to 2 Hz -3 dB, 10% of full scale dc to 10 Hz ± 3 dB

Overshoot: None

Input resistance: 1 megohm minimum

Source resistance: 10 K ohm maximum

Input type: Floating differential or single ended (switchable)

Input breakdown: Up to ± 150 Vdc referred to case

Zero adjust: \pm Full scale

Span adjust: $\pm 25\%$

Span: 100 mV

Writing method: Pressure sensitive

Power requirements: 115V, 50 Hz; 115V, 60 Hz; 230V, 50 Hz; 230V, 60Hz; 12 Vdc internal battery

Temperature stability: (50 K Ω source): $\pm .006$ mV/°C typical (.030 mV/°C max.)

60 Hz rejection: 40 dB minimum

Stock No.	Model No.	Description	Standard	With 1 Event Pen	Visible Chart	Nominal Weight	Nominal Dimensions (W x H x D)	Mounting	Events (Optional)	Input Connections	Price
266823 ¹	425	Single Channel	2 $\frac{3}{16}$ "	2"	2"	3.4 lbs.	3 $\frac{1}{8}$ " x 5 $\frac{1}{8}$ " x 6"	Bench Rack	1	Miniature Banana Jacks	\$560.00
266824 ¹	425X1	Single Channel Extended View	2 $\frac{3}{16}$ "	2"	12"	5.6 lbs.	19" x 3 $\frac{1}{2}$ " x 5 $\frac{1}{32}$ "	Standard 19" Rack	1	Miniature Banana Jacks	\$696.00
266827 ¹	6420 ²	Single Channel 100 mm (OEM)	100 mm	100 mm	4"	3.3 lbs.	6 $\frac{1}{8}$ " x 5 $\frac{1}{8}$ " x 6 $\frac{1}{4}$ "	Flush Mount	1 to 3 available	Barrier Strip	\$765.00
266828 ¹	6425	Single Channel 100 mm	100 mm	100 mm	4"	5.1 lbs.	6 $\frac{1}{8}$ " x 5 $\frac{1}{8}$ " x 6 $\frac{1}{4}$ "	Bench Rack	1 to 3 available	Miniature Banana Jacks	\$792.00

Note:

1. Standard chart speed is 1"/hr using a 2 rpm motor. Speed is changeable in fixed increments from $\frac{1}{8}$ "/hr to 90"/hr by replacing a gear train. Other speeds available from $\frac{1}{32}$ "/hr to 4500"/hr by selecting the proper motor and gear train combination. Units with internal batteries are limited to a maximum motor speed of 16 rpm. Chart speed accuracy is $\pm 5\%$.

2. These recorders are an OEM configuration and do not contain a case assembly. Plug-in signal conditioners not available.

PORTABLE: Internal batteries supplied with external charger for 115 Vac or 12 Vdc (specify). Provisions for trickle charge and 16 hour charge supplied as standard; available on Models 425 and 6425 only. Battery life is 24 hours. Response time for internal battery powered units is 0.4 sec. full scale.

RECORDERS

GUIDE TO RUSTRAK SERVO RECORDERS (cont.)

SERVO COMPATIBILITY TABLE

ACCESSORIES: (SEE NEXT PAGE FOR ALL PLUG-IN SIG. CONDITIONERS)

Stock No.	Model No.	P4001	P4004	P4005	P4006	P4088R	P4093	P4186	P4118	P4107S	P4107L	P4133	P4144	P4155AN or AW	Internal Battery
266823	425	A	A	A	A	A	A	A	A	A	A	A	A	A	A
266824	425X1	A	A	A	A	A	A	A	A	A	A	A	A	A	
266825	2W425	A	A	A	A	A	A	A	A	A	A	A	A	A	
266914	2W425X2	A	A	A	A	A	A	A	A	A	A	A	A	A	
266826	3W425	A	A	A	A	A	A	A	A	A	A	A	A	A	
266828	6425	B	B	B	B	B	B	B	B	B	B	B	B	B	A
266915	6425X2	B	B	B	B	B	B	B	B	B	B	B	B	B	

A = Available. Add suffix IB to plug-in model number if recorder has internal battery option. Example: P4001-IB.

B = Add prefix 4L to plug-in model number. Example 4L-P4001. Add suffix IB to plug-in model number if recorder has internal battery option. Example: 4L-P4001-IB.S = Standard.



MODEL 288
SINGLE CHANNEL

RUSTRAK MODELS 288 AND 291 DC SIGNAL RECORDERS

A wide selection of Rustrak dc recorders permit full scale measurements of voltages from 1 mV to 500V and currents from 1 μ A to 1000 A. By the addition of internal amplifiers or external shunts, both the low and high ends of these ranges can be extended.

SPECIFICATIONS

Accuracy: $\pm 2\%$ of span

Maximum Short Term Input¹: 200%

Environment: Indoor/Outdoor with suitable enclosure

Storage Temperature: -40 to 70°C , -40 to 158°F

Dimensions: $3\frac{1}{2}"(\text{W}) \times 5\frac{1}{8}"(\text{H}) \times 4\frac{1}{16}"(\text{D})$

Weight: 3.75 lbs.

Chart Speed: Optional, see pages 38 & 39

Input Connections: 6 pin connector (exception: 10, 25 or 50 mV = binding posts)

Power Cord: Detachable line cord (exception: 10, 25 or 50 mV = fixed line cord)

Recording Width: 288: $2\frac{1}{16}"$; 291: Two 1" isolated channels

With 1 Event: 288: $2\frac{1}{16}"$; 291: N/A

With 2 Events: 288: 1"; 291: N/A

Response Time: 1 second max.

Maximum Continuous Input: 150%

Operating Temperature: 0 to 60°C , 32 to 140°F

Striking Rate: See chart pages 38 & 39

Package: Cast aluminum

Chart Speed Accuracy: Synchronous with line frequency

Primary Power: 100-130V, 50 Hz; 100-130V, 60 Hz
200-260V, 50 Hz; 200-260V, 60 Hz

Stock No.	Ranges	Price
266023	0-10 Microamperes	\$496.00
266024	0-25 Microamperes	\$496.00
266025	0-50 Microamperes	\$436.00
266026	0-100 Microamperes	\$436.00
266027	0-200 Microamperes	\$436.00
266028	0-500 Microamperes	\$436.00
266029	0-1 Milliamperes	\$436.00
266030	0-1.5 thru 0-750 Milliamperes	\$436.00
266031	1-5 Milliamperes	\$436.00
266032	4-20 Milliamperes Process Control	\$436.00

Stock No.	Ranges	Price
266357	0-1 Amperes	\$436.00
266034	0-3 Amperes	\$436.00
266035	0-5 Amperes	\$436.00
266358	0-10 Millivolts	\$436.00
266359	0-25 Millivolts	\$436.00
266360	0-50 Millivolts	\$436.00
266361	0-100 Millivolts	\$415.00
266036	0-0.5 thru 0-500 Volts	\$436.00

1. One minute unless specified
Consult CAPP For Ranges Not Listed

ORDERING INFORMATION:

MODEL 291:

Stock No.	Ranges	Price
266037	0-10 Microamperes	\$878.00
266038	0-50 Microamperes	\$634.00
266039	0-100 Microamperes	\$634.00
266040	0-200 Microamperes	\$634.00
266041	0-500 Microamperes	\$634.00
266042	0-1 Milliamperes	\$575.00
266043	0-1.5 thru 0-750 Milliamperes	\$634.00
266044	1-5 Milliamperes	\$634.00
266046	4-20 Milliamperes Process Control	\$634.00

Stock No.	Ranges	Price
266047	10-50 Milliamperes	\$634.00
266362	0-1 Amperes	\$634.00
266048	0-3 Amperes	\$634.00
266049	0-5 Amperes	\$634.00
266363	0-10 Amperes	\$634.00
266050	0-25 Amperes	\$634.00
266364	0-50 Amperes	\$634.00
266365	0-100 Amperes	\$571.00
266051	0-0.5 thru 0-500 Volts	\$634.00



MODEL 291
DUAL CHANNEL



MODELS
288R & 293

RUSTRAK MODELS 288R & 293 AC SIGNAL RECORDERS

MODEL 288R

Designed for: Plant maintenance & troubleshooting; Design technicians; energy managers; service technicians; and electrical contractors. Choose up to three ranges:

V Range	Stock No.	Chart Paper	Price
0-10	266250	A	\$464.00
0-50	266253	A	\$464.00
0-150	266254	I	\$464.00

V Range	Stock No.	Chart Paper	Price
0-300	266255	I	\$464.00
0-600	266256	K	\$464.00

±2% of full scale/Voltage
 (10V range = ±3%) / Current
 1 second response time
 200% of full scale/Short-Term Input
 100% of full scale/Continuous Input.

Indoor Use

0 to 50°C, 32 to 122°F/Operating Temp.
 2-5/16"/Recording Width
 2"/Recording Width With 1 Event
 1"/Recording Width With 2 Events
 3 5/8"(W) × 5 5/8"(H) × 4 5/16"(D)/Size

PRIMARY POWER

100-130V, 50 Hz; 100-130V, 60 Hz
 200-260V, 50 Hz; 200-260V, 60 Hz

MODEL 293

Medium resolution with expanded scale, for those applications requiring narrower spans than offered on model 288R. Choose one, two or three ranges per channel.

Model No.	Stock No.	V Range	Chart Paper	Channels	Price
SINGLE RANGE					
293	266258	70-135	C	1	\$475.00
293-1	337360	85-135	A	1	\$475.00
2W293	337361	85-135	AA	2	\$690.00
3W293	337362	85-135	AAA	3	\$690.00
TWO RANGE					
293A	337364	70-135 140-270	C	1	\$505.00
293A-2	337365	85-135 170-270	A	1	\$505.00
2W293A	337370	85-135 170-270	AA	2	\$740.00
3W293A	337372	85-135 170-270	AAA	3	\$740.00
THREE RANGE					
293B	266257	70-135 140-270 280-540	C	1	\$534.00
293B-3	337373	85-135 170-270 340-540	A	1	\$534.00
2W293B	337376	85-135 170-270 340-540	AA	2	\$760.00
3W293B	337414	85-135 170-270 340-540	AAA	3	\$760.00

**CALL CAPP/USA TODAY FOR A FULL SELECTION OF
CHART PAPER, PENS & INKS FOR ALL O.E.M. RECORDERS**

RECORDERS



RTD RECORDER

RUSTRAK LINEAR THERMISTOR RTD RECORDERS

ENVIRONMENT INDOOR/OUTDOOR WITH ENCLOSURE

Interchangeability accuracy = best of all RTD's

Time proven stability.

Ideal characteristics; enhanced by high impedance input of amplifier conditioner.

Extremely wide and accurate spans due to linear resistance vs. temperature function produced by the sensor.

Bare bead sensor available.

Stainless steel probe available.

Numerous made-to-order probes and sensors to meet individual requirements.

Add suffix "B" to model number when dual channel is required.

No self-checking.

SPECIFICATIONS

Weight: 3 3/4 lbs.

Sensor Type: 6K/30K Linear Thermistor

Input Connections: Phone Jack; Fixed Line Cord

Primary Power Requirements: 100-130V, 60 Hz
100-130V, 50 Hz
200-260V, 60 Hz
200-260V, 50 Hz
10-14 Vdc @ 15 mA + dc Motor Current

Dimensions: 3 3/8"(W) x 5 1/2"(H) x 4 3/16"(D)

System Accuracy: ±1% of Span

Maximum Cable Extensions: #18 3 Wire up to 500'

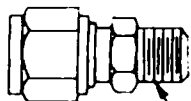
Stock No.	Model No.	System Temperature Limits	Sensor Interchangeability Accuracy	Min. Span	Max. Span	Stability Per Year	Ambient Temperature Limits	Price
266259	Z77L	-30° to 70°C -22° to 158°F	±2°C ±4°F	5°C 10°F	100°C 180°F	±1°C (.2°F) ±5% of Span	-10 to 60°C 14 to 140°F	\$485.00
266260	Z77L(DC)	-30° to 70°C -22° to 158°F	±2°C ±4°F	5°C 10°F	100°C 180°F	±1°C (.2°F) ±5% of Span	-10 to 60°C 14 to 140°F	\$485.00
266261	Z77H	0 to 100°C 32 to 212°F	±2°C ±4°F	5°C 10°F	100°C 180°F	±1°C (.2°F) ±5% of Span	-10 to 60°C 14 to 140°F	\$485.00
266262	Z77H(DC)	0 to 100°C 32 to 212°F	±2°C ±4°F	5°C 10°F	100°C 180°F	±1°C (.2°F) ±5% of Span	-10 to 60°C 14 to 140°F	\$485.00

1. Sensors and electronics are transformer isolated from the primary source and floating with respect to ground. AC models have 1000 volts withstand, from common to frame. Current consumption of DC models is low.

PROBE CONFIGURATION AND TIME CONSTANT

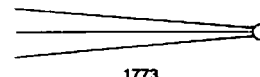
Stock No.	Model No.	Description	Price
266263	1771	Flexible Vinyl Lead and Head Time Constant: 7 Seconds Head: 7/16" Dia. x 7/16" Long. 10' Cable	\$104.66
266265	1773	Encapsulated Thermistor Beads Time Constant: 5 Seconds Bead: .1" Dia., Leads: #32 Solid	\$65.20
266266	1776	Pressure Fitting (300 PSI Maximum) For Model 1772 Probe 304 Stainless Steel	\$31.00

1771



1776

1/8 NPT



1773

THERMISTOR RTD RECORDER

More sensitive for narrow temperature spans.

Uses time proven stable interchangeable thermistor sensor.

Lower cost probes than linear thermistor.

Bridge circuit "linearizes" thermistor signal.

Thermistor scale-linear.

Bridge amplifier circuit allows extremely low thermistor excitation voltage resulting in no self-heating error even with special spans only a few degrees wide.

Add suffix "B" to model number when dual channel is required.

Phone Jack; Fixed Line Cord Input.

#18 2 Wire up to 500' max. cable extensions.

Primary Requirements:

100-130V, 60 Hz Sensors & Electronics

100-130V, 50 Hz Isolated From Primary Source

200-260V, 60 Hz Ground; AC MDLS Are 1000V

200-260V, 50 Hz Current (Common To Frame)

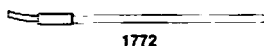
10-14 Vdc @ 15 mA + dc Motor Current.

Stock No.	Model No.	Description	Price
266267	Z33	Temp. Limits: 0° to 100°C, 32° to 212°F Sensor: 2252Ω Thermistor Sensor Accuracy: ±4°C, ±8°F Min. Span: 5°C, 10°F max. Span: 50°C, 100°F Accuracy: ±2% of Span Stability: ±1°C (.2°F) or ±5 of Span Self-Checking: Reads 98 to 100% of Full Scale Ambient Temp.: -10 to 60°C, 14 to 140°F	\$485.00

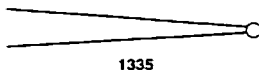
1331

RUSTRAK LINEAR THERMISTOR RTD RECORDERS (cont.)

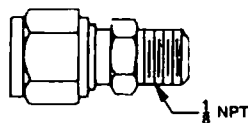
Stock No.	Model No.	Description	Price
266271	1331	Flexible Vinyl Lead and Head Time Constant: 7 Seconds Head: $\frac{3}{16}$ " Dia. x $\frac{3}{16}$ " Long, 10' Cable	\$70.00
266272	1332	Shaft: Tubular 304 Stainless Steel $\frac{3}{32}$ " Dia. x $4\frac{1}{2}$ " Long, 10' Cable Time Constant: 3.7 Seconds Liquid Immersion: 4" Maximum Pressure: 300 PSI Maximum Air or Internal Use	\$152.00
266273	1335	Encapsulated Bead Time Constant: .6 Seconds Bead: Shown actual size.	\$33.00
266274	1336	Pressure Fitting (300 PSI Maximum) For Model 1332 Probe 304 Stainless Steel.	\$31.00
266275	1337-50	Oceanographic Cable for Salt Water Immersion to 50' Depth Time Constant: 20 Seconds Cable: $\frac{1}{4}$ " Dia. x 50' Longer Continuous Lengths Available	\$172.00
266859	1337-100	Oceanographic Cable for Salt Water Immersion to 100' Depth Time Constant: 20 Seconds Cable: $\frac{1}{4}$ " Dia. x 100' Longer Continuous Lengths Available	\$380.00



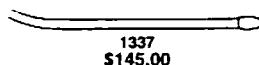
1772



1335



1336



1337
\$145.00

NICKEL RTD RECORDER

Almost instantaneous response to rapid temperature changes—achieved through use of 1442 probe (nickel wire grid on a thin fabric carrier) because of its area and low thermal mass. Designed to use sensors constructed with commercially pure nickel. Bridge amplifier—Sensitive, stable, and allows error free amplification of the low level signal

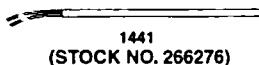
Phone Jack; Fixed Line Cord Input. #18 2 Wire up to 25' max. cable extensions.

Primary Requirements:

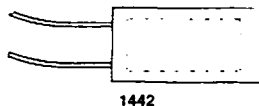
- 100-130V, 60 Hz Sensors & Electronics
- 100-130V, 50 Hz Isolated From Primary Source
- 200-260V, 60 Hz Ground; AC MDLS Are 1000V
- 200-260V, 50 Hz Current (Common To Frame)
- 10-14 Vdc @ 15 mA + dc Motor Current

ORDERING INFORMATION:

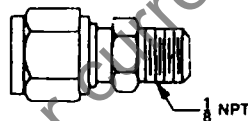
Stock No.	Model No.	Description	Price
266268	Z44	Temp. Limits: -73° to 315°C, -100° to 600°F Sensor: 200Ω CP Nickel Sensor Accuracy: $\pm 1.5^\circ\text{C}$, $\pm 3^\circ\text{F}$ Min. Span: 50°C, 100°F Max. Span: 300°C, 600°F Accuracy: $\pm 3\%$ of Span Stability: $\pm 5^\circ\text{C}$, $\pm 1^\circ\text{F}$ Self-Checking: Reads 98 to 100% of Full Scale Ambient Temp.: -10 to 60°C, 14 to 140°F	\$466.71
266276	1441	Shaft: Tubular 304 Stainless Steel $\frac{7}{16}$ " Dia. x $4\frac{1}{2}$ " Long, 10' Cable Uses: Liquid Immersion: 4" Maximum Pressure: 300 PSI Maximum Air Time Constant: 3 Seconds.	\$115.00
266277	1442	Flexible Nickel Wire Grid Attached to .005" Thick, Soft Stainless Steel with Adhesive Backing Can be Bent to Conform to Most Pipes and Tanks Pad: $\frac{3}{4}$ " x $1\frac{3}{4}$ " x $\frac{1}{32}$ " Thick, 10' Cable Temperature: 500°F. Maximum Time Constant: .5 Seconds.	\$111.09
266278	1443	Pressure Fitting: 300 PSI Maximum For Model 1441 Probe 304 Stainless Steel.	\$31.00



1441
(STOCK NO. 266276)

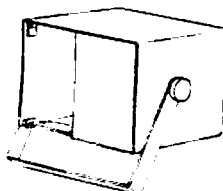


1442



1443

RECORDERS



172-1

ENCLOSURES AND CASES FOR RUSTRAK SIGNAL, RTD, THERMOCOUPLE, EVENT, AND SERVO RECORDERS PORTABLE DUAL PACK ENCLOSURES

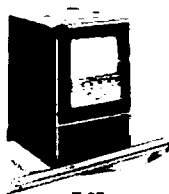
Permits mounting of one or two Rustrak recorders.

Stock No.	Model No.	Description	Price
266847	172-1	Design in your own system Supplied with a blank panel For use with recorder widths of 3 1/8"	\$187.00
266848	172-2	Design in your own system For two recorders For use with recorder widths of 3 1/8"	\$187.00

CARRYING CASES

For transporting recorders between job sites. Leatherette type cases in which most recorders can be housed.

Stock No.	Model No.	Used For	Price
266851	C5613	200 and 400 Series	\$115.50



Z-27

RUSTRAK TEMPERATURE AND RELATIVE HUMIDITY RECORDERS RUSTRAK SERIES Z-27 AND DIGILOG-27

Measures and records relative humidity and temperature on one 2.3 inch chart.

Rustrak's time share feature automatically switches between the two sensors once every two seconds.

Temperature channel is identified by a 1/16" break every 1/2" of paper. During this identifying period, a reference recording is made which confirms the calibration accuracy.

The humidity sensor is a thin film capacitor whose capacitance is dependent on the water absorption in its dielectric material.

Response time is unusually fast (seconds vs. minutes and even hours for some types).

Well proven in thousands of applications all over the world.

Has become the standard of the industry.

Uses standard FRH01 (Degrees Fahrenheit), CRH01 (Degrees Centigrade) chart paper. (2 month roll)

SPECIFICATIONS

Temperature: 30 to 130°F (0 to 50°C)

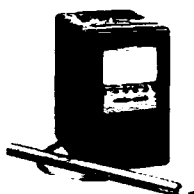
Relative Humidity: 0-100% R.H.

Dimensions: 3 1/8" (W) x 5 1/8" (H) x 4 1/16" (D)

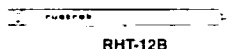
Weight: 3 3/4 lbs.

Stock No.	Model No.	Description	Price
266856	Z-27	Accurate, stable R.H./Temp. Recorder.	\$1,090.00
266857	DIGILOG-27	Accurate, stable R.H./Temp. Recorder with digital readout.	\$1,090.00
266860	RHT-12B	Sensor and electronics assembly can be conveniently wall or ductmounted using Model 2254 fitting. Resistant to most contamination, including sulphur. Moisture permeable surface. Optional Model 2253 recommended if heavy dust is likely to be encountered. Other special cartridges with pore sizes down to one micron are available. Consult CAPP. Humidity channel time constant: 2 sec. Temperature channel time constant: .1 sec. All probes are equipped with a 310 micron SS screen to prevent mechanical damage to the sensors and to filter out large particles.	\$414.00
266913	RHT-12B	Sensor and electronics assembly can be conveniently wall or ductmounted using Model 2254 fitting. Resistant to most contamination, including sulphur. Moisture permeable surface. Optional Model 2253 recommended if heavy dust is likely to be encountered. Other special cartridges with pore sizes down to one micron are available. Consult CAPP. Humidity channel time constant: 2 sec. Temperature channel time constant: .1 sec. All probes are equipped with a 310 micron SS screen to prevent mechanical damage to the sensors and to filter out large particles.	\$414.00
266862	2254	Liquid tight plastic fitting for mounting probe in wall or duct. Requires a 1.10 diameter mounting hole U.S. Telecom; Fixed Line Cord Input Connection 12' standard, others available up to 99' max. cable extensions. Standard 2 RPM = 1/2"/hr. Chart Speed 100-130V, 60 Hz 100-130V, 50 Hz 200-260V, 60 Hz 200-260V, 50 Hz 10-14 Vdc @ 35 mA w/Std. Inverter Motor.	\$20.00

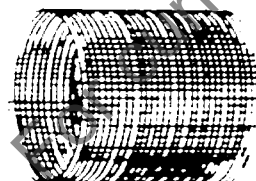
1. Must specify range
2. 12' Lead, standard.
3. Specify length if longer than 12' lead.



DIGILOG-27

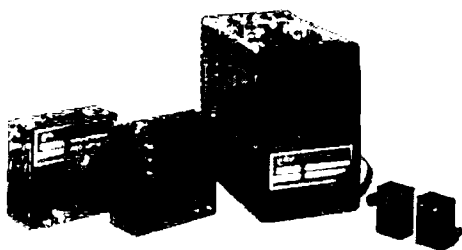


RHT-12B



2253

RECORDERS



SERVO RECORDERS AND PLUG-IN SIGNAL CONDITIONERS DC SIGNAL CONDITIONERS

Enhance servo capabilities by using one of the following quick change plug-in signal conditioners. (matching scales provided) Suggested chart paper is for 400 series recorders only.

Order No.	Must Specify Range	Input/Source Resistance Or Burden (VA)	Accuracy (Module Only)	Suggested Chart Paper	Input Connections	Probes Sensors Transducers	Price
P4001 ^{1,2}	Specify any mV span within the limits of 1 to 9.99 mV	50 K Ω /5 K Ω	$\pm 2\%$	Contingent upon scale selected. ⁸	Two miniature binding posts with .5" centers.	None Required	\$535.00
P4004 ^{1,2}	Specify any mV span within the limits of 10 to 50 mV	50 K Ω /5 K Ω	$\pm 2\%$	Contingent upon scale selected. ⁸	Two miniature binding posts with .5" centers.	None Required	\$535.00
P4005 ^{1,2,3}	Specify one: 1 Vdc 3 Vdc 5 Vdc 10 Vdc 15 Vdc 30 Vdc 50 Vdc 75 Vdc 100 Vdc 150 Vdc 300 Vdc 500 Vdc	.05 M Ω .15 M Ω .25 M Ω .5 M Ω .75 M Ω 3 M Ω 5 M Ω .75 M Ω 1.0 M Ω 1.5 M Ω 3.0 M Ω 5.0 M Ω	$\pm 0.5\%$	A I A A I I I B A I I A	Two miniature binding posts with .5" centers.	None Required	\$535.00
P4006 ^{1,2,4}	Specify one: 50 μ A 100 μ A 100 μ A 200 μ A 500 μ A 1 mA 1.5 mA 3 mA 4 mA ⁷ 5 mA 10 mA 15 mA 16 mA ⁷ 30 mA 40 mA ⁷ 50 mA 75 mA 100 mA 150 mA 300 mA 500 mA 750 mA 1A 3A 5A	5400 Ω 4600 Ω 1000 Ω 2200 Ω 200 Ω 100 Ω 66.6 Ω 33.3 Ω 25 Ω ⁷ 20 Ω 10 Ω 6.66 Ω 6.25 Ω ⁷ 3.33 Ω 2.5 Ω ⁷ 2.00 Ω 1.33 Ω 1.00 Ω .66 Ω .33 Ω 20 Ω 13 Ω 100 Ω .033 Ω .020 Ω	$\pm 0.5\%$	Contingent upon scale selected. ⁸	Two miniature binding posts with .5" centers.	None Required	\$155.00

- Fixed gain dc amplifier increases recorder sensitivity up to 100 times.
- Fixed gain dc amplifier increases recorder sensitivity up to 10 times.
- Voltage multipliers from 1 to 500 Vdc are available in this series.
- Current shunts 50 μ A to ± 1 mA simulate the input resistance and current sensitivity of our popular galvanometric series.
- Recorder sensitivity changes achieved with amplifiers, shunts, and multipliers used in conjunction with the servo offset (zero) adjustment can increase the usefulness of the system.
- Chart style equals span divided by minor divisions. This should be an even division. You can adjust range to suit paper for easier readability.
- For use with process control recorders (25-125 mV) Models 425PC, 2W425PC, 3W425PC, 6425PC.
- Must Specify Range.

AC SIGNAL CONDITIONERS

Order No.	Must Specify Range	Input/Source Resistance Or Burden (VA)	Accuracy (Module Only)	Suggested Chart Paper	Input Connections	Probes Sensors Transducers	Price
P4107S ^{1,4}	Specify one: 0-10A 0-20A 0-30A 0-50A 0-100A 0-200A 0-300A	.01 VA .02 VA .03 VA .05 VA .1 VA 2 VA .3 VA	$\pm 3\%$ (clamp-on and module are calibrated as a set)	A G I A A G I	Two miniature binding posts with .5" centers.	Model 4107TS (required) can be clamped over a one inch diameter conductor. It has a six foot permanently attached cable with matching terminations to the module. Extensions up to 100' are available.	\$198.60

RECORDERS

SERVO RECORDERS AND PLUG-IN SIGNAL CONDITIONERS (cont.) AC SIGNAL CONDITIONERS (cont.)

Order No.	Must Specify Range	Input/Source Resistance Or Burden (VA)	Accuracy (Module Only)	Suggested Chart Paper	Input Connections	Probes Sensors Transducers	Price
P4107L ²	Specify one: 0-100A 0-200A 0-300A 0-400A 0-500A 0-600A 0-800A 0-1000A	.1 VA .2 VA .3 VA .4 VA .5 VA .6 VA .8 VA 1.0 VA	±3% (clamp-on and module are calibrated as a set)	A G I H A K H A	Two miniature binding posts with .5" centers.	Model 4107TL (required) can be clamped over a two inch diameter conductor. It has a six foot permanently attached cable with matching terminations to the module. Extensions up to 100' are available.	\$198.60
P4118 ²	Two ranges are included: 0-1 and 0-5 Aac.	.1 VA .5 VA	±2%	A	Three miniature binding posts with .5" centers.	None required. Cable to the recorder should have a loop resistance of less than .1 Ω	\$226.00

1. Used in conjunction with a clamp-on current transducer, monitor currents up to 300A without a direct connection to the external circuit. The Rustek 4107TS clamp-on transducer is calibrated with its matching plug-in module.
2. Used in conjunction with a clamp-on current transducer, monitor currents up to 1000A without a direct connection to the external circuit. Rustek 4107TL clamp-on transducer is calibrated with its matching plug-in module.
3. The 5A input accepts output from standard current transformers (CT) and older style clamp-ons. The 1A input matches modern clamp-ons such as the AEMC 1000/1.
4. Must Specify Range.

TEMPERATURE LIMITS

Thermocouple Type	Minimum Span	Useful Temperature Range
J (Iron constantan)	60°F (30°C)	-300 to 1400°F
K (chromel/alumel)	60°F (30°C)	-310 to 2000°F
R (platinum 13% - rhodium/platinum)	400°F (200°C)	*32 to 2650°F
S (platinum 10% - rhodium/platinum)	400°F (200°C)	32 to 2650°F
T (copper/constantan)	60°F (30°C)	-310 to 570°F

Offsets up to 5X max. be specified

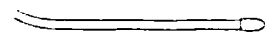
1771
(SEE PG. 202)

PROBES, SENSORS, & TRANSDUCERS

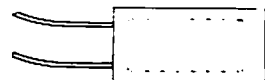
Order No.	Description	Price
FOR P4133		
1331	Flexible vinyl lead and head Time constant: 7 seconds	\$70.00
1332	Shaft: Tubular 304 stainless steel 3/16" dia. x 4 1/2" long, 10' cable. Time constant: 3.7 seconds Liquid immersion: 4" maximum Pressure: 300 PSI max. air or internal use	\$152.00
1335	Encapsulated bead Time constant: .6 seconds Bead: 1" dia., leads: #32 solid	\$33.00
1336	Pressure fitting (300 PSI maximum) For Model 1332 probe 304 stainless steel	\$31.00
1337-50	Oceanographic cable for salt water immersion to 50' depth Time constant: 20 seconds Cable: 1/4" dia x 50' Longer continuous lengths available 1337-100 (100') Model 1337 ext. can not be immersed	\$175.00
FOR P4144		
1441	Shaft: Tubular 304 stainless steel 3/16" dia. x 4 1/2" long, 10' cable Uses: Liquid immersion: 4" maximum Pressure: 300 PSI maximum Air Time constant: 3 seconds	\$115.00
1442	Flexible nickel wire grid attached to .005" thick, soft stainless steel with adhesive backing. Can be bent to conform to most pipes and tanks. Pad: 3/4" x 1 3/4" x 1/2" thick, 10' cable. Temperature: 500°F maximum Time constant: .5 seconds	\$111.09



1335



1337
\$145.00



1442

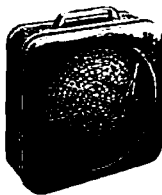
1332
(STOCK NO. 266272)

1441
(STOCK NO. 266276)

SERVO RECORDERS AND PLUG-IN SIGNAL CONDITIONERS (cont.) PROBES, SENSORS, & TRANSDUCERS (cont.)

1551
1552
(STOCK NO. 266795/266796)

Order No.	Description	Price
FOR P4144 (cont.)		
1443	Pressure fitting: 300 PSI maximum For Model 1441 probe 304 stainless steel	\$31.00
FOR P4155AN AND P4155AW		
1551	Type J (Iron Constantan) Both probes have stainless steel sheath Time constant: 5 seconds Shaft: 3/16" dia. x 6" long, 6' armored cable Max. continuous temperature 900°F	\$166.00
1552	Type K (Chromel/Alumel) Both probes have stainless steel sheath Time constant: 5 seconds Shaft: 3/16" dia. x 6" long, 6' armored cable Max. continuous temperature 900°F	\$166.00
1553	Pressure fitting: 300 PSI maximum For models 1551 and 1552 304 stainless steel Head: 3/16" dia. x 3/16" long, 10' cable	\$53.00



TH8

DICKSON TH8 TEMPERATURE/HUMIDITY SUPER SERIES RECORDERS

Provides the accuracy and ease of operation of TH Trace, with the added convenience of a detailed 8-inch chart. Ideal for static electricity control and preservation of material storage.

SPECIFICATIONS

Temp. accuracy: ±2% full scale

Humidity range: 15–85% RH

Humidity accuracy: ±3% RH

Order No.	Stock No.	Temp. Range	Recording Time	Price
TH8-24F	164797	–20–120°F	24-hour	\$588.00
TH8-7F	53689	–20–120°F	7-hour	\$588.00

DICKSON TH8 TEMPERATURE/HUMIDITY SUPER SERIES RECORDERS

Order No.	Stock No.	Temp. Range	Recording Time	Price
TH8-24C	226946	–20–50°C	24-hour	\$588.00
TH8-7C	226951	–20–50°C	7-day	\$588.00

Includes: One "AA" battery, pens, a box of 8" charts and a 1-point NIST Traceable Certificate of Calibration.

ACCESSORIES

Order No.	Stock No.	Description	Price
P246	171330	Replacement Pens (3 red & 3 blue)	\$29.00
N3THM	227149	NIST Traceable Calibration 3-Pt.	\$135.00

CHARTS¹

Order No.	Stock No.	Temperature Range	Price
24-HOUR CHART			
C415	13547	–20–120°F	\$15.00
C472	226954	–20–50°C	\$15.00
7-DAY CHART			
C417	13576	–20–120°F	\$15.00
C473	216673	–20–50°C	\$15.00

1. Sixty (60) per box. Order charts for your specific range.

RECORDERS

DICKSON THDx TEMPERATURE/HUMIDITY SUPER SERIES RECORDERS



THDx

Ideal for recording compliance to regulations and industry standards in critical or clean environments without intruding.

Order No.	Stock No.	Temp. Accuracy	Humidity Ranges	Humidity Accuracy	Chart Size	Ave. Response Time ¹	Temp. Ranges	Price
THDX	149884	±1.8°F	0-95% RH (non-condensing)	±2% bet. 0 and 60% ±3% bet. 61 and 95%	8" dia.	Temp. - 30 sec. and RH - 20 sec. for 63% step change at 1 cfm	-20-120°F 40-110°F -20-50°C 5-40°C	\$625.00

1. Response time is slower when using the back-up battery power source.

Include: AC adapter, pens, a starter box of 8" charts (-20 to 120°F/24-hour, 7-day) and a 1-point NIST Traceable Certificate of Calibration.

ACCESSORIES

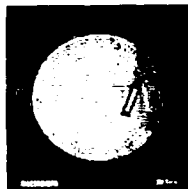
Order No.	Stock No.	Description	Price
A834	226962	Calibration Kit (11% and 75%)	\$125.00
A860	208310	10' Probe Extension Cable	\$38.00
A865	226964	50' Probe Extension Cable	\$67.00
A866	226966	100' Probe Extension Cable	\$97.00
P246	171330	Replacement Pens (3 red & 3 blue)	\$29.00
N3THX	227148	NIST Traceable Calibration 3-Pt.	\$139.00

CHARTS¹

Order No.	Stock No.	Temperature Range	Price
24-HOUR CHART			
C415	13547	-20-120°F	\$15.00
C476	185926	40-110°F	\$15.00
C472	226954	-20-50°C	\$15.00
C478	226967	5-40°C	\$15.00
7-DAY CHART			
C417	13576	-20-120°F	\$15.00
C477	185927	40-110°F	\$15.00
C473	216673	-20-50°C	\$15.00
C479	226975	5-40°C	\$15.00
31-DAY CHART			
C480	226976	-20-120°F	\$15.00
C481	226977	40-110°F	\$15.00
C482	226978	-20-50°C	\$15.00
C483	226980	5-40°C	\$15.00

1. Sixty (60) per box. Order charts for your specific range.

HONEYWELL - PARTLOW - AMPROBE - CHESSELL - DICKSON - RUSTRAK
ALL OF THE NATIONAL BRANDS OF RECORDERS & CONTROLLERS
FEATURED IN THIS CATALOG - CAPP/USA GIVES YOU FREEDOM
OF CHOICE & FLEXIBILITY



TH Trace

DICKSON TH TRACE TEMPERATURE/HUMIDITY SUPER SERIES RECORDERS

Provides all the documentation you need to prove compliance to human comfort and product safety requirements. It is a wonderful combination of accuracy and affordability.

SPECIFICATIONS

Temp. accuracy: $\pm 2\%$ full scale

Humidity accuracy: 20–80% RH

Avg. response time: 11 min. to move 63% of full scale

Humidity range: 20–80% RH

Chart size: 4" dia.

Order No.	Stock No.	Temp. Range	Recording Time	Price
THP24F	208306	0–100°F	24-hour	\$416.00
THP7F	138526	0–100°F	7-day	\$416.00
THP7C	226982	–10–40°C	7-day	\$416.00

Include: One "AA" battery, a box of 4" charts, pens and a 1-point NIST Traceable Certificate of Calibration.

ACCESSORIES

Order No.	Stock No.	Description	Price
A833	226981	Tie-Down Cable	\$14.00
P246	171330	Replacement Pens (3 red & 3 blue)	\$29.00
N3THM	227149	NIST Traceable Calibration 3-Pt.	\$139.00

CHARTS¹

Order No.	Stock No.	Temperature Range	Price
24-HOUR CHART			
C010	13529	0–100°F	\$12.00
7-DAY CHART			
C012	13530	0–100°F	\$12.00
C177	86039	–10–40°C	\$12.00

1. Sixty (60) per box. Order charts for your specific range.



TH550

DICKSON TH550 TEMPERATURE/HUMIDITY/DEW POINT INDICATORS

SPECIFICATIONS

Temp. range: –22–122°F

Humidity range: 0–95% RH (non-condensing)

Dew point range: –22–122°F

Sample rate: Approx. 1 per sec.

Temp. accuracy: $\pm 1.8^\circ\text{F}$ and $\pm 1^\circ\text{C}$

Humidity accuracy: $\pm 2\%$ from 10–60%, ± 3 from 61 to 95% RH

Avg. response time: 5 sec. to move 60% of scale

Order No.	Stock No.	Description	Price
TH550	177361	Indicator—Monitors temperature, humidity and dew point and read the answers on a big digital display.	\$389.00

Include: 9V battery, padded carrying case and a 1-point NIST Traceable Certificate of Calibration.

ACCESSORIES

Order No.	Stock No.	Description	Price
A834	226962	Calibration Kit (11% and 75%)	\$125.00
N3TH5	227161	NIST Traceable Calibration 3-Pt.	\$139.00



DICKSON COMPACT TEMPERATURE RECORDERS SUPER-COMPACT SERIES SC3

Sets a new standard for a compact size recorder while providing the accuracy and resolution required for regulation compliance and quality control. The reusable SC3 is rugged enough to withstand the rigors of transportation and storage applications.

SPECIFICATIONS

Accuracy: $\pm 2^\circ\text{F}$, ($\pm 1^\circ\text{C}$) over full scale

Recording Times: 24-hour or 7-day

Dimensions: 3.7" \times 3.7" \times 2.3"

Dual Range: records in Fahrenheit and Celsius

Chart Size: 3" diameter

Recorder Stock No.	°F Chart Stock No.	°C Chart Stock No.	°F Range	°C Range	Recording Time	Price
267011	267022	267034	–14 to 32°F	–25 to 0°C	24-hour	\$98.00
267012	267023	267035	–14 to 32°F	–25 to 0°C	7-day	\$98.00
267013	267024	267036	4 to 50°F	–15 to 10°C	24-hour	\$98.00
267014	267025	267037	4 to 50°F	–15 to 10°C	7-day	\$98.00

RECORDERS

DICKSON COMPACT TEMPERATURE RECORDERS (cont.)

Recorder Stock No.	°F Chart Stock No.	°C Chart Stock No.	°F Range	°C Range	Recording Time	Price
267015	267026	267038	50 to 96°F	10 to 35°C	24-hour	\$98.00
267016	267031	267039	50 to 96°F	10 to 35°C	7-hour	\$98.00
267017	267032	267040	76 to 122°F	25 to 50°C	24-hour	\$98.00
267018	267033	267041	76 to 122°F	25 to 50°C	7-day	\$98.00

Include: One "AA" battery, pen.

ACCESSORIES

Stock No.	Description	Price
267019	Tamper Seals (60 seals)	\$15.00
267020	Tie-down cable	\$15.00
228171	Replacement Pens (6 red)	\$29.00



SC8

DICKSON SC8 TEMPERATURE RECORDERS

Provides ease of use, superior chart detail and all accuracy you need for documenting moderate temperature environments and human comfort issues. Ideal for verification of temperatures during HVAC balancing and commonly used for areas where quality control compliance to regulations are concerns.

SPECIFICATIONS

Mounting: Portable with keyhole slots for wall mounting
Chart size: 8" dia.

Accuracy: ±2% full scale

Order No.	Stock No.	Temp. Range	Recording Time	Price
SC8-120-B-7	227069	-20-120°F	7-day	\$370.00

Include: One "AA" battery, pen, and a box of 8" charts.

ACCESSORIES

Order No.	Stock No.	Description	Price
P222	13580	Replacement Pens (6 red)	\$29.00
N3S	227152	NIST Traceable calibration 3-Pt.	\$139.00

CHARTS¹

Order No.	Stock No.	Temp. Range	Price
7-DAY			
C417	13576	-20-120°F	\$15.00

1. Sixty (60) per box. Order charts for your specific range.

6



Temp Trace II

DICKSON TEMP TRACE II REMOTE SENSING TEMPERATURE SUPER SERIES RECORDERS

The best bet for documenting temperature in specific areas or extreme environments. Provides a combination of accuracy and affordability, if you have manufacturing or storage processes where there is a need to monitor and record temperature from a distance.

SPECIFICATIONS

Ave. response time: 30 sec. in well-stirred water to move 63% of full scale

Accuracy: ±2% full scale

Probe: External 4" long stainless steel bulb, 1/2" dia., 6' capillary

Chart size: 4" dia

Order No.	Stock No.	Temp. Range	Recording Time	Price
DTP50F24	227103	-50-50°F	24-hour	\$416.00
DTP50F7	208307	-50-50°F	7-day	\$416.00
DTP120F24	227110	-20-120°F	24-hour	\$416.00
DTP120F7	177700	-20-120°F	7-day	\$416.00
DTP100F24	227112	0-100°F	24-hour	\$416.00
DTP100F7	145682	0-100°F	7-day	\$416.00
DTP250F24	227114	0-250°F	24-hour	\$416.00
DTP250F7	208308	0-250°F	7-day	\$416.00

Order No.	Stock No.	Temp. Range	Recording Time	Price
DTP500F24	180740	0-500°F	24-hour	\$416.00
DTP500F7	227118	0-500°F	7-day	\$416.00
DTP50C24	227120	-50-50°C	24-hour	\$416.00
DTP50C7	227121	-50-50°C	7-day	\$416.00
DTP100C24	227122	0-100°C	24-hour	\$416.00
DTP100C7	227123	0-100°C	7-day	\$416.00
DTP250C24	227124	0-250°C	24-hour	\$416.00
DTP250C7	227125	0-250°C	7-day	\$416.00

Include: One "AA" battery, pen and a box of 4" charts.

DICKSON TEMP TRACE II REMOTE SENSING TEMPERATURE SUPER SERIES RECORDERS (cont.)

ACCESSORIES

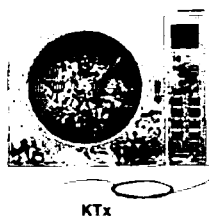
Order No.	Stock No.	Description	Price
A833	226981	Tie-Down Cable	\$14.00
P222	13580	Replacement Pens (6 red)	\$29.00
N3DT	227155	NIST Traceable Calibration 3-Pt.	\$139.00

CHARTS¹

Order No.	Stock No.	Temp. Range	Price
24-HOUR CHART			
C081	227100	-50-50°F -50-50°C	\$12.00
C015	13531	-20-120°F	\$12.00
C010	13529	0-100°F 0-100°C	\$12.00
C032	13540	0-250°F 0-250°C	\$12.00
C028	44043	0-500°F	\$12.00

Order No.	Stock No.	Temp. Range	Price
7-DAY CHART			
C083	122081	-50-50°F -50-50°C	\$12.00
C017	13532	-20-120°F	\$12.00
C012	13530	0-100°F 0-100°C	\$12.00
C039	227101	0-250°F 0-250°C	\$12.00
C056	186507	0-500°F	\$12.00

1. Sixty (60) per box. Order charts for your specific range.



DICKSON K-THERMOCOUPLE REMOTE SENSING TEMPERATURE RECORDERS

SPECIFICATIONS

Temp. ranges: -50-50°F/0°C
0-100°F/0°C
0-250°F/0°C
0-500°F only.

Temp. accuracy: $\pm 0.3\%$ of reading or $\pm 1.8^\circ\text{F}$, $\pm 1^\circ\text{C}$
(recorder only)

Ave. response time: 10 sec. for 60% step change; depending on sensor thermocouple
Recording times: 24-hour, 7-day and 31-day

Chart size: 8" dia.

Order No.	Stock No.	Description	Price
KTX	224343	Developed to provide the ultimate in versatility and accuracy. Accepts any K-thermocouple probe with miniconnector plug, so it serves as many recorders in one.	\$587.00

Include: Bead-wire probe, AC adapter, a box of 8" charts, pen, 1-point NIST Traceable Certificate of Calibration.

ACCESSORIES

Order No.	Stock No.	Description	Price
P222	13580	Replacement Pens (6 red)	\$29.00
D163	227037	Compression Fitting for D164 probe	\$29.00
D164	224344	Stainless Steel Basic Probe (316SS)	\$88.00
Z1347	227040	Replacement Bead Probe, Type "K"	\$29.00
D605	227041	Piercing Probe, 5' coiled cable (4" x 1/32")	\$39.00
D608	227044	Immersion Probe, 5' coiled cable 1650°F	\$39.00
D617	227046	10' Straight Extension Cable	\$28.00

Order No.	Stock No.	Description	Price
A202	227048	100' Straight Extension Cable	\$98.00
N3KTX	227162	NIST Traceable Calibration 3-Pt.	\$139.00

CHARTS¹

Order No.	Stock No.	Temp. Range	Price
24-HOUR CHART			
C411	41041	-50-50°F/°C	\$15.00
C410	13545	0-100°F/°C	\$15.00
C432	71292	0-250°F/°C	\$15.00
C428	38520	0-500°F only	\$15.00
7-DAY CHART			
C414	226953	-50-50°F/°C	\$15.00
C412	13546	0-100°F/°C	\$15.00

Order No.	Stock No.	Temp. Range	Price
7-DAY CHART (cont.)			
C439	13558	0-250°F/°C	\$15.00
C459	84639	0-500°F only	\$15.00
31-DAY CHART			
C406	227017	-50-50°F/°C	\$15.00
C409	13543	0-100°F/°C	\$15.00
C407	227018	0-250°F/°C	\$15.00
C408	227020	0-500°F only	\$15.00

1. Sixty (60) per box. Order charts for your specific range.

RECORDERS



SK4



SL4

DICKSON SK4/SL4 TEMPERATURE SUPER SERIES RECORDERS

Provides an unbeatable combination of durability, accuracy and affordable price.

SPECIFICATIONS

Temp. accuracy: $\pm 2\%$ full scale

Chart size: 4" dia.

Order No.	Stock No.	Temp. Range	Recording Time	Price
SK4 SERIES (NO DIGITAL DISPLAY)				
SK4120F24	136727	-20-120°F	24-hour	\$195.00
SK4120F7	183620	-20-120°F	7-day	\$195.00
SK4100F24	227000	0-100°F	24-hour	\$195.00
SK4100F7	208300	0-100°F	7-day	\$195.00
SK490F24	218375	45-90°F	24-hour	\$195.00
SK4350C24	227002	-30-50°C	24-hour	\$195.00
SK4350C7	227003	-30-50°C	7-day	\$195.00
SK445C24	227005	0-45°C	24-hour	\$195.00
SL4 SERIES¹ (W/DIGITAL DISPLAY)				
SL4120F24	208304	-20-120°F	24-hour	\$224.00
SL4120F7	208303	-20-120°F	7-day	\$224.00
SL4100F7	208302	0-100°F	7-day	\$224.00
SL490F7	208301	45-90°F	7-day	\$224.00
SL4350C7	208305	-30-50°C	7-day	\$224.00

1. Display accuracy: $\pm 2^\circ$.

Include: One "AA" battery, pen and a box of 4" charts.

ACCESSORIES

Order No.	Stock No.	Description	Price
A833	226981	Tie-Down Cable	\$14.00
P222	13580	Replacement Pens (6 red)	\$29.00
N3S	227152	NIST Traceable Calibration 3-Pt.	\$139.00

CHARTS¹

Order No.	Stock No.	Temperature Range	Price
24-HOUR CHART			
C015	13531	-20-120°F	\$12.00
7-DAY CHART			
C017	13532	-20-120°F	\$12.00
C012	13530	0-100°F	\$12.00
C070	13577	45-90°F	\$12.00
C181	226956	-30-50°C	\$12.00

1. Sixty (60) per box.

6



DICKSON TRANSIT TEMPERATURE RECORDER

This single use transit temperature recorder will provide accurate documentation in many different time and temperature ranges. Perfect for proving the integrity of shipments with temperature critical storage parameters. The Dickson temperature recorder comes with a crimped seal that prevents tampering with documented information on the chart. It's low cost and compact size makes this instrument a convenient, economical tool for all on-the-job temperature recording. This recorder includes a tamper proof starting tab, shipment/job sheet and mounting tape.

ORDERING INFORMATION:

SPECIFICATIONS

Recording Ranges: -20 to +100°F, -30 to +37.5°C

Recording Times: 5-day, 10-day, 20-day

Chart Size: 32" to 43", 3 1/8" wide pressure sensitive strip chart

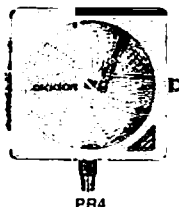
Instrument Dimensions: 7.18" x 5.75" x 2.12"

Accuracy: $\pm 1^\circ\text{F}$ ($+0.6^\circ\text{C}$) from +10 to +70°F (-12 to +21°C)

Operating Range: -20 to +135°, 0 to 95% RH (non-condensing)

Stock No.	Temperature Range	Recording Time	Price
283989	-20 to +100°F	5-day	\$30.00
283990	-20 to +100°F	10-day	\$30.00
283992	-20 to +100°F	20-day	\$30.00

Stock No.	Temperature Range	Recording Time	Price
283993	-30 to +37.5°C	5-day	\$30.00
283994	-30 to +37.5°C	10-day	\$30.00
283995	-30 to +37.5°C	20-day	\$30.00



DICKSON PR4 PRESSURE SUPER SERIES RECORDERS

The most convenient, reliable way to measure and document critical gas and liquid pressure issues overtime. it is so compact that they can replace standard pressure gauges throughout your plant or pumping station.

SPECIFICATIONS

Ave. response time: 1-5 sec.
Ambient oper. range: -22-122°F
Weight: 2.5 lbs.
Mounting: Stem or keyhole slots for wall mounting

Accuracy: $\pm 2\%$ full scale
Chart size: 4" dia
Connection: $\frac{1}{4}$ " male NPT, stainless steel
Case: NEMA 2 all metal case w/window in door (not waterproof)

Order No.	Stock No.	Pressure Range	Recording Time	Price
PR4100PB24S	208314	0-100 psi	24-hour	\$342.00
PR4100PB7S	208313	0-100 psi	7-day	\$342.00
PR4200PB24S	208316	0-200 psi	24-hour	\$342.00
PR4200PB7S	208315	0-200 psi	7-day	\$342.00

Include: One "AA" battery, pen, and a box of 4" charts.

ACCESSORIES

Order No.	Stock No.	Description	Price
A7981	227088	Accessory Kit	\$73.00
32011	227091	Filter Kit	\$24.00
A7983	227092	Filter Hydrant Adapter	\$139.00
P222	13580	Replacement Pens (6 red)	\$29.00
N1PR	227157	NIST Traceable calibration 1-Pt.	\$89.00
N3PR	227159	NIST Traceable calibration 3-Pt.	\$139.00

CHARTS¹

Order No.	Stock No.	Pressure Range	Price
24-HOUR CHART			
C010	13529	0-100 psi	\$12.00
C026	13539	0-200 psi	\$12.00
7-DAY CHART			
C012	13530	0-100 psi	\$12.00
C040	13541	0-200 psi	\$12.00

1. Sixty (60) per box. Order charts for your specific range.



DICKSON PR8 PRESSURE SUPER SERIES RECORDERS

The most convenient, reliable way to measure and document critical gas and liquid pressure issues overtime. it is so compact that they can replace standard pressure gauges throughout your plant or pumping station.

SPECIFICATIONS

Avg. response time: 1-5 sec.
Ambient oper. range: -22-122°F
Weight: 6 lbs.
Mounting: Stem or keyhole slots for wall mounting

Accuracy: $\pm 2\%$ full scale
Chart size: 8" dia
Connection: $\frac{1}{4}$ " male NPT, stainless steel
Case: NEMA 2 all metal case w/window in door (not waterproof)

Order No.	Stock No.	Pressure Range	Recording Time	Price
PR8100PB24S	227073	0-100 psi	24-hour	\$489.00
PR8100PB7S	227075	0-100 psi	7-day	\$489.00
PR8200PB24S	142777	0-200 psi	24-hour	\$489.00
PR8200PB7S	227083	0-200 psi	7-day	\$489.00

Include: One "AA" battery, pen, a box of 8" charts, and filter kit.

ACCESSORIES

Order No.	Stock No.	Description	Price
A7981	227088	Accessory Kit	\$73.00
32011	227091	Filter Kit	\$24.00
A7983	227092	Fire Hydrant Adapter Kit	\$139.00
P222	13580	Replacement Pens (6 red)	\$29.00
N1PR	227157	NIST Traceable calibration 1-Pt.	\$89.00
N3PR	227159	NIST Traceable calibration 3-Pt.	\$139.00

CHARTS¹

Order No.	Stock No.	Pressure Range	Price
24-HOUR CHART			
C410	13545	0-100 psi	\$15.00
C441	306818	0-1000 psi	\$15.00
C456	13559	0-200 psi	\$15.00
7-DAY CHART			
C412	13546	0-100 psi	\$15.00
C436	13557	0-200 psi	\$15.00
C441	306818	0-1000 psi	\$15.00

1. Sixty (60) per box. Order charts for your specific range.

**CALL CAPP/USA TODAY FOR A FULL SELECTION OF
CHART PAPER, PENS & INKS FOR ALL O.E.M. RECORDERS**

RECORDERS



DICKSON WEATHER RESISTANT PRESSURE RECORDERS

Like our 4" pressure recorders, but need a water resistant case? Here is the answer! Introducing our new PW4 weather resistant pressure recorder. The NEMA 4X case provides a degree of protection against corrosion, windblown dust and rain, splashing water and hose-directed water. PW includes: Battery, pen and box of charts.

ORDERING INFORMATION:

SPECIFICATIONS

Accuracy: $\pm 2\%$ full scale

Ambient Operating Range: -22 to $+122^{\circ}\text{F}$, -30 to $+50^{\circ}\text{C}$

Average Response Time: 1 to 5 seconds

mounting: stem of keyhole slots or wall mounting

Weight: 6 lbs.

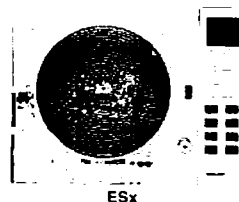
Case: Fiberglass NEMA 4X with door window (weather resistant, water resistant)

Stock No.	Pressure Range	Chart Size	Connection	Price
24-HOUR				
283957	0 to 100PSI	8" diameter	1/4" male NPT	\$448.00
283960	0 to 200PSI	8" diameter	1/4" male NPT	\$448.00
283962	0 to 500PSI	8" diameter	1/4" male NPT	\$448.00
7-DAY				
283964	0 to 100PSI	8" diameter	1/4" male NPT	\$448.00
283967	0 to 200PSI	8" diameter	1/4" male NPT	\$448.00
283968	0 to 500PSI	8" diameter	1/4" male NPT	\$448.00

Note: Dickson pressure recorders are not suitable for ammonia service.

ACCESSORIES

Stock No.	Description	Price
227088	Accessory Kit	\$75.00
227091	Filter Kit	\$25.00
227092	Fire Hydrant Adapter Kit	\$139.00
228171	Pens (6 red)	\$30.00
227157	NIST Traceable Calibration 1-Pt.	\$89.00
227159	NIST Traceable Calibration 3-Pt.	\$139.00



DICKSON ESx VARIABLE INPUT RECORDERS

Ideal for anyone requiring high accuracy or multiple and changing recording needs. It is the nearest thing to a universal recorder.

Order No.	Stock No.	Input Ranges	Accuracy	Ambient Oper. Temp.	Ave. Response Time	Chart Size	Price
ESX	227127	0-20 mA, 4-20 mA, 0-5 Vdc, 1-5 Vdc	0.3% full scale ± 1 digit (recorder only)	32-122°F (0-50°C), 0-90% RH (non-condensing)	20 sec. full scale	8" dia	\$629.00

Transmitter compatibility: Any powered voltage or current transmitter with specified recorder input range
Include: AC adapter, a box of 8" charts (0-100/7-day) and a pen.

CHARTS¹

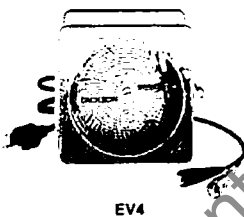
Order No.	Stock No.	Output Range	Price
24-HOUR CHART			
C420	181822	0-10	\$15.00
C410	13545	0-100	\$15.00
C441	227129	0-1000	\$15.00
C457	13560	0-14	\$15.00
C425	13553	0-150	\$15.00
C456	13559	0-200	\$15.00
C443	227130	0-2000	\$15.00
C432	71292	0-250	\$15.00
C424	13552	0-30	\$15.00
C422	13551	0-300	\$15.00
C491	227131	0-45	\$15.00
C428	38520	0-500	\$15.00
C429	227132	0-60	\$15.00
C476	185926	40-110	\$15.00

DICKSON ESx VARIABLE INPUT RECORDERS (cont.)

Order No.	Stock No.	Output Range	Price
24-HOUR CHART (cont.)			
C495	227133	-10-10	\$15.00
C442	227135	-150-250	\$15.00
C472	226954	-20-50	\$15.00
C415	13547	-20-120	\$15.00
C486	227137	-30-50	\$15.00
C411	41041	-50-50	\$15.00
7-DAY CHART			
C498	97527	0-10	\$15.00
C412	13546	0-100	\$15.00
C440	227138	0-1000	\$15.00
C453	227139	0-14	\$15.00
C435	13556	0-150	\$15.00
C436	13557	0-200	\$15.00
C444	227140	0-2000	\$15.00
C439	13558	0-250	\$15.00
C463	140991	0-30	\$15.00
C431	13555	0-300	\$15.00
C451	227141	0-45	\$15.00
C459	84639	0-500	\$15.00
C465	13561	0-60	\$15.00
C477	105927	40-110	\$15.00
C405	227142	-10-10	\$15.00
C452	227143	-150-250	\$15.00
C473	216673	-20-50	\$15.00
C417	13576	-20-120	\$15.00
C487	227144	-30-50	\$15.00
C414	226953	-50-50	\$15.00
31-DAY CHART			
C409	13543	0-100	\$15.00
C407	227018	0-250	\$15.00
C408	227020	0-500	\$15.00
C481	226977	40-110	\$15.00
C482	226978	-20-50	\$15.00
C480	226976	-20-120	\$15.00
C406	227017	-50-50	\$15.00

1. Sixty (60) per box. Order charts for your specific range.

6



EV4

DICKSON EV4 ON-OFF EVENT RECORDERS

Features include: 5' cord with alligator clips; monitors on/off events from 120V to 240 Vac; parallel (voltage triggered operation); portable and wall mountable; compact; simple; efficient; and chart size is 4" diameter.

Order No.	Stock No.	Power Source	Recording Time	Price
EV4-P-B-24	227063	Battery	24-hour	\$371.00
EV4-P-B-7	227065	Battery	7-day	\$371.00

Include: One "AA" battery, pen, and a box of 4" charts.

ACCESSORIES

Order No.	Stock No.	Description	Price
P222	13580	Replacement Pens (6 red)	\$29.00

CHARTS¹

Order No.	Stock No.	Power Source	Price
24-HOUR CHART			
C009	13604	Battery 120V @ 60 Hz	\$12.00
7-DAY			
C007	227061	Battery 120V @ 60 Hz	\$12.00

1. Sixty (60) per box. Order charts for your specific range.

RECORDERS



DICKSON CARBON DIOXIDE INDOOR AIR QUALITY RECORDERS

SPECIFICATIONS

Accuracy: $\pm 5\%$ of full scale (0-2200)

Ambient oper. temp.: +50 to 90°F

Chart size: 8" dia.

Order No.	Stock No.	Description	Price
C02X	200097	Recorder with pen, a box of 8" charts (7-day/0-2200 ppm) and 120 Vac adapter.	\$975.00
C02XA	227050	Recorder with pen, a box of 8" charts (7-day/0-2200 ppm), 120 Vac adapter, and a 10' probe cord for remote sensing.	\$996.00

ACCESSORIES

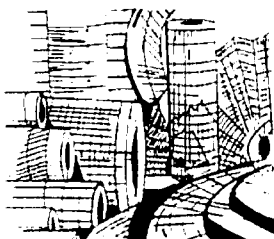
Order No.	Stock No.	Description	Price
P222	13580	Replacement Pens (6 red)	\$29.00
A707	227058	Calibration Kit (includes 1 cylinder)	\$299.00
A706	227060	Replacement Gas (1 cylinder)	\$73.00

CHARTS¹

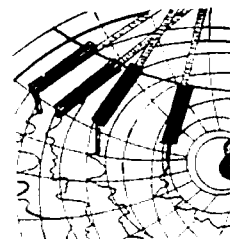
Order No.	Stock No.	Ranges	Price
24-HOUR CHART			
C404	227052	0-2200 ppm	\$15.00
C402	227055	0-1100 ppm	\$15.00
7-DAY CHART			
C419	227053	0-2200 ppm	\$15.00
C418	227057	0-1100 ppm	\$15.00

1. Sixty (60) per box. Order charts for your specific range.

6



MANUFACTURERS COMPLETE CHART PAPER SELECTION



CAPP/USA STOCKS A COMPLETE LINE OF BOTH CIRCULAR CHARTS, STRIP CHARTS, FAN-FOLD CHARTS, LABORATORY CHARTS, AND THERMAL CHARTS, TO FIT YOUR NEEDS.

HOW TO USE THIS SECTION:

1. FIND THE NAME OF THE MFGR. YOU ARE LOOKING FOR BELOW.
2. SIMPLY FAX CAPP/USA AT (800) 356-3262 WITH THE MFGR'S. CHART-PART NO.
3. SIMPLY CALL CAPP/USA AT (800) 356-8000 WITH THE MFGR'S. CHART-PART NO.

~ ABB/KENT
~ ABB/TAYLOR
~ AMERICAN METER
~ AMETEK
~ AMPROBE
~ ANDERSON
~ BADGER-METER
~ BAILEY
~ BARBER-COLMAN
~ BARTON (ITT)
~ BECKMAN
~ BIF
~ BRISTOL
~ BROWN INSTRUMENT
~ BRUSH-GOULD
~ BUILDERS IRON FOUNDRY
~ CHESSELL
~ CHINO
~ CLEVELAND CONTROLS
~ CONSOLIDATED
~ ESTERLINE-ANGUS
~ FISCHER & PORTER
~ FISHER CONTROLS
~ FOXBORO
~ GENERAL ELECTRIC
~ GOULD
~ GRAPHIC CONTROLS
~ HAGAN
~ HAYS REPUBLIC

~ HONEYWELL
~ KAYE
~ LEEDS & NORTHRUP
~ MASONEILAN
~ MOLYTEK
~ MOORE
~ PARTLOW
~ PERKIN-ELMER
~ RUSTRAK
~ TAYLOR INSTRUMENT
~ TRACOR-WESTRONICS
~ UNITED CONTROLS
~ UNIVERSAL INST.
~ WEKSLER
~ WESTRONICS
~ YEW
~ YOKOGAWA

"ALL THE CHARTS THAT ARE FIT TO
PRINT"

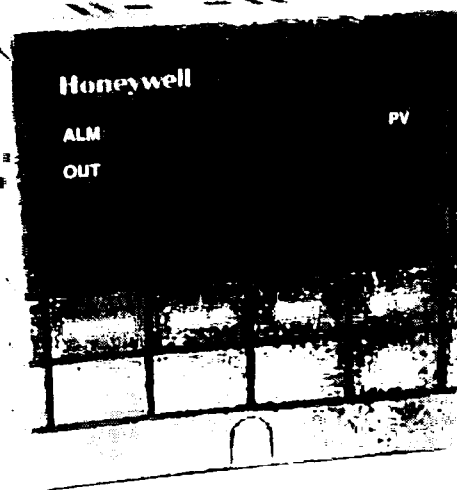
LOOKING FOR AN ODD-BALL CHART
THAT'S NOT ON OUR LIST?.....SEND IT
TO US AND WE'LL PLATE IT & PRINT IT
FOR YOU!

7

TEMPERATURE CONTROLLERS

DIGITAL PROCESS CONTROLLERS - 1/4 DIN

HONEYWELL® UDC-2000 DIGITAL CONTROLLER THE MINI-PRO® SERIES:



UDC-2000

UDC-2000 FEATURES:

THE UDC-2000 SERIES CONTROLLER IS MICROPROCESSOR-BASED AND IS VERY VERSATILE AS IT CAN CONTROL AND MONITOR MANY VARIABLES AND TEMPERATURES.

THIS CONTROLLER ACCEPTS UP TO 10 DIFFERENT INPUTS; HAS THERMOCOUPLE FAILSAFE FEATURE; IS EASILY CONFIGURED BY THE USER; HAS DUAL SETPOINTS; AND COMES COMPLETE WITH A MOISTURE-RESISTANT FRONT-PANEL.

OPTIONAL FEATURES AVAILABLE:

- AUTO TUNE
- RAMP AND SOAK PROGRAMMING
- ALARMS
- ADDITIONAL SECOND INPUT
- AUXILIARY OUTPUT
- EXTERNAL CONTROL RELAY

COMMON APPLICATIONS/USES:

- FURNACE CONTROL
- OVEN CONTROL
- O.E.M. MACHINERY SUCH AS EXTRUDERS; MOLDERS; PACKAGERS, BOILERS, ETC.

CAPP-FACT: CAPP/USA IS THE ONLY COMPANY THAT REPAIRS HONEYWELL DIALATROLS & DIALAPAKS WITH MORE THAN 1,100 REPAIRS EACH YEAR! SO DON'T THROW 'EM AWAY, HAVE CAPP REPAIR 'EM TODAY

TEMPERATURE CONTROLLERS

ORDERING INFORMATION – UDC-2000

ORDERING IS **EASY**- JUST SELECT AN OPTION
FROM THE 6 TABLES BELOW:

OPTION TABLES

BASE/SERIES NO. DC200 -

OUTPUT #1:		
1:	C: CURRENT / 4-20mA	\$340.00
	E: ELECTROMECHANICAL RELAY / 5AMP.	\$345.00
	A: SOLID STATE RELAY	
	AC / 1AMP.	\$345.00
	T: OPEN COLLECTOR	
	OUTPUT / 20mA	\$345.00
	*L: LOW LIMIT	\$350.00
	*H: HIGH LIMIT	\$350.00
	I: DIGITAL INDICATOR ONLY	\$310.00

* (FOR T/C & RTD INPUTS ONLY)

ADDITIONAL RELAYS:		
2:	0: NO ADDL. RELAYS	\$0.00
	*1: SECOND RELAY	\$78.00
	2: TWO ALARM RELAYS	

* (USED FOR 3-POSITION STEP
PLUS 1 ALARM RELAY, OR
DUPLEX OUTPUT.)

INTERFACE (EXTERNAL):		
3:	0: NO EXTERNAL INTERFACE	\$0.00
	2: DIGITAL INPUT OR AUX. OUTPUT	\$59.00

OPTIONAL INPUT:		
4:	0: NO OPTIONAL INPUT	\$0.00
	1: 4-20MA OR 1-5V	\$83.00

OPTIONAL SOFTWARE:		
5:	0: NO OPTIONAL SOFTWARE	\$0.00
	A: AUTOTUNE	\$0.00
	B: AUTOTUNE & SETPOINT	
	PROGRAMMING.	\$167.00

ORDERING INFORMATION CONTINUED ON THE NEXT PAGE

7

cont.



TEMPERATURE CONTROLLERS_____

ORDERING INFORMATION — UDC-2000 (continued)

OPTION TABLES

BASE/SERIES NO. DC200 -

<u>POWER</u>		
□	1: 120 VAC / 50-60HZ.	\$0.00
	2: 240 VAC / 50-60HZ.	\$0.00

EXAMPLE STOCK NO.:
DC200C000A1

EXAMPLE PRICE:
\$340.00

NOTE: (IF ANY):
PLEASE SPECIFY ANY
ORDERING TAGS; CUSTOM
CONFIGURATIONS; OR
APPROVALS SUCH AS U.L.
F.M., ETC.; WHEN ORDERING.

ADDITIONAL SPECIFICATIONS:

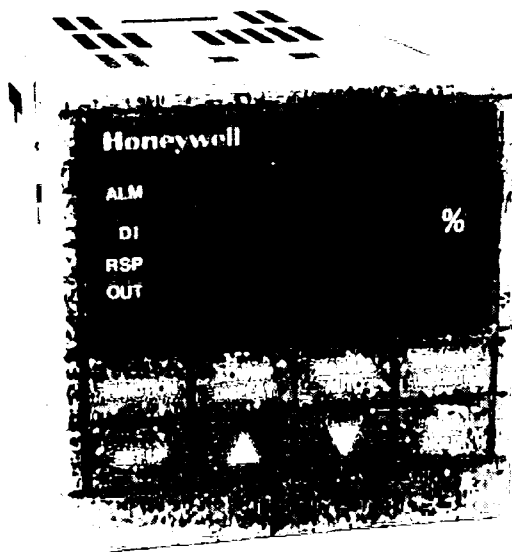
- MOUNTING: PANEL MTD., 4.2" DEPTH.
- ACCURACY: $\pm 0.50\%$ OF % OF SPAN.
- WEIGHT: 2.3 LBS.
- WIRING: CONNECTIONS ARE SCREW-TERMINALS
- AMBIENT
TEMP. RATING: 40°F - 135°F
- DIMENSIONS: FACE: 96mm WIDE; 96mm HIGH.
UNIT: 105.4mm LONG; 90.7mm HIGH.
PANEL CUTOUT: 92mm WIDE; 92mm HIGH

7

TEMPERATURE CONTROLLERS

DIGITAL PROCESS CONTROLLERS - 1/4 DIN

HONEYWELL® UDC-3000 DIGITAL CONTROLLER THE VERSA-PRO® SERIES:



UDC-3000

UDC-3000 FEATURES:

THE UDC-3000 SERIES CONTROLLER IS A MICROPROCESSOR-BASED CONTROLLER.

BENEFICIAL FEATURES TO THE END USER CONSIST OF:

- 2 SETS OF TUNING CONSTANTS
- THERMOCOUPLE FAILSAFE
- 2 LOCAL SETPOINTS
- 2 DUAL DISPLAYS
- MANUAL & AUTOMATIC MODES
- SETPOINT RAMP
- DEVIATION BARGRAPH DISPLAY

OPTIONAL FEATURES AVAILABLE:

- ACCUTUNE™ ADAPTIVE TUNING
- FULL COMMUNICATIONS
- TRANSMITTER POWER
- ALARMS
- 2 DIGITAL INPUTS
- AUXILIARY OUTPUT
- RAMP & SOAK PROGRAMMING
- ADDITIONAL SECOND INPUT

COMMON APPLICATIONS / USES:

- | | |
|----------------------------|---------------------------|
| — FURNACE CONTROL | — BOILER & BURNER CONTROL |
| — OVEN CONTROL | — ENVIRONMENTAL CHAMBERS |
| — O.E.M. MACHINERY SUCH AS | — ALL PANEL APPLICATIONS |
| EXTRUDERS, LEHRS, MOLDERS | — ELECTROPLATING |
| — KILN CONTROL | — INCINERATION |

**OUR AIM IS "TRU" WITH A FULL SELECTION OF
HONEYWELL TRULINE RECORDERS TO CHOOSE FROM
STARTING ON PAGE 144**

TEMPERATURE CONTROLLERS

ORDERING INFORMATION — UDC-3000

ORDERING IS EASY- JUST SELECT AN OPTION
FROM THE 7 TABLES BELOW:

OPTION TABLES

BASE/SERIES NO. DC300-

OUTPUT #1:

1:	L: LIMIT CTRL. OUTPUT / 5 AMP WITH 1 ALARM	\$524.00
	E: ELECTROMECHANICAL RELAY / 5 AMP W/ALARM #1	\$524.00
	A: SOLID STATE RELAY / AC 1 AMP W/ALARM #1	\$524.00
	C: CURRENT / 4-20mA - NO ALARMS.	\$510.00
	K: CURRENT / 4-20mA - WITH ALARM #1.	\$545.00
	T: OPEN COLLECTOR OUTPUT / 20mA W/1 ALARM.	\$533.00

OUTPUT #2:

2:	0: NO ADDL. OUTPUT.	\$0.00
	A: SOLID STATE RELAY / AC-1 AMP.	\$29.00
	E: ELECTROMECHANICAL RELAY / 5 AMP.	\$29.00
	L: LIMIT CTRL. / ALARM #2 RELAY - 5 AMP.	\$29.00
	T: OPEN COLLECTOR OUTPUT / 20mA.	\$29.00

INTERFACE: (EXTERNAL)

3:	0: NO EXTERNAL INTERFACE.	\$0.00
	1: RS422/485.	\$250.00
	2: AUXILIARY OUTPUT.	\$108.00
	4: DMCS.	\$250.00

OPTIONAL SOFTWARE:

4:	0: NO SOFTWARE.	\$0.00
	A: ADAPTIVE TUNING.	\$29.00
	B: ADAPTIVE TUNING & SETPOINT PROGRAMMING.	\$167.00

ORDERING INFORMATION CONTINUED ON THE NEXT PAGE

7

TEMPERATURE CONTROLLERS

ORDERING INFORMATION—UDC-3000 (continued)

OPTION TABLES

BASE/SERIES NO. DC300 -

NO. OF DIGITAL INPUTS:			
5:	0:	NO DIGITAL INPUTS	\$0.00
	3:	2-DIGITAL INPUTS	\$98.00

PV INPUTS:			
6:	1:	THERMOCOUPLE, RTD,	
		mV, 1-5V	\$0.00
	2:	THERMOCOUPLE, RTD,	
		mV, 1-5V, 4-20mA	\$0.00
	3:	THERMOCOUPLE, RTD,	
		mV, 1-5V, 4-20mA,	
		0-10V	\$29.00

OPTIONAL INPUTS:			
7:	0	NO OPTIONAL INPUTS	\$0.00
	1	1-5V OR 4-20mA	\$108.00
	2	SLIDEWIRE INPUT	\$108.00

EXAMPLE STOCK NO.:
DC300C000010

EXAMPLE PRICE:
\$510.00

NOTE: (IF ANY):
PLEASE SPECIFY ANY
ORDERING TAGS; CUSTOM
CONFIGURATIONS; OR
APPROVALS SUCH AS U.L.,
F.M., ETC.; WHEN ORDERING.

ADDITIONAL SPECIFICATIONS:

- MOUNTING: PANEL MTD, 5.82" DEPTH.
- ACCURACY: $\pm 0.20\%$ OF % OF SPAN.
- WEIGHT: 3 LBS.
- WIRING: CONNECTIONS ARE SCREW-TERMINALS
- AMBIENT
TEMP. RATING: 30°F - 135°F
- DIMENSIONS: FACE: 96mm WIDE; 96mm HIGH.
UNIT: 147.3mm LONG; 90.7mm HIGH.
PANEL CUTOUT: 92mm WIDE; 92mm HIGH

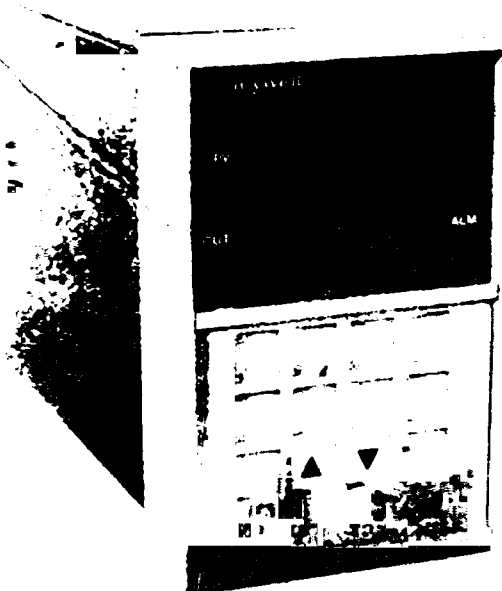
Did you know... That CAPP/USA repairs all
Honeywell UDC controllers and then back's
them up with a two (2) year warranty?

7

TEMPERATURE CONTROLLERS

DIGITAL PROCESS CONTROLLERS

HONEYWELL® UDC-5000 DIGITAL CONTROLLER THE ULTRA-PRO® SERIES:



UDC-5000

UDC-5000 FEATURES:

THIS CONTROLLER COMBINES ACCURACY, PERFORMANCE, AND VERSATILITY INTO ONE MICRO-PROCESSOR BASED UNIT AND IS PRIMARILY USED IN CRITICAL PROCESSES WHERE QUALITY OF PRODUCT(S) CANNOT BE COMPROMISED.

- 3 LOCAL SETPOINTS.
- THERMOCOUPLE FAILSAFE
- DUAL, BRIGHT DISPLAYS.
- VERY HIGH ACCURACY.
- HIGH NOISE & VIBRATION IMMUNITY.
- 2 SETS OF TUNING CONSTANTS.
- CONTINUOUS DIAGNOSTICS.

OPTIONAL FEATURES AVAILABLE:

- 2 INDEPENDENT CONTROL LOOPS
- INTERNAL CASCADING ALGORITHM AND SEVERAL MATH OPTIONS
- TRANSMITTER POWER.
- SETPOINT RAMP & SOAK PROGRAMMING.
- AUXILIARY OUTPUTS & DIGITAL INPUTS.
- COMMUNICATIONS.

7

COMMON APPLICATIONS / USES:

- | | |
|---------------------------------|---------------------------|
| — FURNACE CONTROL | — BOILER & BURNER CONTROL |
| — OVEN CONTROL | — ENVIRONMENTAL CHAMBERS |
| — O.E.M. MACHINERY SUCH AS | — ALL PANEL APPLICATIONS |
| EXTRUDERS, LEHRS, MOLDERS, etc. | — ELECTROPLATING |
| — KILN CONTROL | — INCINERATION |

GET 'EM FAST, GET 'EM NOW...CAPP'S LINE OF CAPPOPAK
THERMOCOUPLES ARE MADE TO DIRECTLY REPLACE
ALL HONEYWELL MEGOPAK STYLES IN FORM, FIT, & FUNCTION

TEMPERATURE CONTROLLERS

ORDERING INFORMATION — UDC-5000

ORDERING IS EASY- JUST SELECT AN OPTION
FROM THE 9 TABLES BELOW:

OPTION TABLES

OUTPUTS:		
1:	DC5067:	UNIVERSAL OUTPUTS / 2 ALARMS \$1,215.00
	DC5061:	CURRENT PROPORTIONAL / NO ALARMS \$1,085.00
	DC5062:	CURRENT PROPORTIONAL / 2 ALARMS \$1,142.00
	DC5066:	POSITION PROPORTIONAL OR
		3-POSITION STEP WITH THE MOTOR
		POSITION INDICATED / 2 ALARMS \$1,215.00
	DC5063:	CURRENT / TIME DUPLEX / 2 ALARMS \$1,196.00
	DC5064:	TIME PROPORTIONAL / 2 ALARMS \$1,127.00
2:	DC5065:	TIME PROPORTIONAL DUPLEX WITH
		3 POSITION STEP / 2 ALARMS \$1,215.00
COMMUNICATIONS:		
2:	0:	NO COMMUNICATIONS \$0.00
	1:	DMCS \$250.00
	2:	RS422/485 \$250.00
OPTIONAL SOFTWARE:		
3:	0:	NO SOFTWARE \$0.00
	A:	AUTOTUNE & ADAPTIVE TUNE \$83.00
	B:	SETPOINT PROGRAMMING & MATH \$220.00
	C:	SETPOINT PROGRAMMING & MATH
		& ADAPTIVE TUNE \$304.00
	D:	2-LOOPS OF CONTROL / CASCADE \$274.00
	E:	2-LOOPS / CASCADE & AUTOTUNE \$358.00
4:	F:	2-LOOPS / CASCADE, AUTOTUNE
		SETPOINT PROGRAMMING, & MATH OPTIONS \$583.00
TRANSMITTER POWER:		
4:	0:	NO TRANS. MTR. POWER \$0.00
	1:	PROCESS VARIABLE / INPUT NO. 1 \$64.00
	2:	INPUT NO. 2 \$64.00
	3:	PROCESS VARIABLES / INPUT NO. 1 & 2 \$64.00

ORDERING INFORMATION CONTINUED ON THE NEXT PAGE

7

cont.

TEMPERATURE CONTROLLERS

ORDERING INFORMATION — UDC-5000 (cont.)

OPTION TABLES

INTERFACE: (EXTERNAL)

5:	0:	NO EXTERNAL INTERFACE.	\$0.00	—
	1:	AUXILIARY OUTPUT.	\$142.00	
	2:	REMOTE-MODE SWITCHING; (DIGITAL INPUTS)	\$103.00	
	3:	DIGITAL INPUT AND AUXILIARY OUTPUT.	\$245.00	

PROCESS VARIABLES: (INPUT1)

6:	1:	THERMOCOUPLE.	\$0.00	—
	2:	R.T.D.	\$0.00	
	3:	4 TO 20mA dc.	\$0.00	
	4:	0 TO 10 VOLTS dc.	\$34.00	
	5:	MILLIVOLT: 1 TO 5 Vdc.	\$0.00	
	*22:	RELATIVE HUMIDITY	\$157.00	

* THIS OPTION REQUIRES INPUT 2.

INPUT #2:

7:	0:	NO SECOND INPUT.	\$0.00	—
	1:	THERMOCOUPLE.	\$157.00	
	2:	R.T.D.	\$157.00	
	3:	4 TO 20 mA dc.	\$157.00	
	4:	0 TO 10 VOLTS dc.	\$186.00	
	5:	MILLIVOLT: 1 TO 5 Vdc.	\$157.00	

INPUT #3:

8:	0:	NO THIRD INPUT.	\$0.00	—
	1:	4 TO 20 mA dc.	\$64.00	
	2:	1 TO 5 VOLTS dc.	\$64.00	

ADDITIONAL OPTIONS:

9:	00:	NO ADDL. OPTIONS.	\$0.00	—
	S1:	2 AMP SOLID STATE RELAY.	\$69.00	
	S2:	2 AMP DUAL SOLID STATE RELAY.	\$113.00	
	S3:	10 AMP SOLID STATE RELAY.	\$113.00	
	C1:	OPEN-COLLECTOR OUTPUT.	\$34.00	

ORDERING INFORMATION CONTINUED ON THE NEXT PAGE

TEMPERATURE CONTROLLERS

ORDERING INFORMATION — UDC-5000 (continued)

OPTION TABLES

EXAMPLE STOCK NO.:
DC5061-0-0-0-2-0-0-00.

EXAMPLE PRICE:
\$1,085.00

NOTE: (IF ANY).
PLEASE SPECIFY ANY
ORDERING TAGS; CUSTOM
CONFIGURATIONS; OR
APPROVALS SUCH AS F.M.
OR C.S.A.; WHEN ORDERING.

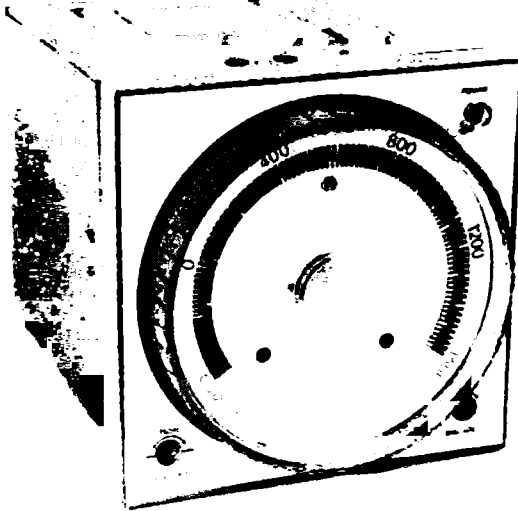
ADDITIONAL SPECIFICATIONS:

- MOUNTING: PANEL MTD., 7.8" DEPTH.
- ACCURACY: $\pm 0.05\%$ OF SPAN.
- WEIGHT: 4.9 LBS.
- WIRING: CONNECTIONS ARE SCREW-TERMINALS
- AMBIENT
TEMP. RATING: 30°F - 145°F
- DIMENSIONS: FACE: 100mm WIDE; 150mm HIGH
UNIT: 198mm LONG
PANEL CUTOUT: 92mm WIDE; 138mm HIGH

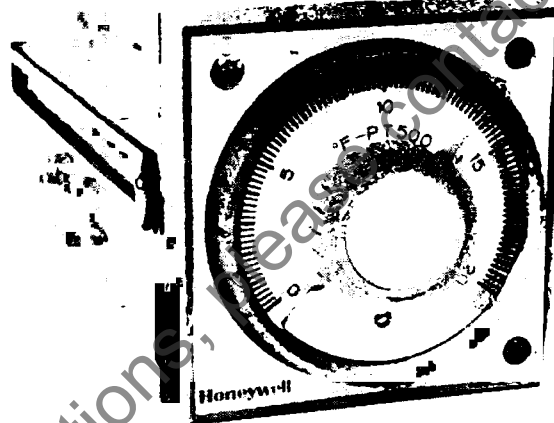
TEMPERATURE CONTROLLERS_____

ELECTRONIC TEMPERATURE CONTROLLERS

HONEYWELL® DIALATROL'S & DIALAPAK'S
REPAIRED & REBUILT BY CAPP/USA:



DIALATROL CONTROLLER



DIALAPAK CONTROLLER

TAKE A WALK DOWN MEMORY LANE AND THINK BACK TO THE DAYS OF THESE DIALATROLS & DIALAPAKS. YES, THEY ARE OLDIES BUT GOODIES!

AMERICAS PLANT ENGINEERS & MAINTENANCE PEOPLE WERE BORN AND BRED ON THE DIALATROL & DIALAPAK AS THEIR MAIN SOURCE OF CONTROLLING THE PLANTS' PROCESSES.

AND EVEN THOUGH THESE OLDIES HAVE BEEN REPLACED BY THE MICROPROCESSOR-BASED PID CONTROLLERS, THERE ARE STILL OVER 1/2 A MILLION OF THESE UNITS STILL ACTIVELY OPERATING IN AMERICA'S PLANTS AND CAPP IS THE ONLY COMPANY WHO REPAIRS & REBUILDS.

SEND US YOUR DIALATROL OR DIALAPAK TODAY AND WE'LL REPAIR IT IN TIP-TOP CONDITION FOR YOU.

TEMPERATURE CONTROLLERS

- WE'LL ALSO SEND WITH YOUR DIALATROL / DIALAPAK A NEW THERMOCOUPLE AT HALF PRICE!
- OR, WE'LL REPLACE YOUR OLD DIALATROL / DIALAPAK WITH A NEW MICROPROCESSOR-BASED DIGITAL CONTROLLER OF YOUR CHOICE.

ORDER TODAY! ONE CALL DOES IT ALL
FOR ALL OF YOUR INSTRUMENTATION
1-800-356-8000

For current pricing and specifications, please contact us.

7

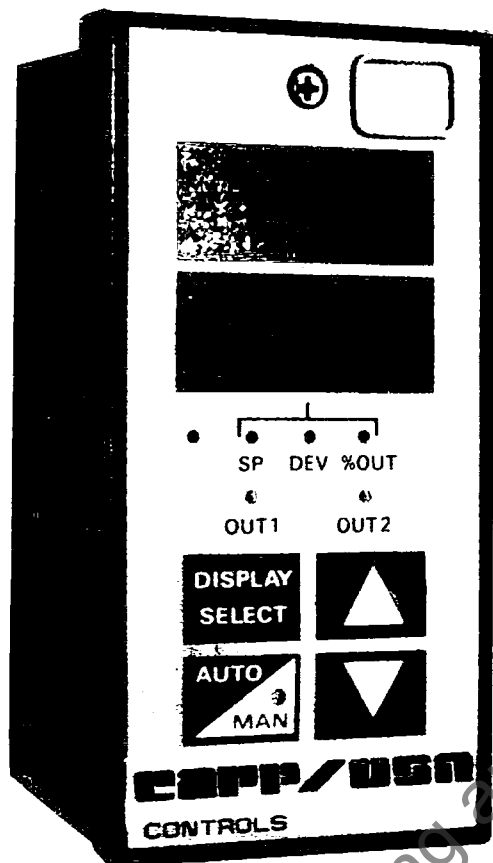
TEMPERATURE CONTROLLERS

CAPP/USA DIGITAL PROCESS CONTROLLERS (1/8 DIN)



CAPP SERIES CTC-338820 PROCESS CONTROLLER

CTC-338820 FEATURES :



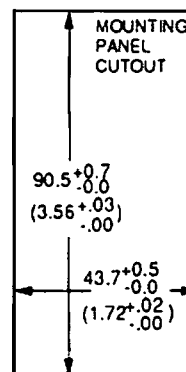
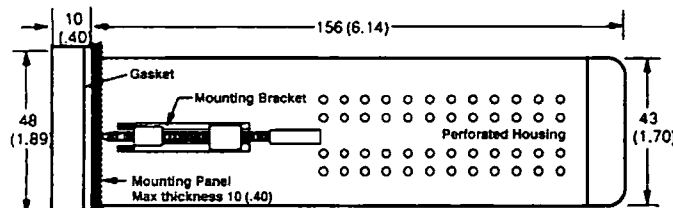
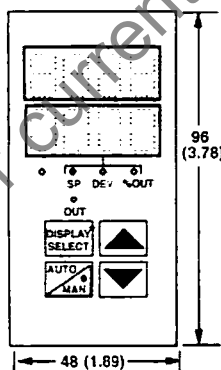
- Sealed Membrane Keys create a durable responsive front panel.
- Dual Displays - Dedicated PV upper display and selectable lower display (set point, deviation, % output or parameters) allow operator to view process in most appropriate manner.
- Mnemonic-prompted Set Up simplifies configuration procedure.
- User Scaleable Process Variable simplifies ordering, set up and stocking requirements.
- Control Algorithms - P, PID or On-Off control allow user to select best algorithm for specific process.
- Non-volatile Memory - EEPROM backup in event of power loss.
- Communications Link - optional RS 485 interface allows supervision and data acquisition by higher level devices.
- Ramp to Set Point function helps eliminate overshooting set point on start up.
- Three Outputs can be configured as control, alarm or retransmission.

30 model only

• 1/8 DIN

Process Controller & Cutout Dimensions

mm (inches)
(CTC-338820)



TEMPERATURE CONTROLLERS

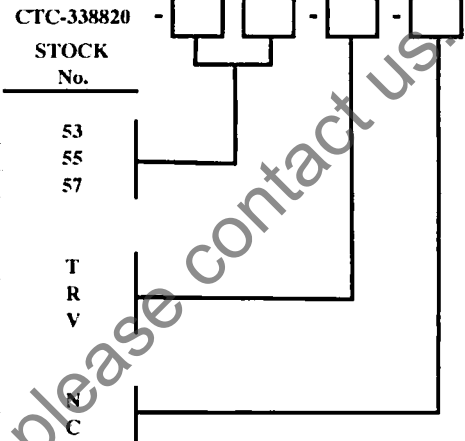
CAPP SERIES CTC-338820 PROCESS CONTROLLERS

COMPLETE ORDERING INFORMATION

ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 3 TABLES BELOW:

OPTION TABLES

	Description		
1:	Limit Controller, One 4A Relay Output	\$309.00	53
	Controller, One 4A Relay (or SSR Drive) Output	\$309.00	55
	Controller, Two 4A Relays, mA Output	\$358.00	57
2:	Input		
	Thermocouple (All Types)	\$0.00	T
	RTD (100 WPT) (not available with 610 Model)	\$0.00	R
3:	Voltage/current (not available with 610 Model)	\$0.00	V
	Communications		
	No communications	\$0.00	N
	RS-485 (not available with 610 Model)	\$73.00	C



CTC-338820 Process Controllers

All CTC-338820 Process Controllers are 1/8 DIN micro-based instruments

• EXAMPLE PART NO. : CTC-338820-57-T-N

• EXAMPLE PRICE. : \$358.00.

TEMPERATURE CONTROLLERS

CAPP/USA MODEL SPM18 SMART PROCESS MONITOR

Volts, Current, Thermocouple, or RTD Process Measurements with Intelligent Features

- Universal input capability: DC Process Volts, Current, and Temperature
- Quick and easy front panel input scaling
- Field interchangeable outputs provide flexibility and minimize downtime
- Up to three alarms fully configurable for High or Low operation
- 4-20 mA output can be used to retransmit the process value to a strip chart recorder or PLC
- Max and Min value capture provides valuable process information
- Serial communications for interface to a host device
- NEMA 4/IP65 rated front panel for use in washdown environments
- Transmitter power supply simplifies wiring
- Universal AC power supply

The CAPP/USA SPM18 Process Meter can display a wide variety of process input signals while providing a host of intelligent features.

Housed in an industry standard 1/8 DIN case, the instrument is field configurable to accept standard DC current or voltage process signals as well as most thermocouple and RTDs.

Its 0.56" high LED display, available in red or green, is easily scaled through the front panel to display in engineering units. Standard with a relay alarm output, other functions can be installed at CAPP/USA or later in the field. Choose from additional alarm relays, an auxiliary power supply for use with the input transmitter/sensor, a remote

alarm reset, a DC output for retransmission to a strip chart recorder or PLC. An optional RS-485 serial communication board supports Modbus or open ASCII protocol.

Alarm outputs can be field configured for high or low operation and combinational logic. Its unique accumulated alarm time function tells how long the alarm condition has been present.

Other key process monitoring features include max and min value capture, process value offset, and programmable input filtering. A universal AC power supply meets global requirements, and an EEPROM retains all data when power is not present.



**COMPLETE
SPECIFICATIONS &
ORDERING INFORMATION
ON NEXT PAGE.**

7

TEMPERATURE CONTROLLERS

CAPP/USA MODEL SPM18 - CONTINUED BUILD-YOUR-OWN CONTROLLER:

ORDERING INFORMATION:

SPM18 - ☐ ☐ ☐ ☐ ☐ ☐ BASE PRICE: \$187.00

Input Type
1 RTD or DC (mV) N/C
2 Thermocouple N/C
3 DC (mA) N/C
4 DC (V) N/C

LED Color
1 Red N/C
2 Green N/C

***Options**
0 None N/C
5 RS-485 \$64.00
6 Remote Reset \$29.00

Output 1
1 Relay N/C

***Output 2**
0 None N/C
1 Relay \$24.00
3 4-20 mA \$49.00

***Output 3**
0 None N/C
1 Relay \$24.00
8 Trans PWS \$49.00

* Option module may be purchased for field upgrade

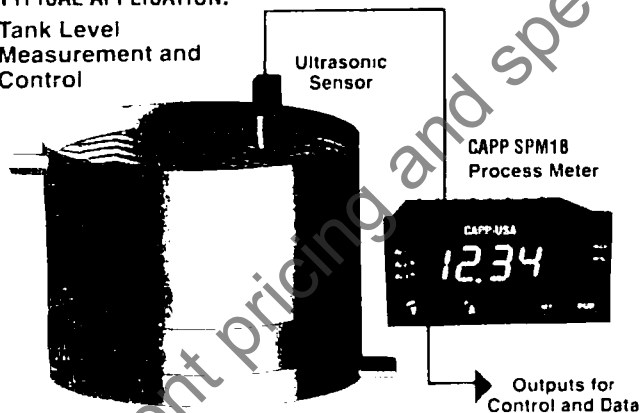
SAMPLE STOCK NO.: SPM18-1-1-0-0-0-1

SAMPLE PRICE: \$187.00

The SPM18 is the perfect solution for a host of process applications. Highly versatile, the same instrument can be used for temperature, pressure, level, displacement, and many other tasks.

TYPICAL APPLICATION:

Tank Level
Measurement and
Control



SPM18 SPECIFICATIONS:

Inputs:

Sample Rate: 250 ms

Resolution: 14 bits approximately

Thermocouple:

Types: R, S, J, K, L, T, B and N; Accuracy: $\pm 0.25\%$ of Full Scale ± 1 LSD

RTD and DC mV:

Type: Three-wire Pt100; Accuracy: $\pm 0.25\%$ of Full Scale ± 1 LSD; Sensor Current: 150 μ A

DC mA and DC V:

Types: 0-20 mA, 4-20 mA, 0-5V, 1-5V, 0-10V, 2-10V; Scale Range Max: -1999 to 9999; Scale Range Min: -1999 to 9999; Accuracy: $\pm 0.05\%$ of Full Scale ± 1 LSD

Outputs:

Relay: SPDT (Form C); 2A resistive at 120/240 VAC

DC: 0-20 mA, 4-20 mA, 0-10V and 0-5V;

Resolution: Eight bits in 250 ms, 10 bits in 1 second typical; Update Rate: 250 ms

Transmitter Power: 20-28 VDC, 24 VDC nominal

General:

Power Supply: 90-264 VAC, 50/60 Hz; 4 Watts

Display: Red or Green 7 segment LED; 4 digits, 0.56" high; 6 LED annunciators

Dimensions: 48mm x 96mm, 110mm deep

Mounting: Panel mount (mounting bracket supplied) 45mm x 92mm cutout

Terminals: Screw Type - combination head

Weight: 16.1 Oz. (480 grams)

Environmental:

Operating Temperature: 0° to 55° Celsius, 32° to 131° Fahrenheit

Storage Temperature: -20° to 80° Celsius, -4° to 176° Fahrenheit

Relative Humidity: 20% to 95% non-condensing

Front Panel Rating: NEMA 4/IEC IP66

7

TEMPERATURE CONTROLLERS

CAPP/USA 1/16 DIN TEMPERATURE CONTROLLER

Ultimate Simplicity Combined with Solid Performance in a 1/16 DIN Package

- Full PID controller with simple operator interface
- Unique autotune procedure provides tight control and eliminates the need for any operator involvement
- Large LED display indicates temperature while annunciator light confirms control accuracy
- Field configurable to accept most popular thermocouples and RTDs
- Choose Relay or SSR driver for primary control output
- Available with or without alarm relay
- Universal AC power supply satisfies global requirements
- NEMA 4-IP65 rated front panel for use in washdown environments
- UL recognized, CE compliant

**COMPLETE
SPECIFICATIONS &
ORDERING INFORMATION
ON NEXT PAGE.**

Are you looking for a solid performing PID controller that won't confuse your operators with a host of features you don't use? Then the CAPP/USA brand is just what you need.

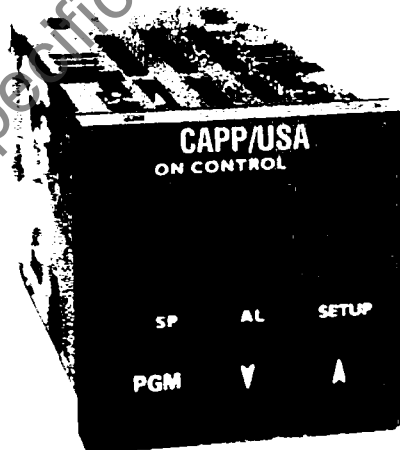
Designed for maximum simplicity, all programming is done using 3 front panel keys. Configuration is as simple as selecting an input type, and control action. The only on line values that need to be entered are the setpoint, cycle time, offset value, and if installed, the alarm value.

During operation, the temperature value is displayed on a large (0.56") LED display, while annunciator lights indicate control accuracy and alarm status.

The setpoint is accessed by a single key press, then altered via the up down arrow keys. A lockout feature can be activated to prevent the setpoint from being changed.

But don't be misled by the unit's simplicity - This is a powerful PID controller. Its unique autotune function works during start-up, eliminating any need for operator involvement. This gets rid of the control fluctuations which are induced by most standard autotunes.

A universal AC power supply (94-264 VAC) meets global power requirements, while its NEMA 4-IP65 rated front panel provides reliable operation in harsh environments.



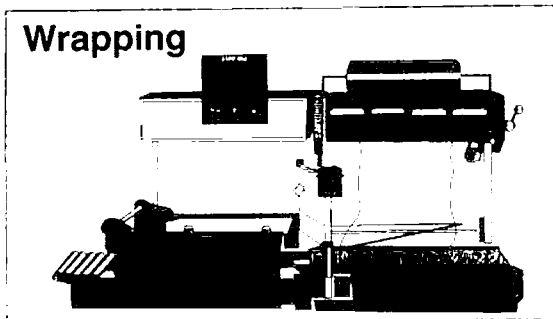
TEMPERATURE CONTROLLERS

CAPP/USA 1/16 DIN TEMP. CONTROLLER - CONTINUED

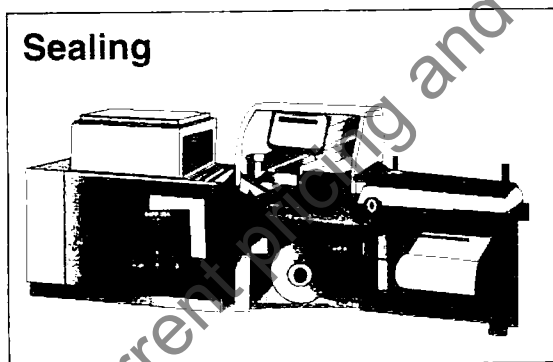
ORDERING INFORMATION:

DESCRIPTION	STOCK NO.	EACH
Relay Output, No Alarm	319522	\$164.05
SSR Driver Output, No Alarm	319532	\$164.05
Relay Output, Alarm	319541	\$178.50
SSR Driver Output, Alarm	319544	\$178.50

Wrapping



Sealing



SPECIFICATIONS:

Inputs:

Thermocouple: Types J, L, K, N, T²

RTD: Three-wire PT100, DIN 43760

Sample Rate: 250 ms

Outputs:

Relay: SPDT rated at 2 amps resistive at 120/240 VAC

SSR Driver: 10 VDC nominal into 500 minimum

Control:

Mode: PID with Autotune, On/Off

Control Action: Selectable for Reverse (heating) or Direct (cooling)

Cycle Time: 0.5 secs. to 512 secs. in binary steps

Offset: \pm selected input range

Alarm (opt.): Field selectable for Process, Deviation or band alarm, and Reverse or Direct acting

Physical:

Dimensions: 48mm x 48mm, 110 mm deep

Mounting: Panel mount (mounting bracket supplied). 45mm x 45mm cutout

Terminals: Screw Type - combination head

Display: Single line, 3 digit, 7 segment LED display with annunciator for control accuracy

General:

Supply Voltage: 90 - 264 VAC 50/60 Hz

Front Panel Rating: NEMA 4/IP65

Operating Temperature: 0°C to 55°C

Common Mode Rejection: 120 db at 50/60 Hz

Series Mode Rejection: > 500% of span 50/60 Hz

Approvals: UL, CE

TEMPERATURE CONTROLLERS

CAPP/USA MODEL 116TPC TEMPERATURE & PROCESS CONTROLLER

1/16 DIN Controller with Adaptive Tuning Provides Optimum Performance Even Under Changing Process Conditions

- Pre-Tune & Adaptive Tune Algorithms combine to optimize PID constants and provide tight control
 - Universal Inputs for use in a wide variety of process applications
 - Field Interchangeable Outputs provide flexibility and reduce downtime
 - NEMA 4/IP65 Rated Front Panel for use in washdown environments
 - RS-485 Communication allows interfacing to a PLC or other host
 - Loop-Break Alarm provides early detection of control element failure
 - Ramp to SP feature for applications that require precise control on start-up
 - 250 ms Sample Rate allows control of fast reacting processes
 - Multi-Level Security prevents unauthorized parameter changes
 - All Programming done through the front panel for quick setup
- 7** COMPLETE SPECIFICATIONS & ORDERING INFORMATION ON NEXT PAGE

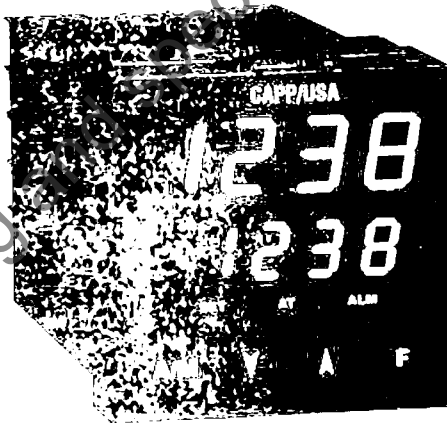
The 116TPC is a full PID controller that contains capabilities, such as adaptive tuning, normally found in larger, more expensive units. While standard autotune procedures generally provide adequate control as long as process conditions remain constant, our adaptive tune method enables the 116TPC to continually alter the PID constants to quickly respond to changes in load, set-point or overall system variations - all without any operator involvement.

The universal input feature allows one unit to be configured to accept a variety of thermocouples, as well as RTD and analog inputs.

The controller's versatility is further increased by plug-in outputs. A total of three outputs are possible and can be configured as one control with two alarms or dual control outputs with one alarm for use in heat/cool applications.

Communication capability can be used to enhance plant-wide automation by using an RS-485 link to interface to a supervisory system or to a chart recorder with the retransmission output.

A universal AC power supply (322886) meets global power requirements, while the NEMA 4/IP65 rated front panel provides reliable operation in harsh environments.



**MODEL 116TPC
(STOCK NO. 338768)**

TEMPERATURE CONTROLLERS

CAPP/USA MODEL 116TPC - CONTINUED

BUILD-YOUR-OWN CONTROLLER:

ORDERING INFORMATION:

BASE PRICE: \$188.00 338768

OPTION TABLES:

A. Input Configuration*

- 1 RTD or DC (mV) N/C
- 2 Thermocouple N/C
- 3 DC (mA) N/C
- 4 DC (V) N/C

B. Output 1

- 0 None N/C
- 1 Relay N/C
- 2 SSR Driver N/C
- 3 4-20 mA** \$29.00

C. Output 2

- 0 None N/C
- 1 Relay \$24.00
- 2 SSR Driver \$24.00
- 3 4-20 mA** \$49.00

D. Output 3

- 0 None N/C
- 1 Relay \$24.00
- 2 SSR Driver \$24.00
- 3 4-20 mA*** \$49.00

E. Options

- 0 None N/C
- 5 RS-485 \$64.00

* Can be reconfigured in the field

** For control output only

*** For retransmission only

SAMPLE STOCK NO.: 116TPC-2-0-0-0-0

SAMPLE PRICE: \$188.00

116TPC SPECIFICATIONS:

Input:

Thermocouple: Types: R, S, J, K, L and B.

RTD: Three-wire PT100, DIN 43760.

Process: 0-20mA, 4-20mA, 0-50mV, 10-50mV, 0-5V, 1-5V, 0-10V, 2-10V.

Sample Rate: 250ms.

Resolution: 14 bits approximately.

Outputs:

Relay: Contact Type: SPDT; Rating 2A resistive at 120/240 VAC.

SSR Drive: Drive Capability: SSR > 4.3 VDC into 250 ohm minimum.

DC: Field Configurable Ranges: 0-20mA, 4-20mA, 0-10V and 0-5V; Resolution: Eight bits in 250 ms, 10 bits in 1 second typical.

Control:

Modes: ON/OFF, PID, Manual.

Proportional Band: 0 (Off), 0.5% - 999.95% of Full Scale.

Reset Time (Integral): 1 sec - 99 min 59 sec. and Off.

Rate Time (Derivative): 0 (Off) - 99 min 59 sec.

Cycle Times: 0.5 sec - 512 sec in binary steps.

ON/OFF Hysteresis: 0.1% - 10% of Full Scale.

Alarms:

Maximum Number: Two "soft" alarms plus Loop Alarm.

Maximum Number of Outputs: Up to 2 for alarm purposes.

Combinational Alarms: Logical OR or AND of alarms to a physical output.

Physical:

Dimensions: 48mm x 48mm, 110mm deep.

Mounting: Panel mount (mounting bracket supplied), 45mm x 45mm cutout.

Terminals: Screw Type - combination head.

General:

Front Panel Rating: NEMA 4/IP65.

Supply Voltage: 90 - 264 VAC, 50/60 Hz.

Common Mode Rejection: 120 dB at 50/60 Hz.

Series Mode Rejection: >500% of span at 50/60 Hz.

7

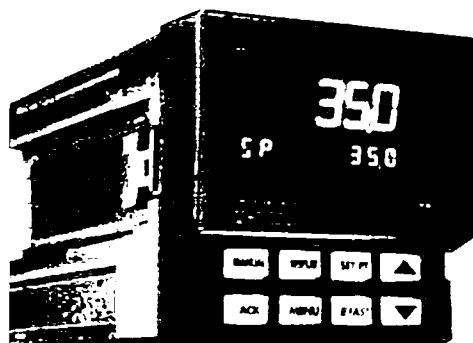
TEMPERATURE CONTROLLERS

CAPP/USA DIGITAL PROCESS CONTROLLERS (1/4 DIN)

CAPP SERIES 1776 PROCESS CONTROLLER / "THE SPIRIT OF AMERICA"



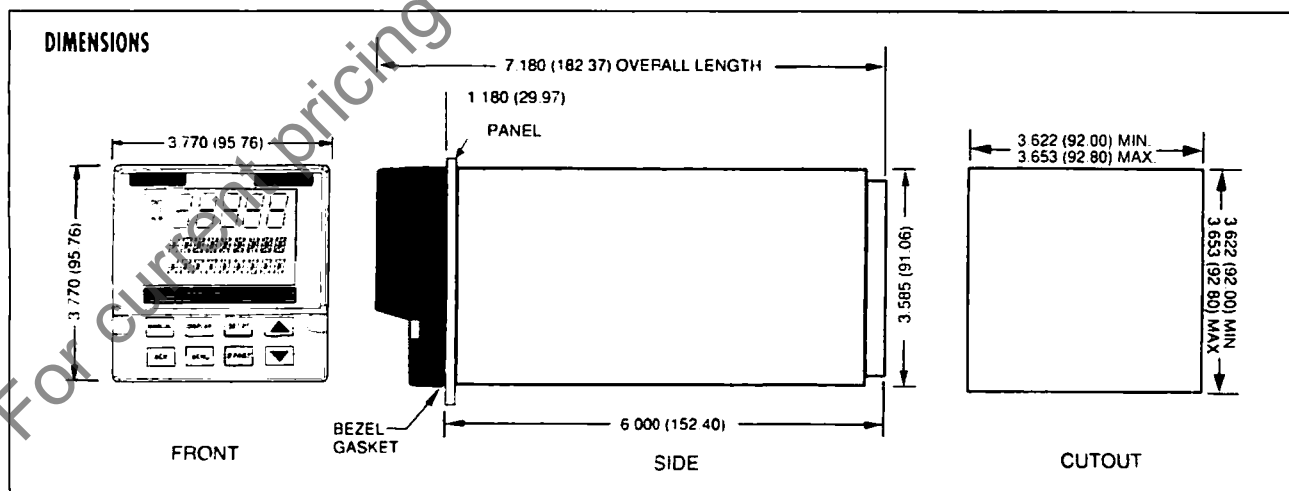
CAPP 1776 FEATURES:



SERIES 1776

- 1/4 DIN
- SINGLE LOOP

- Unique, bolted "clamshell" front panel provides a NEMA 4X watertight front panel rating, allowing you to hose down the controller with the reset of your equipment.
- Adaptive tuning to automatically adjust your tuning parameters as your process changes to ensure close, accurate control.
- Eight local setpoints and eight sets of PID parameters allow you to quickly change batches without having to reenter data.
- Field-installable output modules and a universal process input provide tremendous flexibility in case your process needs change.
- Illuminated, raised rubber keys yield much longer life than common dome-type keys, provide excellent tactile feel, and can be easily read in the dark.
- Vacuum fluorescent display featuring a single large five-digit upper display and two nine-character lines of alphanumeric makes monitoring, operating, and setting-up the 1776 a breeze.
- Quick, easy, unattended start-up without overshoot, is possible thanks to a unique "load line" feature, a trip to automatic feature, a controller setpoint ramping feature, and the automatic selection of sets of PID values based on the process variable value.
- Optional RS-485 serial communications using baud rates up to 19,200 allows you to monitor your process from a personal computer or other host.
- Sophisticated control algorithms, including heat/cool control, split range outputs, and position proportioning control with or without an external feedback signal.
- Square root linearization of the input signal allows you to directly control flow loops without the need for expensive signal conditioners.
- User-defineable, 15-point linearization allows customized linearization of the input signal for highly accurate measurements in engineering units.
- Sophisticated alarm capabilities allow the choice of the type of alarm (including rate-of-change), latching sequence, relay action, and customized alarm messages.
- User-defineable security allows you to select which functions you want to secure.
- Recessed area below the display accommodates an instrument nomenclature tag.



COMPLETE ORDERING INFORMATION
ON FOLLOWING PAGE

TEMPERATURE CONTROLLERS

CAPP SERIES 1776 PROCESS CONTROLLER (CONTINUED)

COMPLETE ORDERING INFORMATION
ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 8 TABLES BELOW:

BASE UNIT PRICE \$550.00

STOCK No.: 1776-

**OPTION
TABLES DESCRIPTION**

**STOCK
NO.**

1:	Output 1 - Control		
	None	\$0.00	0
	Mechanical relay (5 amp)	\$24.00	M
	Analog (milliamp)	\$49.00	A
	Solid State Relay (triac) (1 amp)	\$49.00	S
	DC logic (SSR drive)	\$24.00	D
2:	Output 2 - Control, alarm or retransmission		
	None	\$0.00	0
	Mechanical relay (5 amp)	\$24.00	M
	Analog (milliamp)	\$49.00	A
	Solid State Relay (triac) (1 amp)	\$49.00	S
	DC logic (SSR drive)	\$24.00	D
3:	Output 3 - Alarm or retransmission		
	None	\$0.00	0
	Mechanical relay (5 amp)	\$24.00	M
	Analog (milliamp)	\$49.00	A
	Solid State Relay (triac) (1 amp)	\$49.00	S
	DC logic (SSR drive)	\$24.00	D
	Loop Power	\$49.00	L
4:	Output 4 - Alarm, retransmission or loop power		
	None	\$0.00	0
	Mechanical relay (0.5 amp, 24 V)	\$24.00	M
	Analog (milliamp)	\$49.00	A
	Solid State Relay (triac) (0.5 amp, 24 V)	\$49.00	S
	DC logic (SSR drive)	\$24.00	D
	Loop Power	\$49.00	L
5:	Optional inputs (enter "0" if optional input not desired)		
	Slidewire feedback for position proportioning output	\$39.00	S
6:	Remote setpoint	\$39.00	R
7:	Set of five digital inputs	\$73.00	S
8:	Serial Communications (enter "0" if communications not desired)		
	RS-485 serial communications	\$122.00	C

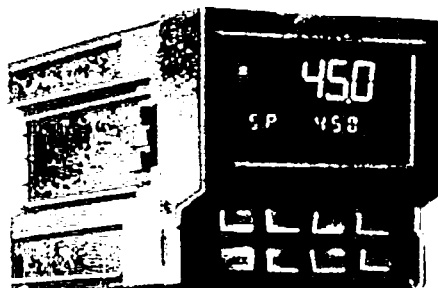
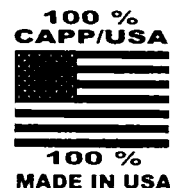
· **EXAMPLE PART NO. :** 1776-SS00SR50.

· **EXAMPLE PRICE:** \$799.00

TEMPERATURE CONTROLLERS

CAPP/USA DIGITAL PROCESS CONTROLLERS (1/4 DIN)

CAPP SERIES 5000 PROCESS CONTROLLER

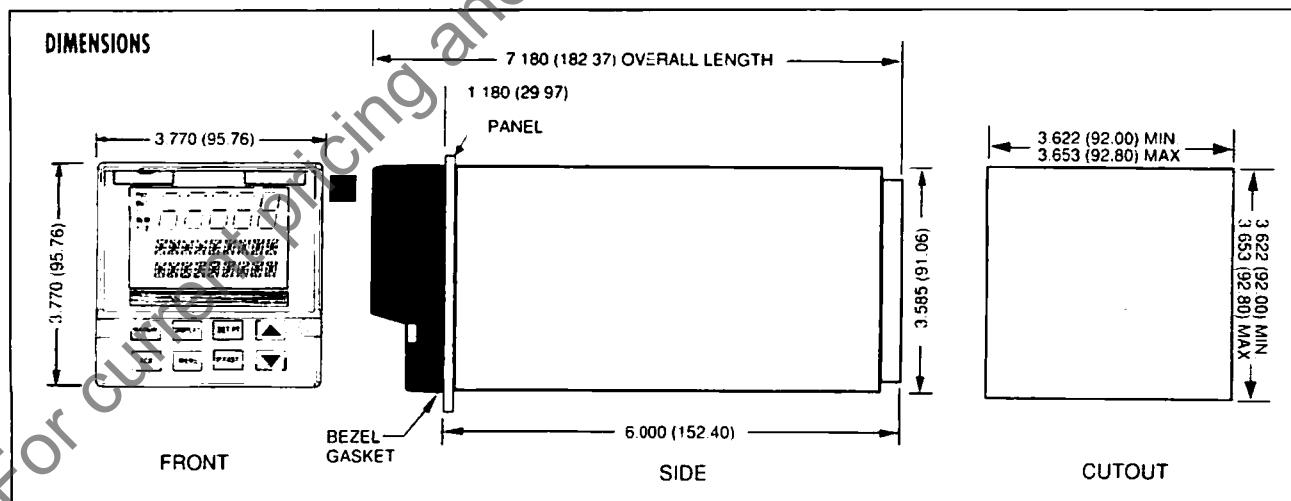


SERIES 5000

- 1/4 DIN
- SINGLE LOOP
- DUAL LOOP
- CASCADE CONTROL
- RATIO CONTROL
- FEED FORWARD

CAPP 5000 FEATURES:

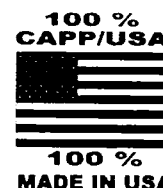
- Two independent full featured control loops. Can be programmed to operate independently, or configured for Ratio, Cascade and Feed Forward applications.
- Unique, bolted "clamshell" front panel provides a NEMA 4X watertight front panel rating, allowing you to hose down the controller with the rest of your equipment.
- Adaptive tuning to automatically adjust your tuning parameters as your process changes to ensure close, accurate control.
- Eight local setpoints and eight sets of PID parameters allow you to quickly change batches without having to reenter data.
- Field-installable output modules and a universal process input provide tremendous flexibility in case your process needs change.
- Illuminated, raised rubber keys yield much longer life than common dome-type keys, provide excellent tactile feel, and can be easily read in the dark.
- Vacuum fluorescent display featuring a single large five-digit upper display and two nine-character lines of alphanumeric makes monitoring, operating, and setting-up the 5000 is a breeze.
- Quick, easy, unattended start-up, without overshoot, is possible thanks to a unique "load line" feature, a trip to automatic feature, a controlled setpoint ramping feature, and the automatic selection of sets of PID values based on the process variable value.
- Optional RS-485 serial communications using baud rates up to 19,200 allows you to monitor your process from a personal computer or other host.
- Sophisticated control algorithms, including duplex control, split range outputs, and position proportioning control with or without an external feedback signal.
- Square root linearization of the input signal allows you to directly control flow loops without the need for expensive signal conditioners.
- User-definable, 15-point linearization allows customized linearization of the input signal for highly accurate measurements in engineering units.
- Sophisticated alarm capabilities allow the choice of the type of alarm (including rate-of-change), latching sequence, relay action, and customized alarm messages.
- User-definable security allow you to select which functions you want to secure.



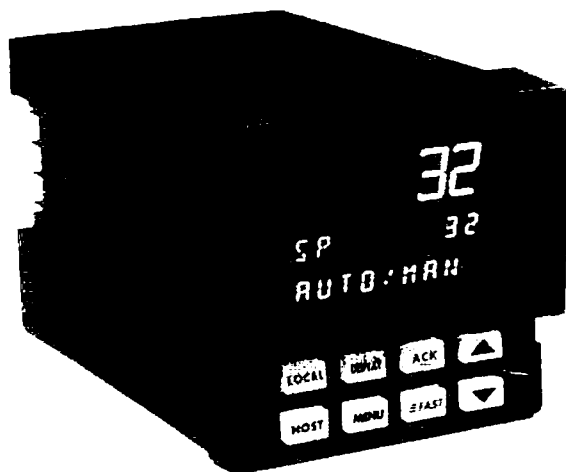
**COMPLETE ORDERING INFORMATION
ON FOLLOWING PAGE**

TEMPERATURE CONTROLLERS

CAPP/USA DIGITAL PROCESS CONTROLLERS (1/4 DIN)



CAPP SERIES MLS MANUAL LOADING STATION

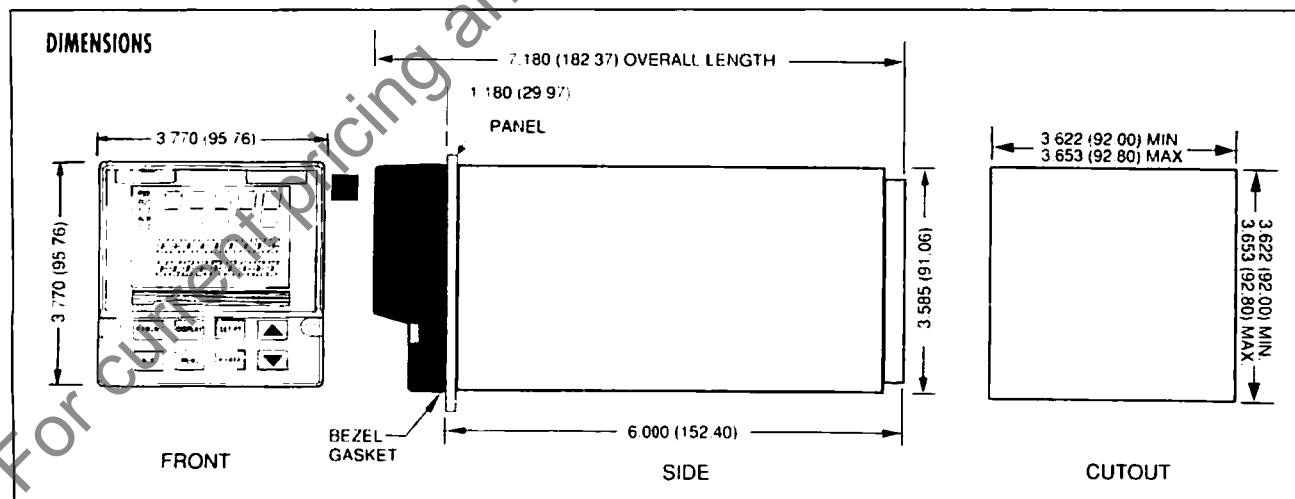


SERIES MLS

- 1/4 DIN
- SINGLE LOOP

CAPP MLS FEATURES:

- Provides manual control of any final control device that accepts a 0-20 mA or 4-20mA signal. Can also accommodate an electrical actuator with slidewire feedback.
- Display function indicator accepts thermocouple, RTD, linear or non-linear control signals
- Has full alarm functions.
- Unique, bolted "clamshell" front panel provides NEMA 4X watertight rating. You can hose down the MLS with the rest of your equipment.
- Illuminated raised rubber keys yield much longer life than common dome-type keys, provide excellent tactile feel, and are easily read in the dark.
- Optional RS-485 serial communications with baud rates up to 9,200 will allow you to monitor your process from a personal computer or other host.
- Vacuum fluorescent display features a single large five-digit display and two nine character lines of alphanumerics.
- Recessed area below the display accommodates a nomenclature tag.



**COMPLETE ORDERING INFORMATION
ON FOLLOWING PAGE.**

TEMPERATURE CONTROLLERS

CAPP SERIES MLS MANUAL LOADING STATION

COMPLETE ORDERING INFORMATION
ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 7 TABLES BELOW:

BASE UNIT PRICE \$555.00

OPTION
TABLES DESCRIPTION

1:	OUTPUT 1 — CONTROL	None	\$0.00
		Mechanical relay (5 amp)	\$24.00
		Analog (milliamp)	\$49.00
		Solid state relay (triac) (1 amp)	\$49.00
		DC logic (SSR drive)	\$24.00
2:	OUTPUT 2 — CONTROL, ALARM or RETRANSMISSION	None	\$0.00
		Mechanical relay (5 amp)	\$24.00
		Analog (milliamp)	\$49.00
		Solid state relay (triac) (1 amp)	\$49.00
		DC logic (SSR drive)	\$24.00
3:	OUTPUT 3 — ALARM or RETRANSMISSION	None	\$0.00
		Mechanical relay (5 amp)	\$24.00
		Analog (milliamp)	\$49.00
		Solid state relay (triac) (1 amp)	\$49.00
		DC logic (SSR drive)	\$24.00
		Loop Power	\$49.00
4:	OUTPUT 4 — ALARM, RETRANSMISSION or LOOP POWER	None	\$0.00
		Mechanical relay (0.5 amp, 24 V)	\$24.00
		Analog (milliamp)	\$49.00
		Solid state relay (triac) (0.5 amp, 24 V)	\$49.00
		DC logic (SSR drive)	\$24.00
		Loop power	\$49.00
5:	OPTIONAL INPUTS ENTER "0" IF NOT DESIRED	Slidewire feedback for electric actuator control	\$39.00
6:	•	Set of 3 digital inputs	\$73.00
7:	SERIAL COMMUNICATIONS ENTER "0" IF NOT DESIRED	RS-485 serial communications	\$125.00

STOCK NO.:

* MLS -

0						
M						
A						
S						
D						
L						
3						
C						

• EXAMPLE PART NO.: MLS-S00S030.

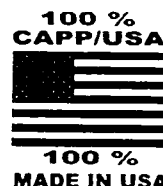
• EXAMPLE PRICE: \$716.00

* PV INDICATION STANDARD.

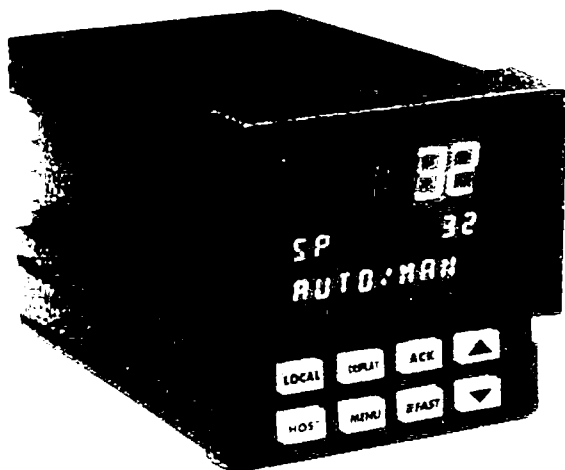
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TEMPERATURE CONTROLLERS

CAPP/USA DIGITAL PROCESS CONTROLLERS (1/4 DIN)



CAPP SERIES MBS MANUAL BACKUP STATION

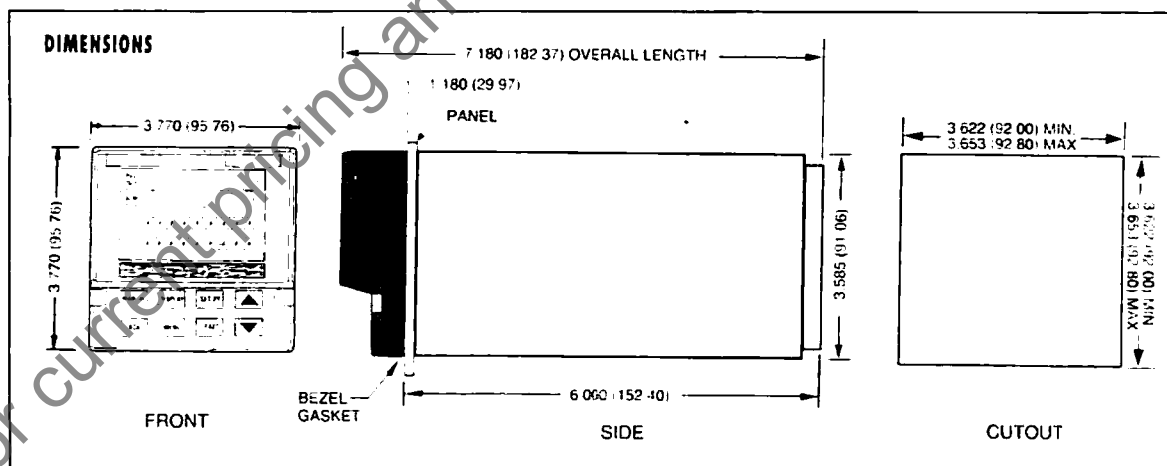


CAPP MBS FEATURES:

- Provides automatic and manual control backup of critical control loops.
- Transfers between REMOTE and LOCAL modes via keypad command, digital input, RS485 Communications or loss/return of control signal.
- Upon keypad command or loss of signal, generates a control signal based on the last known HOST value or a preprogrammed valve.
- Can utilize a programmable rate-of-change ramp when switching to a preprogrammed control value (CV) or returning to REMOTE mode.
- Provides an alarm output in LOCAL mode for status.
- Display function always shows the Control Value (CV), and will show the process variable (PV) and Setpoint (SP) or Valve Position (VP) if desired.
- Accepts a retransmitted PV or direct input of thermocouples, RTDs and linear signals.

SERIES MBS

- 1/4 DIN
- SINGLE LOOP



**COMPLETE ORDERING INFORMATION
ON FOLLOWING PAGE.**

TEMPERATURE CONTROLLERS

CAPP SERIES MBS MANUAL BACKUP STATION

COMPLETE ORDERING INFORMATION
ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 3 TABLES BELOW:

BASE UNIT PRICE: \$700.00

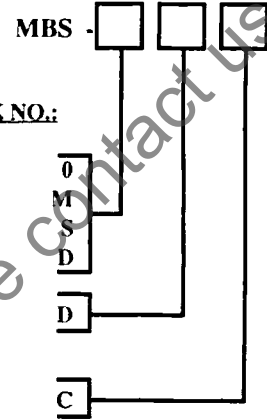
OPTION TABLES

DESCRIPTION

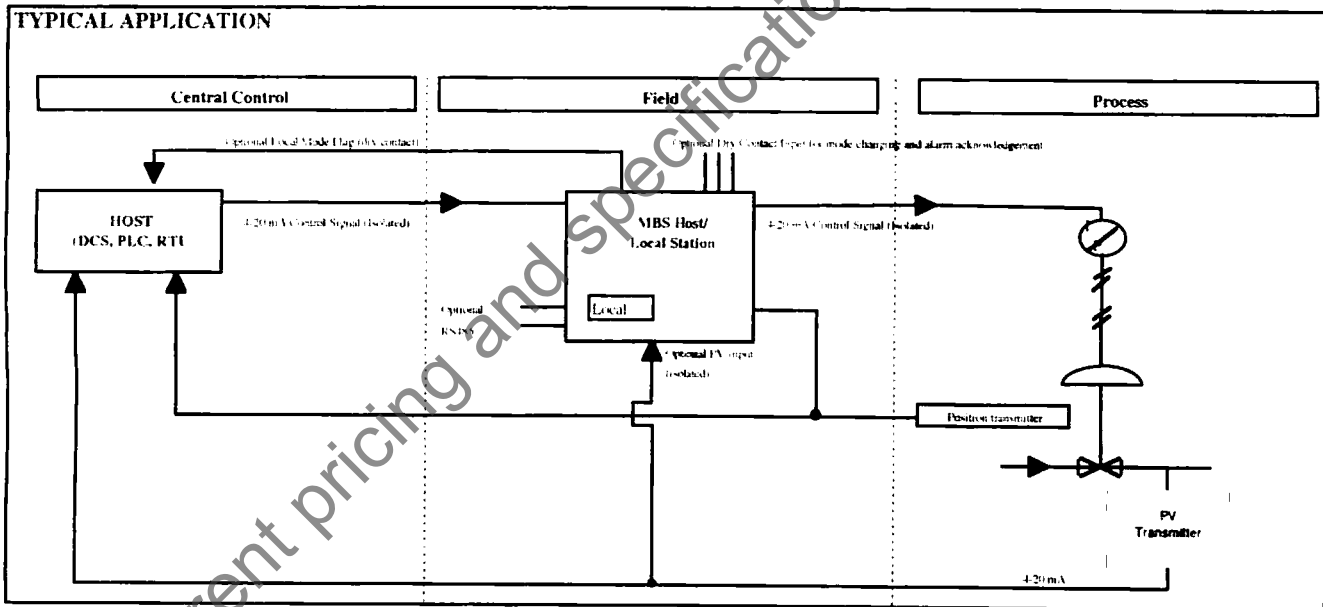
STOCK NO.:

1:	OUTPUT 1 -- ALARM	None	\$0.00
		Mechanical relay	\$25.00
		Solid state relay (triac) (1 amp)	\$51.00
		DC logic (SSR drive)	\$25.00
2:	OPTIONAL INPUTS ENTER "0" IF NOT DESIRED	Set of 3 digital inputs	\$77.00
3:	SERIAL COMMUNICATIONS ENTER "0" IF NOT DESIRED	RS-485 serial communications	\$127.00

* PV INDICATION IS STANDARD



TYPICAL APPLICATION



• EXAMPLE PART NO. : MBS-0-D-0.

• EXAMPLE PRICE: \$777.00

7

TEMPERATURE CONTROLLERS

CAPP/USA MODEL 116CC COMPACT PRESET COUNTER

**Powerful Preset Counter in Compact 1/16 DIN
Package Available with LED or LCD Display**

- Choice of LED or LCD display to meet any viewing requirement

- Button per digit setting and direct access keys simplify setup and operation

- Input Scaling Function enables display of engineering units (length, volume)

- Add/Subtract, Add/Add and Quadrature input modes

- Accepts input signals from a variety of sources: dry-contact, PNP or NPN sensors, encoders

- Can be field configured to perform rate metering or timing functions

- Relay and transistor outputs programmable for latching or timed operation

- Reset via front panel, remote input or automatically

- 12-24 VDC auxiliary supply for powering input devices

- NEMA 4/IP65 rated front panel for use in washdown environments

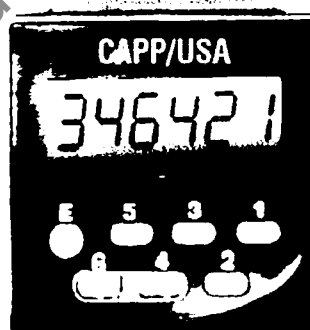
Never before has so much performance been packed into such a small package. The **CAPP/USA MODEL 116CC** is a full-featured preset counter that can be field configured to perform as a rate meter or an elapsed time counter, both with outputs. Choose an LCD display or the industry's only 6 digit, 48mm x 48mm preset counter with an LED display.

Functionality and simplicity go hand in hand - all models can be configured through the front panel to accept inputs from dry contacts, encoders, or photoelectric or proximity switches with either PNP or NPN outputs. Its input can be easily scaled using a multiplier constant, allowing display in Feet, Meters, Gallons, etc.

Important parameters such as preset and prescale entries can be called up with direct access keys. Values can be quickly entered or changed using a simple button per digit method.

Single or dual preset models are available. Each preset features a transistor output, which can interface to an external SSR or PLC, and a relay output for directly driving a load. Outputs can be programmed for latching or timed operation.

An auxiliary power supply simplifies wiring of inputs, and the draw-out case enhances serviceability. The NEMA 4 rated front panel allows use in washdown environments.



7

**COMPLETE
SPECIFICATIONS &
ORDERING
INFORMATION ON NEXT
PAGE.**

**COMPARE OURS
TO
VEEDER-ROOT!**

TEMPERATURE CONTROLLERS

CAPP/USA MODEL 116CC - CONTINUED BUILD-YOUR-OWN COUNTER:

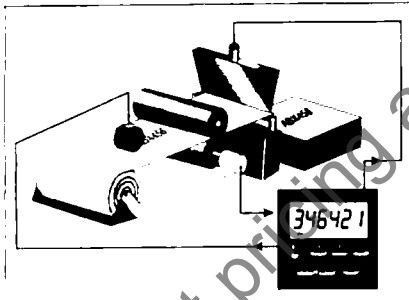
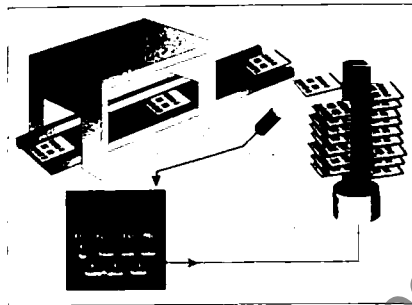
ORDERING INFORMATION:

DESCRIPTION	STOCK NO.	EACH
LCD/Single Preset/AC115	307896	\$139.00
LCD/Single Preset/AC230	319024	\$139.00
LCD/Single Preset/DC 12-24	319025	\$139.00
LCD/Dual Preset/AC115	319026	\$165.00
LCD/Dual Preset/AC230	319034	\$165.00
LCD/Dual Preset/DC 12-24	319035	\$165.00
LED/Single Preset/AC115	319036	\$169.00
LED/Single Preset/AC230	319037	\$169.00
LED/Single Preset/DC12-24	305785	\$169.00
LED/Dual Preset/AC115	319040	\$196.00
LED/Dual Preset/AC230	319041	\$196.00
LED/Dual Preset/DC 12-24	319063	\$196.00

CAPP MODEL 116CC DELIVERS

Great Features and Specifications for Maximum
Application Flexibility

Circuit
Board
Stacking



Cut-to-
Length
with
Marking

116CC SPECIFICATIONS:

Operation:

Count Modes: Add/Subtract, Add/Add, Count/Direction, or
Quadrature, field selectable

Count Speed: 30 Hz or 5kHz, field selectable

Presets: 6 digit; Single, Dual

Reset: Front panel (selectable enable), remote input or
automatic

Calibrator: 0.001 to 9.999 multiplier common to inputs A
and B

Decimal Point: Selectable from XXXXXX to XXX.XXX

Inputs:

Count Inputs: Contact Closure, Sourcing, Sinking; low < 2.0
VDC, high > 8.0 VDC, 40 VDC max.

Control Inputs: Remote Reset and Program Enable; low <
2.0 VDC, high > 8.0 VDC, 40 VDC max.

Outputs:

Number: 1 relay and 1 transistor per preset

Relay(s): SPDT 1A resistive @ 250 VAC

Transistor: PNP open collector, 24 VDC max, 10 mA max

Physical:

Dimensions: 48mm x 48mm, 93.5mm deep

Mounting: Panel mount (mounting bracket supplied), 45mm
x 45mm cutout

Terminals: Screw Type

Display: Single line seven segment LED, 7.6mm high or
Single line LCD, 9mm high

General:

Supply Voltage: 115 VAC, 230 VAC 50/60 Hz; 12 -24 VDC

Accessory Power: 12 to 24 VDC, 0-50mA

Ambient Temperature - Operating: 0 to 50° Celsius, 32 to
122° Fahrenheit

Ambient Temperature - Storage: -20 to 60° Celsius, -4 to
140° Fahrenheit

Front Panel Rating: NEMA 4/IP65

Approvals: CE

7

TEMPERATURE CONTROLLERS

CAPP/USA MODEL 116MFT MULTI-FUNCTION TIMER

High Accuracy Digital Timer Features Dual Line LCD, Multiple Ranges, and Versatile Functions

- Button-per-digit preset entry simplifies setup and operation
- High Contrast dual line LCD display indicates both Process Time and Preset Value
- Field selectable for operation in On-Delay, Off-Delay, Interval, or Repeat Cycle modes
- Universal Power Supply accepts 24 - 240 VAC or 24 VDC
- Designed to meet IEC 801 level 4 noise immunity standards for increased reliability
- Unique On-Delay/Interval mode lets one unit do the work of two in many applications
- Industry standard socket connection
- Programmable security levels prevent unauthorized setpoint or program changes
- Start and Reset input signals provide more flexible control
- IEC IP65 rated front panel for use in washdown environments

**COMPLETE
SPECIFICATIONS &
ORDERING INFORMATION
ON NEXT PAGE.**

An excellent value in its class, the 116MFT features a compact 1/16 DIN package, the precision of digital setting, versatile functionality, and a straightforward button-per-digit interface.

It can be easily programmed to perform any standard timing operation: On-Delay, Off-Delay, Interval, or Repeat Cycle. A unique On-Delay/Interval Mode can in many cases perform the function of two separate timers.

Five selectable time ranges, and a programmable decimal point provide preset times ranging from .01 seconds to 9999 hours.

An available model's output can be configured as a timed 5 amp DPDT relay or as separate timed and instantaneous SPST contacts.



Simplicity of operation is maintained while still providing a high level of functionality. All programming is done through the front panel, with an intuitive button-per-digit keypad that makes entry of preset times quick and easy. A crisp dual line LCD display lets the operator readily view elapsed or remaining cycle time as well as the preset value. Prominent annunciators indicate information such as the time range and the status of the input and outputs.

Reliability is a key feature of the 116MFT. IEC Level 4 noise immunity ensures flawless operation in harsh electrical environments, while its IEC IP65 enclosure rating allows use in washdown conditions.

Wiring via an industry standard 11 pin socket and a power supply that can accept 24 - 240 VAC or 24 VDC vastly simplify setup.

**COMPARE OURS
TO
EAGLE SIGNAL**

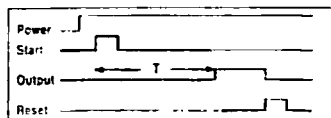
TEMPERATURE CONTROLLERS

CAPP/USA MODEL 116MFT MULTI-FUNCTION TIMER (CONTINUED)

OPERATING MODES:

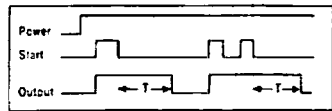
On-Delay

Timing begins on the leading edge of the start input. The output will activate at the completion of the preset time (T) and will remain active until the reset signal is applied or power is interrupted.



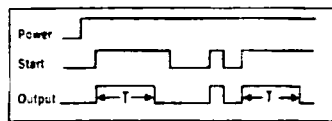
Off-Delay

The output is activated at the leading edge of the start signal. Timing begins on the trailing edge. The output will remain active until the preset time (T) has elapsed or power is interrupted. Reapplying the start signal before T has elapsed will reset the time value. The reset input is not used.



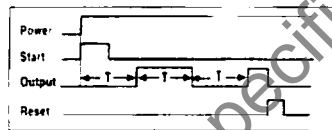
Interval

On the leading of the start input, the output is activated and timing begins. The output will remain active until the preset time (T) has elapsed or power is interrupted. Removal of the start signal will also cause the output to be deactivated and the time value reset. The reset input is not used.



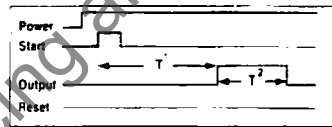
Repeat Cycle

Timing begins on the leading edge of the start input. A cycle is initiated where the output will be OFF for the preset time (T), then ON for the preset time. This cycle will continue until a reset signal is applied or power is interrupted. The unit can also be programmed for the timing sequence to begin with an ON cycle.



On-Delay/Interval

Timing begins on the leading edge of the start signal. The output turns ON when the delay preset time (T1) has elapsed. The output remains ON for the duration of the interval time (T2), then turns OFF. T2 is settable from 0.1 to 999.9 seconds.



116MFT SPECIFICATIONS:

INPUTS:

Start: NPN or Dry Contact

Reset: NPN or Dry Contact

Outputs:

Timed (318941): DPDT - 5 amp

Timed (318942): SPDT - 5 amp

Instantaneous (318942): SPDT - 5 amp

Physical:

Dimensions: 48mm x 48mm, 85mm deep

Mounting: Panel Mounting in 45x45 cutout

Wiring Connection: Via 11 pin plug-in socket

Operation:

Supply Voltage: 24-240 VAC 50/60 Hz, and 24 VDC

Power Consumption: < 10 VA

Time Ranges: Field selectable for Hours, Minutes, Seconds, Hours:Minutes, Minutes:Seconds

Resolution: Field selectable from XXXX to XX.XX for Hours Minutes and Seconds

Operating Modes: On-Delay, Off-Delay, Interval, Repeat, On-Delay/Interval

Repeat Accuracy: $\pm 0.03\%$

Electrical Service Life: 100,000 cycles at full load

Mechanical Service Life: 10 million cycles at min. Load

Environmental:

Front Panel Rating: IEC IP65

Operating Temperature: 0° to 60° C STK# 318941, 0° to 50° C STK# 318942.

Storage Temperature: -40° to 90° C

Humidity: 5% to 95% RH non-condensing

Weight: 100 grams (3.5 ounces)

ORDERING INFORMATION:

Description	Stock No.	EACH
Multi-Function Timer	318941	\$75.40
As above w/Instant Contacts	318942	\$79.00
Accessory:	Stock No.	EACH
11 Pin Socket	275906	\$6.92

TEMPERATURE CONTROLLERS

CAPP/USA'S FAMILY OF PANEL INSTRUMENTATION

Cost Effective, Compact Solutions for a Wide Variety of Timing, Counting and Rate Meter Applications

- Ten Different Models that look and program alike
- Dedicated Functionality Units reduce or eliminate setup time
- Ease of Programming
- High Visibility 8-digit LCD display with backlight capability standard
- A Lithium Battery provides long life and eliminates the need for external power
- Input signals accepted from a variety of sources: Dry Contact, PNP or NPN Sensors. Encoders
- High and low speed input signals for counting and rate meter versions
- Count and time values resettable remotely or from the front panel
- Programmable security disables preset value changes and/or front panel reset
- Option modules provide added functionality and convenience

7 COMPLETE SPECIFICATIONS & ORDERING INFORMATION ON NEXT PAGES.

The CAPP family of panel instrumentation provides a range of capabilities unequaled in products of similar size and cost.

The CAPP series offers ten different models of counting, timing, and rate measurement devices. There are seven types of indicators for counting, time totalizing, and rate metering, plus three units with an output, including a preset timer and counter. With this wide range of functionality in a uniform package, you can completely fill your control panel with a family of devices that look and program alike.

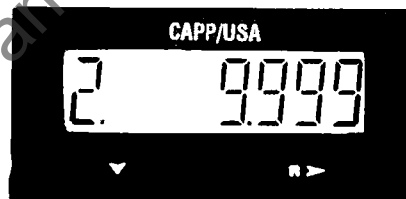
Ease of programming gives added value to the CAPP family. Dedicated functionality by model means you pay only for the features you require and programming is simplified or eliminated.

In addition to a supertwist LCD display with thick .47" high digits

allowing easy viewing at a glance, all models come standard with backlight capability by connecting an external 12 VDC supply.

Numerous types of inputs can be accepted including magnetic pickups on the tachometer and rate versions, giving you a totally self-contained system not requiring external power. The units themselves are powered by an internal 3 volt battery. A unique design allows the battery to be placed in one of two slots; this allows changing the battery with no loss of memory.

The value of the CAPP family of products is further enhanced by a series of option modules which can be used to provide a sensor power supply, backlight the unit, and accept high or low voltage AC or DC input signals. For CAPP models with an output, a relay option module is available to directly drive a load.



CAPP PANEL INSTRUMENTATION MEANS STANDARDIZATION

TEMPERATURE CONTROLLERS

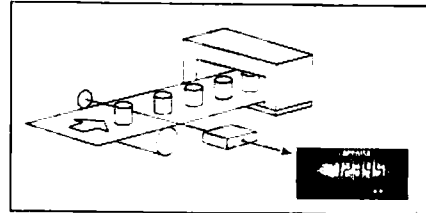
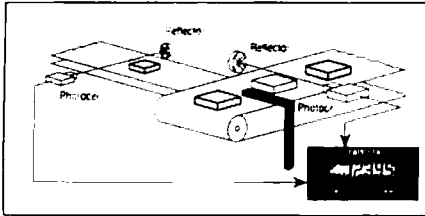
CAPP/USA PANEL INSTRUMENTATION - CONTINUED

(ORDER ALL UNITS BY CAPP STOCK NO.)

CAPP/USA TOTALIZER

STOCK NO. 318895 EACH: \$55.00

- Eight digit count display
- No Scaling required
- Thirty Hz and 10 kHz input speeds
- Remote or front panel reset



CAPP/USA ADD/SUBTRACT TOTALIZER

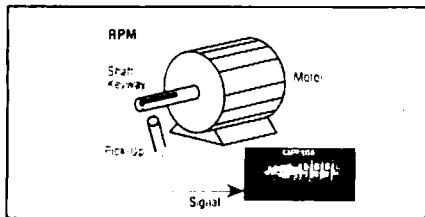
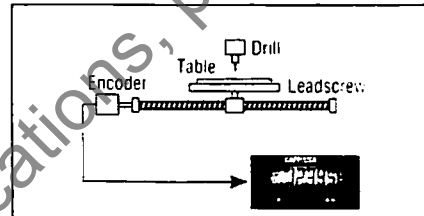
STOCK NO. 318896 EACH: \$76.50

- Eight digit positive count, 7 digit negative count
- Channel A increments while B decrements
- Input scale multiplier (0.0001 to 99.9999)
- Decimal point programmable to 5 places
- Remote or front panel reset

CAPP/USA POSITION INDICATOR

STOCK NO. 318900 EACH: \$76.50

- Accepts quadrature signals from an encoder
- Programmable reset value (-999999 to 999999)



CAPP/USA TACHOMETER

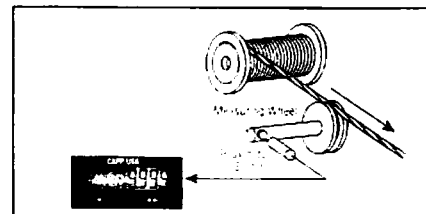
STOCK NO. 318903 EACH: \$69.50

- No programming - Plug and Play simplicity
- Display input frequency (60 PPR input devices will create an RPM display)
- Accepts low speed, high speed and magnetic inputs

CAPP/USA PROGRAMMABLE RATE METER

STOCK NO. 318905 EACH: \$74.30

- Input scale multiplier (0.001 to 9999)
- Time interval measurement for accurate display
- Programmable decimal point position
- Accepts low speed, high speed and magnetic inputs



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cont.

7

TEMPERATURE CONTROLLERS

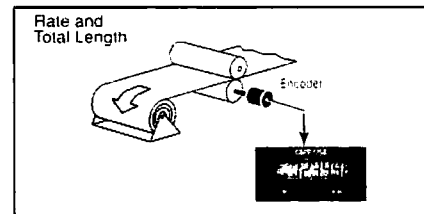
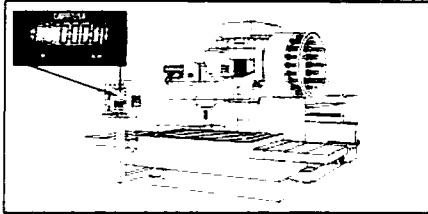
CAPP/USA PANEL INSTRUMENTATION - CONTINUED

(ORDER ALL UNITS BY CAPP STOCK NO.)

CAPP/USA RATE METER & TOTALIZER

STOCK NO. 318930 EACH: \$84.05

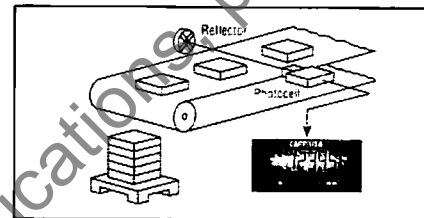
- Toggle between rate display and background total
- Eight digit totalizer
- Four digit rate display plus rate legend
- Independent scale factors for both total & rate



CAPP/USA ELAPSED TIME INDICATOR

STOCK NO. 318931 EACH: \$59.00

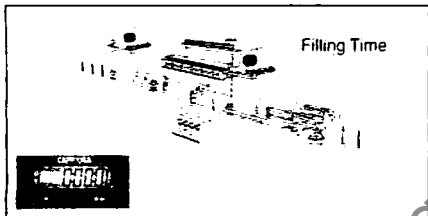
- Seven digit display
- Programmable to read in Seconds, Minutes, Hours or Hours:Minutes:Seconds
- Remote or front Panel Reset



CAPP/USA PRESET COUNTER

STOCK NO. 275932 EACH: \$82.10

- Seven digit preset and count display
- SSR relay output (0.1 amp)
- Programmable for up or down counting
- Field selectable for NO or NC operation
- Preset lock function for added security



CAPP/USA PRESET TIMER

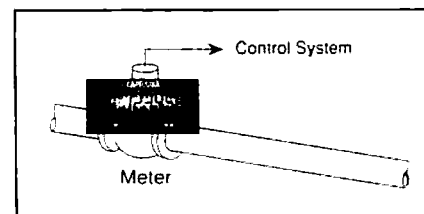
STOCK NO. 318936 EACH: \$84.00

- Time format identical to 318931*
- Field selectable interval or On Delay Operation
- Programmable for Up or Down timing
- SSR relay output (0.1 amp)
- Preset Lock function for added security

CAPP/USA RATE & TOTAL W/PULSED OUTPUT

STOCK NO. 318937 EACH: \$89.60

- Eight digit totalizer
- Four digit rate display plus rate legend
- Independent scale factors for both total & rate
- Pulse output function retransmits input signal based on scale factor of 0.001 to 9999



(CONTINUED ON NEXT PAGE)

TEMPERATURE CONTROLLERS

CAPP/USA PANEL INSTRUMENTATION - CONTINUED

OPTION MODULES

AC Power Supply Module

- 115 or 230 VAC capability on the same module
- Provides 10 to 20 VDC sensor power supply
- Generates 12 VDC for display backlighting

High Voltage Input Module

- 100 to 260 Volt AC/DC for count or timing input

Mechanical Relay Output Module

- SPDT (Form C) configuration
- Rated for 5 Amps @ 120/240 VAC or 30 VDC

Low Voltage Input Module

- 5 to 30 VAC or VDC

STOCK NO.	DESCRIPTION	EACH
319247	HV Input	\$14.66
319253	Relay Output	\$14.00
319278	AC Power Supply	\$29.90
319279	HV Input/Relay	\$26.00
319316	HV Input/Power Supply	\$37.20
319317	Power Supply/Relay	\$39.05
319328	HV Input/Power Supply/Relay	\$50.00
319454	LV Input	\$15.00
319455	LV Input/Relay	\$24.70
319456	LV Input/Power Supply	\$39.00
319457	LV Input/Power Supply/Relay	\$48.72

KEY SPECIFICATIONS

Low Speed Input

Type: NPN Signal, Contact Closure

Count Speed: 30 Hz Maximum

(50% duty cycle)

Logic: Low <1.0 VDC, High >2.0 VDC

Minimum Pulse Width: 12 ms

Maximum Input: 28 VDC

High Speed Input

Type: PNP Signal

Count Speed: 10 kHz maximum

(50% duty cycle)

Logic: Low <1.0 VDC, High >2.0 VDC

Minimum Pulse Width: 45 µsecond

Maximum Input: 28 VDC

Magnetic Inputs: Stock #'s

318903 & 318905 Only.

Impedance: Capacitive coupled input

Count Speed: 10 kHz (50% duty cycle)

Sensitivity: 0.2 V peak

Maximum Input: 28 VDC

Outputs: Stock #'s 275932,

318936, & 318937 Only.

Type: Photomos Relay

Load Current: 0.1 amp @ 30 VAC/DC

On Resistance: >50Ω

Isolation: Isolated from inputs

Power Source

Type: Single or dual 3 volt lithium battery

Expected Life: 5 years typical - single battery,

10 years typical - dual batteries

Low Power Indicator: "Low Bat" display

flashes on approximately 2 weeks prior to end of battery life

Display

Type: Supertwist LCD for use with or without backlighting

Number:

8 digits: Stk. #'s 318895, 318896, 318900, & 318930.

7 digits: Stk. #'s 318931, 275932, & 318936.

4 digits: Stk. #'s 318405 & 318930.

Height: 12mm (.47")

Backlighting: Green Illumination over entire viewable area with a 10 to 28 VDC supply

Physical

Dimension: 36mm x 72mm, 38mm deep

Mounting: Panel Mount (mounting bracket

supplied) 33mm x 68mm panel cutout

Connections: Up to 8 screw terminals

Weight: Approximately 2.25 ounces

Front Panel: NEMA 4/IP66 rated

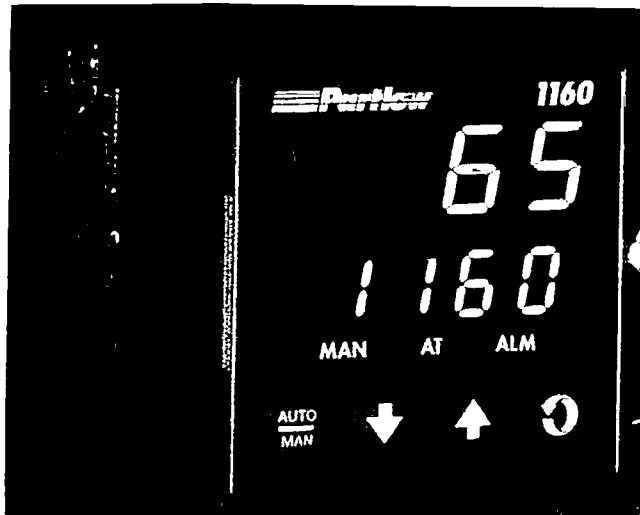
**CAPP/USA BAYONET & NOZZLE-MELT THERMOCOUPLES MANUFACTURED
"TO FIT" ALL BARBER COLMAN STYLES IN FORM, FIT & FUNCTION
SELECTION STARTS ON PAGE 34**

TEMPERATURE CONTROLLERS

PARTLOW DIGITAL PROCESS CONTROLLERS (1/16 DIN)



MIC 1160 Microbased 1/6 DIN Controller



MIC-1160 FEATURES:

Full MIC Series programming ease and operation
Adaptive and Auto Tune for hands-free tuning accuracy
Full PID heat/cool capability
Unique Loop Break Alarm
Dual Alarm Capability
Universal inputs
Analog retransmission-recorder output
RS-485 Communications
Universal power supply
Sealed front panel

ORDERING IS EASY - JUST SELECT AN OPTION FROM THE 4 TABLES:

BASE UNIT PRICE \$195.00

OPTION TABLES

STOCK NO:

1 1 6 0 [] [] [] []

1: OUTPUT 1		
1 Relay		\$0.00
2 SSR Driver		\$0.00
3 4-20mA		\$29.00
2: OUTPUT 2		
0 None		\$0.00
1 Relay		\$24.00
2 SSR Driver		\$24.00
3 4-20mA		\$44.00
3: OUTPUT 3		
0 None		\$0.00
1 Relay		\$24.00
2 SSR Driver		\$24.00
3 4-20mA		\$44.00
4: OPTIONS		
0 None		\$0.00
1 RS-485 Communications		\$59.00

• EXAMPLE PART NO. : 1160-1-0-0-0.

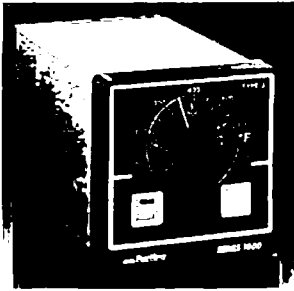
• EXAMPLE PRICE: \$195.00

TEMPERATURE CONTROLLERS

PARTLOW DIGITAL PROCESS CONTROLLERS (1/4 DIN)



SERIES 1000 1/4 DIN HIGH/LOW LIMIT CONTROLLER



SERIES 1000 FEATURES:

Analog based

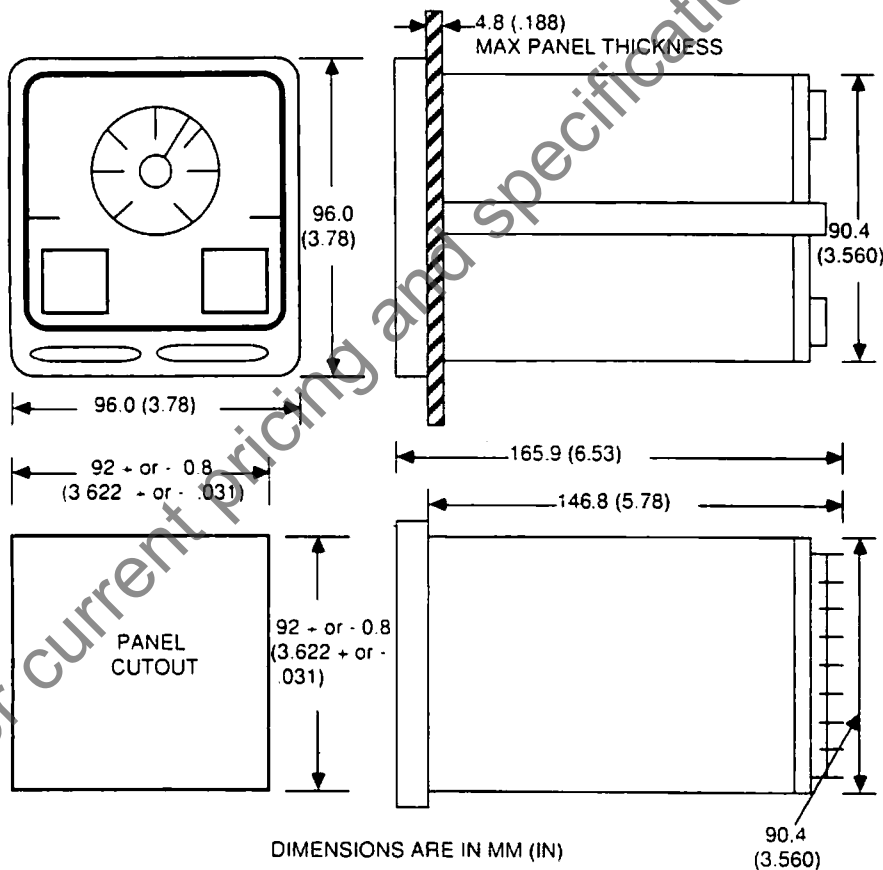
*UL and CSA approved as a
controlling device*

FM approved as a limit device

*Accommodates most thermocouple
types and ranges*

*Commonly used as a high limit device
or single loop controller*

This solid state instrument line offers a quality level not commonly found in comparably priced devices. In addition, it is an ideal instrument for narrow panel widths as it is only 5.8 inches deep. It is available as an On-Off controller or as a High Limit or Low Limit safety device.



TEMPERATURE CONTROLLERS

ORDERING INFORMATION - SERIES 1000

ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 6 TABLES BELOW

OPTION TABLES

STOCK NO.:

1 0 0 0 0 0 0 0 0 0 0 0

TYPE OF UNIT

0	Controller	\$214.00
1	High Limit	\$214.00
2	Low Limit	\$214.00

FIXED CHARACTER

INPUT

11	J T/C	0 to 400°C	40 to 750°F	
12	J T/C	0 to 750°C	40 to 1400°F	
13	J T/C	0 to 120°C	32 to 250°F	
14	J T/C	0 to 540°C	30 to 1000°F	
21	K T/C	0 to 1350°C	50 to 2500°F	\$0.00
31	T T/C	-100 to 200°C	(Celsius scale only)	
32	T T/C	-100 to 200°C	-150 to 400°F	
41	R T/C	200 to 1660°C	400 to 3000°F	
51	B T/C	500 to 1800°C	900 to 3300°F	
61*	S T/C	200 to 1650°C	400 to 3000°F	

OUTPUT 1

1	Relay - SPST N.O. Contact	\$0.00
2	SSR Driver	\$0.00
3	Relay SPDT N.O./N.C. Contact	\$11.75

FIXED CHARACTER

OPTIONS

0	None	\$0.00
1	Remote Reset	\$18.50

VOLTAGE

1	115 VAC	\$0.00
2	230 VAC	\$18.50

STANDARD JUMPER CONFIGURATION

000	High Limit with Upscale Sensor Break
001	Low Limit with Downscale Sensor Break
101	On/Off Direct Controller (Cooling) with Downscale Break
200	On/Off Reverse Controller (Heating) with Upscale Sensor Break

* Available only on High Limit.

EXAMPLE PART NO.: 100012101000.

EXAMPLE PRICE: \$214.00

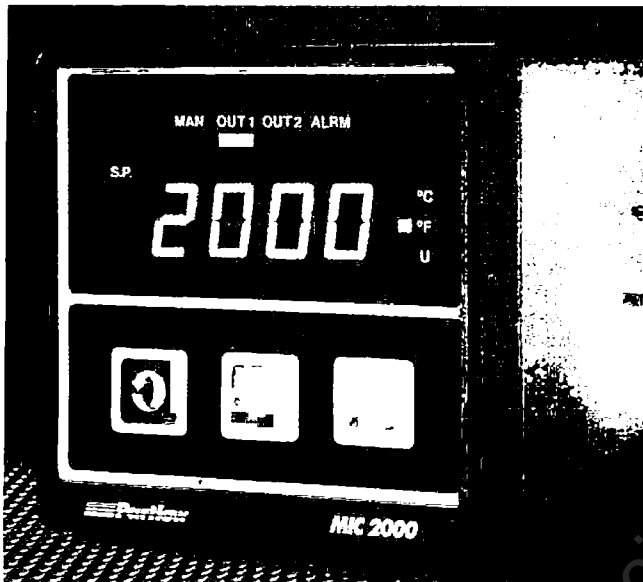
7

TEMPERATURE CONTROLLERS

PARTLOW DIGITAL PROCESS CONTROLLERS (1/4 DIN)



MIC 2000 Microbased 1/4 DIN Single Loop Controller



MIC - 2000 FEATURES:

Input can include thermocouple, RTD, millivolt, volt, and milliamp.

Standard features include: isolated process input, setpoint and output limits, on-off hysteresis and .56 inch high LEDs that will display process, setpoint, deviation, or percent output.

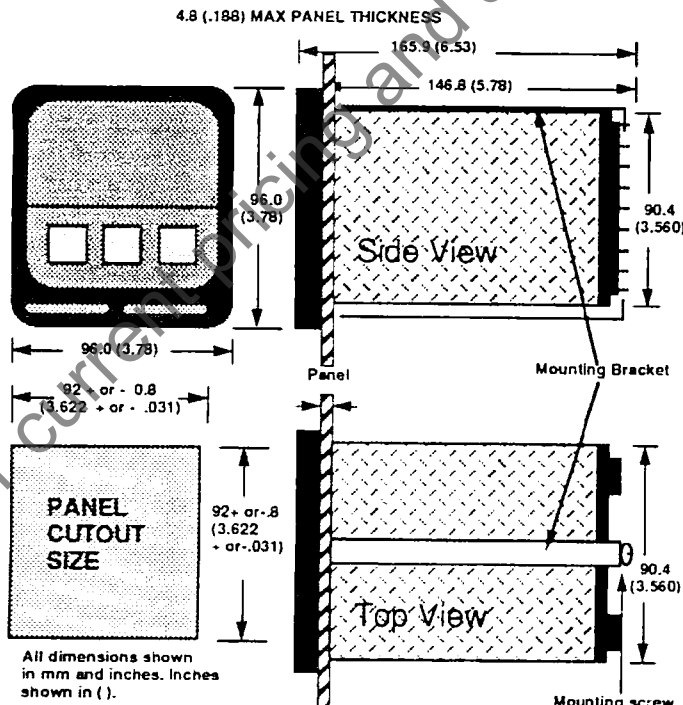
Optional features include: single or dual 4-20mA output for control or process retransmission value, up to 3 relay outputs, three types of alarms, remote setpoint input, electric motor modulation, 24V transmitter power supply and RS-485 communications.

Available control types include on-off, time proportioning, current proportioning, dual output, and position proportioning.

Provides a high level of accuracy with a measurement error limit of $\pm 0.25\%$ of reading.

Access to configuration procedures and setpoint may be restricted by using the instrument's security access mode.

PANEL OPENING SIZES AND INSTALLATION



**COMPLETE ORDERING
INFORMATION ON
FOLLOWING PAGE.**

7

TEMPERATURE CONTROLLERS

ORDERING INFORMATION - MIC 2000

ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 7 TABLES BELOW:

OPTION TABLES

STOCK No.

2

1: Input		
1	T/C or mV	\$419.00
2	Volts/mA	\$419.00
3	RTD	\$455.00
4	All inputs	\$495.00

2: Output 1		
1	Relay	\$0.00
2	SSR Driver	\$0.00
3	4-20mA & Relay	\$43.00

3: Output 2		
0	None	\$0.00
1	Relay	\$33.00
2	SSR Driver	\$27.00
3	4-20mA	\$43.00

4: Alarm		
0	None	\$0.00
1	Relay	\$33.00
2	SSR Driver	\$27.00

5: Remote		
0	None	\$0.00
1	Position Proportioning	\$42.00
2	Remote Setpoint	\$42.00
3	RS-485 Standard Com.	\$132.00
5	RS-485 Total Access Com.	\$186.00

6: Voltage		
1	115VAC Input & Relays	\$0.00
2	230VAC Input & Relays	\$32.00
3	115VAC Input, 230VAC Relays	\$21.00

7: Option Suffix		
(Blank)	None	\$0.00
EA	Extended Feature Software	\$54.00
EB	Extended Feature Software	\$63.00
XP	24VDC Transmitter Power Supply	\$79.00
XA	24VDC Power Supply	\$79.00
BA	Remote Keypad	\$54.00

· EXAMPLE PART NO. : 2330101.

· EXAMPLE PRICE: \$531.00

TEMPERATURE CONTROLLERS

PARTLOW DIGITAL PROCESS CONTROLLERS (1/4 DIN)



MIC 6000 Microbased 1/4 DIN Controller with Programmable Setpoint Profiles



MIC-6000 FEATURES:

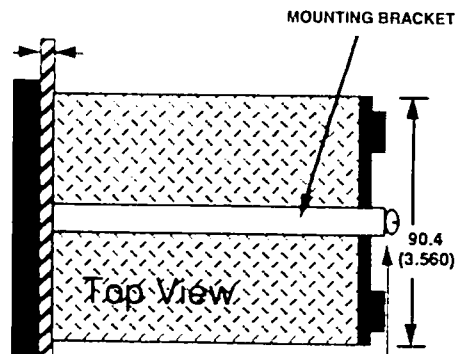
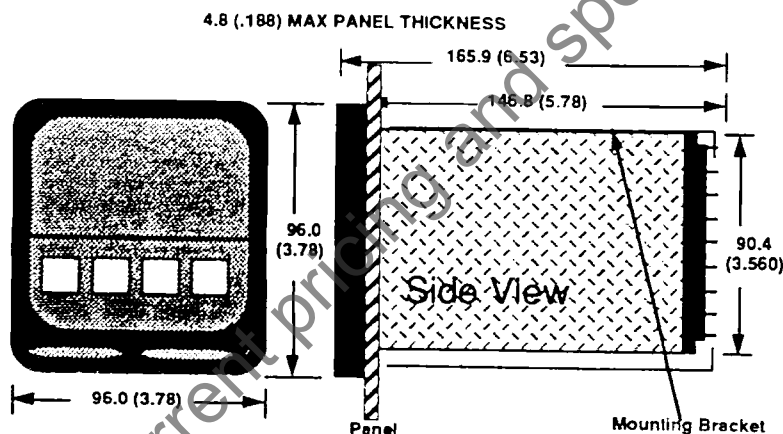
Each instrument will accommodate a variety of thermocouple, RTD, and process inputs, and provides single or dual control outputs and up to 3 event outputs.

Each profile can have six ramp and six soak segments.

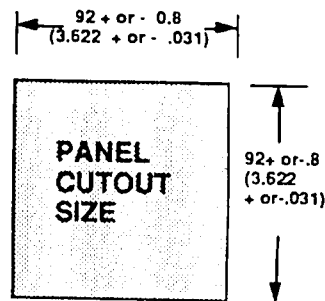
Complex profiles can be accomplished because any number of profiles may be linked together.

Unit can include dual 4-20 mA current outputs which can be used for control or optional process value retransmission, and three relay or solid state relay driver outputs which can be used for control or event outputs.

Optional features include: up to 3 relay outputs, three types of alarms, remote run/hold, electric motor modulation, 24V transmitter power supply and RS-485 communications.



All dimensions shown in mm and inches. Inches shown in ().



COMPLETE ORDERING
INFORMATION ON
FOLLOWING PAGE.

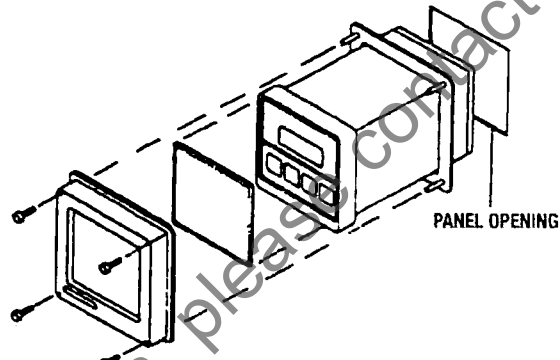
TEMPERATURE CONTROLLERS_____

ORDERING INFORMATION - MIC 6000

ORDERING IS EASY - JUST SELECT AN OPTION FROM THE 7 TABLES BELOW:

OPTION TABLES		STOCK NO.: 6	
1:	INPUT		
	1	T/C or mV	\$669.00
	2	Volts/mA	\$669.00
	3	RTD	\$710.00
	4	All Inputs	\$750.00
2:	OUTPUT GROUP 1 CONTROL GROUP 1 AND/OR EVENT		
	1	Relay	\$0.00
	2	SSR Driver	\$0.00
	3	4-20mA & Relay	\$43.00
	4	4-20mA & SSR	\$43.00
3:	OUTPUT GROUP 2 CONTROL GROUP 2 AND/OR EVENT		
	0	None	\$0.00
	1	Relay	\$33.00
	2	SSR Driver	\$27.00
	3	4-20mA	\$43.00
	4	4-20mA & Relay	\$76.00
4:	OUTPUT GROUP 3 ALARM OR EVENT		
	0	None	\$0.00
	1	Relay	\$33.00
	2	SSR Driver	\$27.00
5:	REMOTE		
	0	None	\$0.00
	1	Position Proportioning*	\$42.00
	2	Remote Run-Hold	\$42.00
	3	RS-485 Std. Com.**	\$132.00
	4	RS-485 Std. Com.***	\$186.00
	5	RS-485 Total Access Com.**	\$186.00
6:	VOLTAGE		
	1	115VAC Input & Relays	\$0.00
	2	230VAC Input & Relays	\$32.00
	3	115VAC Input, 230VAC Relays	\$21.00
7:	OPTION SUFFIX		
	00	No Options	\$0.00
	EO	Extended Feature Software	\$54.00
	XP	24VDC Transmitter Power Supply	\$79.00
	XA	24VDC Power Supply	\$79.00
	A1	40 Profiles	\$126.00

OPTIONAL:



STOCK NO. 221610.

LIFEGUARD®

The MIC 6000 is designed and manufactured for reliable operation in harsh industrial environments. When equipped with an exclusive Partlow LifeGuard splashproof cover it is an excellent instrument for use in environments commonly requiring NEMA-4 type protection. The LifeGuard is a specially designed accessory intended to provide watertight protection and unobstructed access to front panel keys on all Partlow MIC Series 1/4 DIN process controllers. It will protect the MIC 6000 in environments of excessive moisture, dirt, dust, or oil. Installation is done easily without cutting, drilling or any special tools. The LifeGuard may be ordered as an accessory by specifying CAPP STOCK NO. 221610: \$44.00

• EXAMPLE STOCK NO. : 61100010.

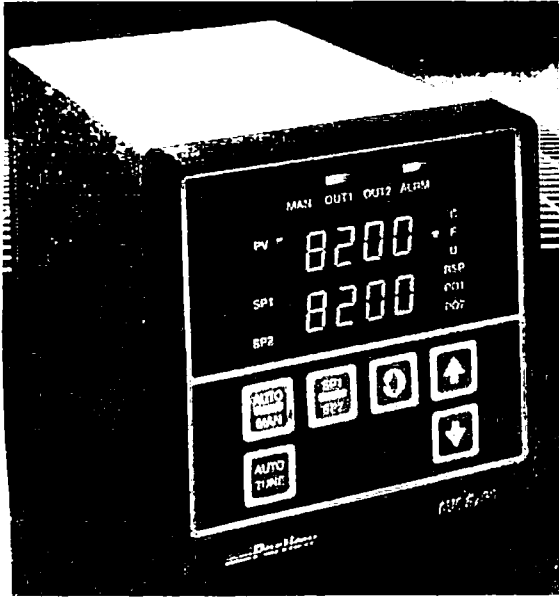
• **EXAMPLE PRICE: \$669.00**

TEMPERATURE CONTROLLERS

PARTLOW DIGITAL PROCESS CONTROLLERS (1/4 DIN)



MIC 8200 Microbased 1/4 DIN Dual Display Controller



MIC - 8200 FEATURES:

Inputs include thermocouple, RTD, VDC, and mA.

Clearly visible status indicators are provided for each display, resolution programmable for 0 to 3 decimal places, depending upon input type selected.

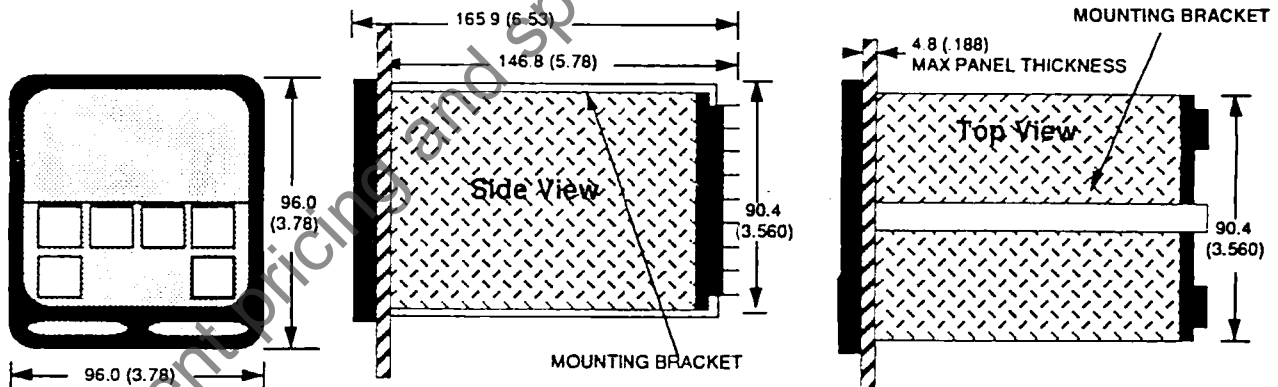
Standard features include: isolated process input, setpoint and output limits, dual .36 inch high 1.4-inch displays that will indicate process, setpoint, deviation, or percent output, and independent hysteresis for control and alarm outputs.

Optional features include: single or dual 4-20 mA output for control or process retransmission value, up to 3 relay outputs, three types of alarms, remote setpoint input, electric motor modulation, 24V transmitter power supply and RS-485 communications

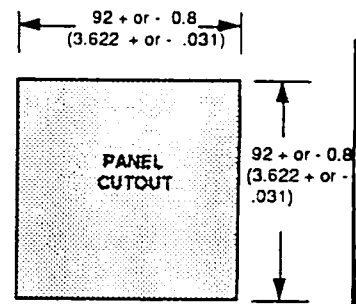
Has dual local setpoint capabilities which are easily changed with one keystroke

Dual proportional control applications are provided with separate, fully programmable PID parameters.

PANEL OPENING SIZES AND INSTALLATION



COMPLETE ORDERING INFORMATION
ON FOLLOWING PAGE



TEMPERATURE CONTROLLERS

ORDERING INFORMATION - MIC 8200

ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE 6 TABLES BELOW:

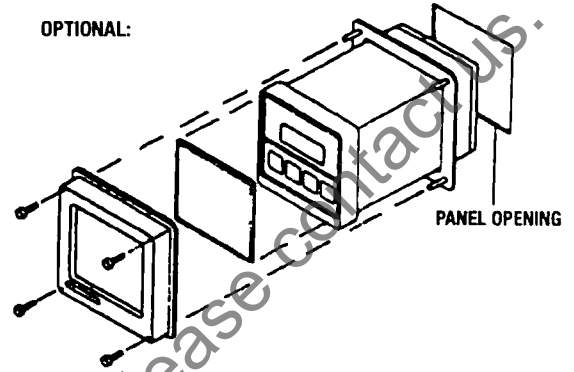
BASE UNIT PRICE: \$579.00

OPTION
TABLES

STOCK NO.: **8** **2** ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

1:	OUTPUT 1		
	1	Relay	\$0.00
	2	SSR Driver	\$0.00
	3	4-20mA & Relay	\$43.00
	4	4-20mA & SSR	\$43.00
2:	OUTPUT 2		
	0	None	\$0.00
	1	Relay	\$33.00
	2	SSR Driver	\$27.00
	3	4-20mA	\$43.00
	4	4-20mA & Relay	\$76.00
	5	4-20mA & SSR	\$70.00
3:	ALARM/OUTPUT		
	0	None	\$0.00
	1	Relay	\$33.00
4:			
	2	SSR Driver	\$27.00
	REMOTE		
	0	None	\$0.00
	1	Position Proportioning*	\$42.00
	2	Remote Run-Hold	\$42.00
	3	RS-485 Std. Com. **	\$132.00
	4	RS-485 Std. Com. ***	\$186.00
	5	RS-485 Total Access Com. **	\$186.00
5:			
	6	RS-485 Total Access Com. ***	\$238.00
	VOLTAGE		
	1	115VAC Input & Relays	\$0.00
	2	230VAC Input & Relays	\$32.00
6:			
	3	115VAC Input, 230VAC Relays	\$21.00
	OPTION SUFFIX		
	(Blank)	No Options	\$0.00
	XP	24VDC Transmitter Power Supply	\$79.00
	XA	24VDC Power Supply	\$79.00

OPTIONAL:



STOCK NO. 221610.

LIFEGUARD®

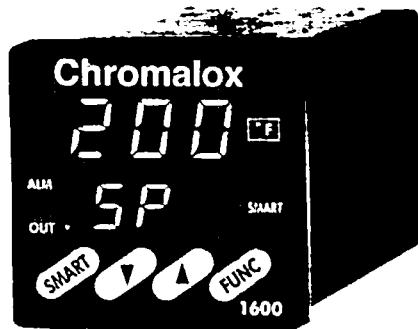
The MIC 8200 is designed and manufactured for reliable operation in harsh industrial environments. When equipped with an exclusive Partlow LifeGuard splashproof cover it is an excellent instrument for use in environments commonly requiring NEMA-4 type protection. The LifeGuard is a specially designed accessory intended to provide water-tight protection and unobstructed access to front panel keys on all Partlow MIC Series 1/4 DIN process controllers. It will protect the MIC 6000 in environments of excessive moisture, dirt, dust, or oil. Installation is done easily without cutting, drilling or any special tools. The LifeGuard may be ordered as an accessory by specifying CAPP STOCK NO.: 221610: \$44.00

EXAMPLE STOCK NO.: 8231011.

EXAMPLE PRICE: \$697.00

TEMPERATURE CONTROLLERS

CHROMALOX TEMPERATURE CONTROLLERS (1/16 DIN) MODEL 1603:



Description

The fully field configurable Chromalox model 1603 1/16 DIN controller combines advanced hardware design and sophisticated electronic control technology into a compact, reliable 1/16 DIN package.

Easy to Install and Operate

The 1603 plug-in design requires only panel cutout, instrument mounting, setpoint and alarm setpoint adjustment to set up.

Applications

- Rubber production, polymerization and synthetic fibers plants
- Packaging and packing equipment
- Extrusion lines, coextrusion lines, plastic films and injection presses
- Fermentation equipment, reactors for chemical and pharmaceutical industries
- Food industries
- Environmental chambers and refrigeration

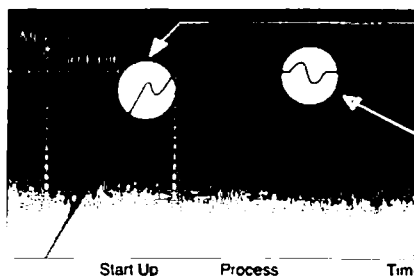
Special Control Features

- Heat/Cool Control Features
- Selection of Cooling Medium and Overlap
- Soft Start - Timed Output Power Limit on Start-Up
- Control Output "Turn Off" Via Pushbuttons
- Programmable offset of Process Temperature

SMART Self-Tuning

The model 1603 meets the application needs of operators with or without skills in temperature processes and PID control. SMART self-tuning automatically adjust the controller to rapidly respond to all process changes. Sophisticated control features include:

- Start-up and continuous in-process tuning
- Continuous self-tuning without artificial upset
- Proprietary control algorithm using fuzzy logic/artificial intelligence concepts
- Proven maximum suppression of overshoot



During Start-Up

the SMART self-tuning function calculates the control parameters to optimize the rise to setpoint.

During process

SMART updates the control parameters as needed to respond to setpoint changes or a load change

7

TEMPERATURE CONTROLLERS

EXPLODED VIEW OF MODEL 1603

ISO 9001 Certified

Quality Construction and Reliability

Manufactured with SMT and verified with long burn-in times and temperature cycling, the 1603 is guaranteed for reliability and long, maintenance-free service.

Lower Display

(3 Orange 7-Segment LEDs)

For set point value. During configuration, shows the code of the selected parameter.

Indicators Red LEDs

ALM Alarm condition exists
OUT Load output is on



IP54 Splashproof

Front Faceplate

Upper Display

(3 Green 7-Segment LEDs)

For process temperature. During configuration, shows the programmed value of selected parameter.

Indicators Red LEDs

SMART SMART tuning is active

Programming Security Levels

Access to programmed parameters is protected by 4 security levels:

- Level 1 Set point and SMART self-tuning
- Level 2 All control parameters and alarm setpoint
- Level 3 Main configuration level
- Level 4 Special functions configuration

Large Target Pushbuttons Simplify Operator Adjustments



Enables SMART self-tuning. During configuration, scrolls back parameters without storing them.



Decrease/Increase Parameter Values



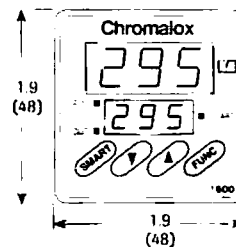
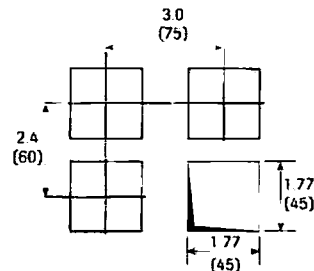
Scrolls parameter display forward and stores previous parameter value.

Dimensions

Dimensions in inches (mm in parenthesis)



3.9
(100)



TEMPERATURE CONTROLLERS

ORDERING INFORMATION - MODEL 1603: ORDERING IS EASY - JUST SELECT AN OPTION FROM THE SELECTIONS BELOW:

Model 1/16 DIN Temperature Controller

1603 SMART Self-Tuning, 2 Outputs (Heat/Cool or Control/Alarm), Dual 3-Digit Display of Process and Setpoint, Field Selectable Universal Thermocouple or RTD Inputs, Programmable Alarms, IEC 801-4 Noise Immunity, IP54 Splashproof Faceplate.

Code Output 1 - Heat or Cool

1 Relay, 3 Amps at 250 Vac (Resistive)
6 SSR Drive, 14 Vdc at 20 mA

Code Output 2 - Cool or Alarm

Relay, 1 Amp at 250 Vac (Resistive Load)

Code Power Supply

3 100 to 240 Vac
5 24 Vac/dc

STOCK NO. SELECTIONS:

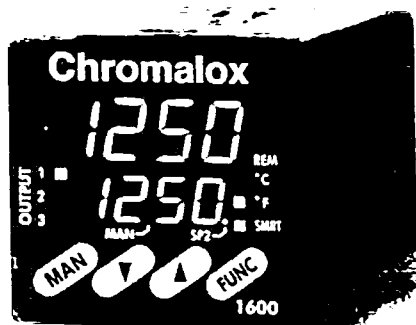
<u>MODEL NO.</u>	<u>STOCK NO.</u>	<u>PRICE</u>
1603-1-1-3	281252	\$201.00
1603-6-1-5	281253	\$236.00
1603-1-1-5	281254	\$236.00
1603-6-1-3	281255	\$201.00

CAPP/USA ALSO STOCKS THE COMPLETE LINE
OF CHROMALOX ELECTRIC HEATERS

TEMPERATURE CONTROLLERS

CHROMALOX TEMPERATURE CONTROLLERS

(1/16 DIN) MODEL 1604:



Description

The fully field configurable Chromalox model 1604 1/16 DIN controller combines advanced hardware design and sophisticated electronic control technology into a compact, reliable 1/16 DIN package.

Easy to Install and Operate

The 1604 plug-in design requires only panel cutout, instrument mounting, setpoint and alarm setpoint adjustment to set up.

Applications

- Packaging and packing equipment
- Extrusion lines, coextrusion lines, plastic films and injection presses
- Fermentation equipment, reactors for chemical and pharmaceutical industries
- Food industries
- Environmental chambers and refrigeration

Special Control Features

- Heat/Cool Control Features
- Selection of Cooling Medium and Overlap
- Heater Break Down (HB)
- Alarm/Current Transformer Input
- Auto/Manual Control
- ChromaSoft® Remote Operator Interface Software Compatibility
- Soft Start - Timed Output Power Limit on Start-Up
- Control Output "Turn Off" Via Pushbuttons
- Programmable Ramp on Setpoint Changes

SMART Self-Tuning

The model 1604 meets the application needs of operators with or without skills in temperature processes and PID control. Simply enable the SMART function and the controller self-adjust automatically and rapidly to all process changes - load changes, setpoint changes and more. Sophisticated control features include:

- Start-up and continuous in-process tuning
- Continuous self-tuning without artificial upset
- Proprietary control algorithm using fuzzy logic/artificial intelligence concepts
- Proven maximum suppression of overshoot



During Start-Up

the SMART self-tuning function calculates the control parameters to optimize the rise to setpoint.

During process

SMART updates the control parameters as needed to respond to setpoint changes or a load change

TEMPERATURE CONTROLLERS

EXPLODED VIEW OF MODEL 1604

ISO 9001 Certified
Quality Construction and Reliability

Manufactured with SMT (Surface Mount Technology) and verified with long burn-in times and temperature cycling, the 1604 is guaranteed for reliability and long service life.

IP54 Splashproof
Front Faceplate

Lower Display
(4 Orange 7-Segment LEDs)
For setpoint value. During configuration, shows the code of the selected parameter

Output 1, 2, 3
Indicate load output ON and
Heater Break Down

MAN - Red LED
Indicates manual control
is active

**Heater Break Down Current
Monitoring**
Indicates heater failure(s)

Upper Display
(4 Green 7-Segment LEDs)
For process temperature. During
configuration, shows the
programmed value of selected
parameter.

Indicators - Red LEDs

- SMRT** SMART tuning
is active
- REM** Digital Communications
is active
- SP2** Setpoint #2 is active
and displayed in lower
display

Digital Communications
RS485 communications
available and can be operated
using *ChromaSoft*® Remote
Operator Interface Software,
and can be networked with
other Chromalox controllers
via RS-485 digital communica-
tions (optional).

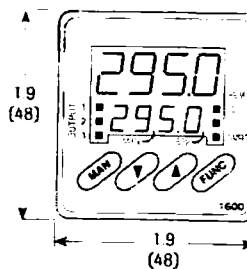
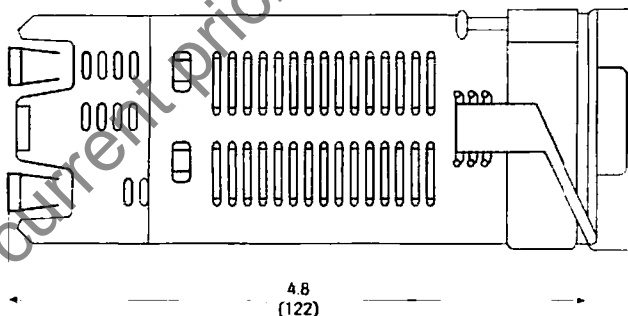
Large Target Pushbuttons Simplify Operator Adjustments

MAN
Toggles between Auto
and Manual control
modes

**Decrease/Increase
Parameter Values**

FUNC
Scrolls parameter
display forward and
stores previous
parameter value.

Dimensions in inches (mm in parenthesis)



7

TEMPERATURE CONTROLLERS

ORDERING INFORMATION - MODEL 1604:

ORDERING IS EASY - JUST SELECT AN OPTION
FROM THE SELECTIONS BELOW:

Model 1/16 DIN Temperature Controller

1604 SMART Self-Tuning, 2 Outputs (Heat/Cool or Control/Alarm), Dual 4-Digit Display of Process and Setpoint, Field Selectable Universal Thermocouple, RTD, Voltage or Current Inputs, Auto-Manual Control, Programmable Alarms, 0.1 Degree Display Resolution, IEC 801-4 Noise Immunity, Optional Heater Break Alarm/Current Transformer Input, IP54 Splashproof Faceplate, Optional RS485 Digital Communications, Compatible with *ChromaSoft*® Remote Operator Interface Software.

Code Output 1 - Heat or Cool

1 Relay, 3 Amps at 240 Vac
6 SSR Drive, 14 Vdc at 20 mA

Code Output 2 - Cool or Alarm

1 Relay, 2 Amps at 240 Vac

Code Options

0 None
1 Output #3, 2 Amps at 250 Vac (Resistive Load)
2* Heater Break Down Input and Output #3
3 RS485 Digital Communications and Output #3
4* RS485 Digital Communications, Heater Break Down Input and Output #3

Code Power Supply

3 100/240 Vac
5 24 Vac/dc

1604 - 1 - 1 - 0 - 3 : EXAMPLE STOCK No.

Accessories

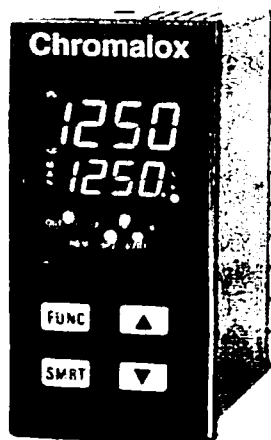
7

*Controllers with the Heater Break Down option, models 1604-xx2xx and 1604-xx4xx require a Current Transformer. Specify one of the three Current Transformers listed below when ordering a controller with the Heater Break Down option.

	Model No.	PCN	Stock No.	PRICE
Current Transformer, for 0-25 Amp Load Current	0005-12127	306350	281243	\$29.00
Current Transformer, for 0-50 Amp Load Current	0005-12128	306368	281245	\$29.00
Current Transformer, for 0-100 Amp Load Current	0005-12129	306376	281248	\$29.00
ChromaSoft® Remote Operator Interface Software	SOFT-12000	-	281250	\$288.00

TEMPERATURE CONTROLLERS

CHROMALOX TEMPERATURE CONTROLLERS (1/8 DIN) MODEL 8004:



Description

The fully field configurable Chromalox model 8004 1/8 DIN controller combines advanced hardware design and sophisticated electronic control technology into a compact, reliable 1/8 DIN package.

Easy to Install and Operate

The 8004 plug-in design requires only panel cutout, instrument mounting, setpoint and alarm setpoint adjustment to set up.

Applications

- Packaging and packing equipment
- Extrusion lines, coextrusion lines, plastic films and injection presses
- Rubber production plants
- Food industries
- Environmental chambers and refrigeration

Special Control Features

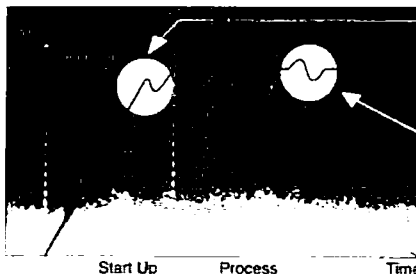
- Heat/Cool Control Features
- Selection of Cooling Medium and Overlap
- Heater Break Down (HB)
- Alarm/Current Transformer Input
- Auto/Manual Control
- ChromaSoft™ Remote Operator Interface Software Compatibility
- Soft Start—Timed Output Power Limit on Start-Up
- Auto/Manual Control
- Control Output "Turn Off" Via Pushbuttons
- Programmable Ramp on Setpoint Change

SMART Self-Tuning

The model 8004 meets the application needs of operators with or without skills in temperature processes and PID control. Simply enable the SMART function and the controller self-adjusts automatically and rapidly to all process changes - load changes, setpoint changes and more.

Sophisticated control features include:

- Start-up and continuous in-process tuning
- Continuous self-tuning without artificial upset
- Proprietary control algorithm using fuzzy logic/artificial intelligence concepts
- Proven maximum suppression of overshoot



During Start-Up

the SMART self-tuning function calculates the control parameters to optimize the rise to setpoint.

During process

SMART updates the control parameters as needed to respond to setpoint changes or a load change

7

TEMPERATURE CONTROLLERS

EXPLODED VIEW OF MODEL 8004

ISO 9001 Certified Quality Construction and Reliability

Manufactured with SMT (Surface Mount Technology) and verified with long burn-in times and temperature cycling, the 8004 is guaranteed for reliability and long service life.

IP54 Splashproof

Front Faceplate

Programming Security Levels

Access to programmed parameters is protected by 4 security levels:

- Level 1 Set point and SMART self-tuning
- Level 2 All control parameters and alarm threshold with optional user defined security code
- Level 3 Main configuration level
- Level 4 Special functions configuration

Lower Display

(4 Orange 7-Segment LEDs)

For setpoint value or heater consumption (amps). During configuration shows code of the selected parameter.

MAN - Red LED

Indicates manual output control is active.

Heater Break Down

Current Monitoring indicates heater failure(s).

Chromalox

1250

1250.

Upper Display

(4 Green 7-Segment LEDs)

For process temperature. During configuration, shows the selected parameter value.

Indicators - Red LEDs

- OUT1-4 Output/Alarm is on
- OUT3 Flashes to indicate heater breakdown
- REM Digital Communications is active
- SP2 Setpoint 2 is active and displayed in lower display
- SMART SMART tuning is active

Large Target Pushbuttons Simplify Operator Adjustments



FUNC

MAN

- Decrease/Increase Parameter Values

Scrolls setup parameter display forward and stores previous parameter value.

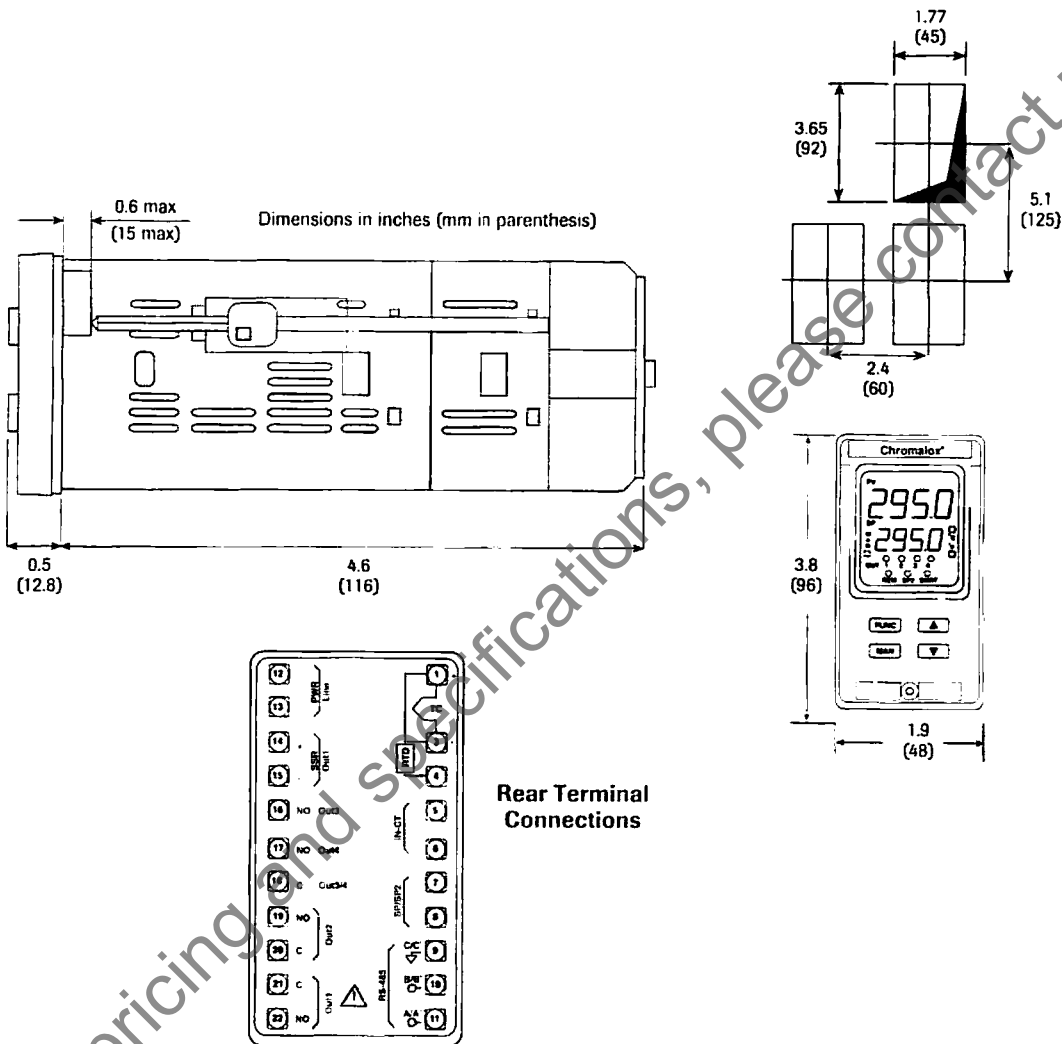
Toggles between AUTO and MANUAL control modes.

Digital Communications

Like all Chromalox microprocessor-based controllers, the 8004 can be operated using *ChromaSoft*® Remote Operator Interface software, and can be networked with other Chromalox controllers using RS-485 digital communications (optional).

MODEL 8004 DIMENSIONS

Physical Specifications 1/8 DIN, 1.9 x 3.8 inches (48mm x 96mm), 4.6 inches deep (116mm)
Panel cutout 1.77 x 3.62 inches (45mm x 92mm), 1 lbs. (450 grams)



TEMPERATURE CONTROLLERS

ORDERING INFORMATION - MODEL 8004:

ORDERING IS EASY - JUST SELECT AN OPTION FROM THE SELECTIONS BELOW:

Model 1/8 DIN Temperature Controller

8004 SMART Self-Tuning, 2 Outputs (Heat/Cool or Control/Alarm), Dual 4-Digit Display of Process and Setpoint, Field Selectable Universal Thermocouple, RTD, Voltage or Current Inputs, Auto-Manual Control, Programmable Alarms, 0.1 Degree Display Resolution, IEC 801-4 Noise Immunity, Optional Heater Break Alarm (#3)/Current Transformer Input, IP54 Splashproof Faceplate, Optional RS485 Digital Communications, Compatible with *ChromaSoft*® Remote Operator Interface Software.

Code Output 1 - Heat or Cool

1 Relay, 3 Amps at 240 Vac or
SSR Drive, 14 Vdc at 20 mA, Jumper Selectable

Code Output 2 - Cool or Alarm

1 Relay, 2 Amps at 240 Vac

Code Options

1 Output #3, 2 Amps at 250 Vac (Relative Load)
2* Heater Break Down Input, Output #3 and Output #4
3 RS485 Digital Communications, Output #3 and Output #4
4* RS485 Digital Communications, Heater Break Down Input,
Output #3 and Output #4

Code Power Supply

3 100/240 Vac
5 24 Vac/dc

8004 1 1 2 3 : EXAMPLE STOCK No.

Accessories

*Controllers with the Heater Break Down option, models 8004-xx2xx and 8004-xx4xx require a Current Transformer. Specify one of the three Current Transformers listed below when ordering a controller with the Heater Break Down option.

Current Transformer, for 0-25 Amp Load Current
Current Transformer, for 0-50 Amp Load Current
Current Transformer, for 0-100 Amp Load Current
ChromaSoft® Remote Operator Interface Software

Model No.	PCN	Stock No.	PRICE
0005-12127	306350	281243	\$29.00
0005-12128	306368	281245	\$29.00
0005-12129	306376	281248	\$29.00
SOFT-12000	-	281250	\$288.00

TEMPERATURE CONTROLLERS

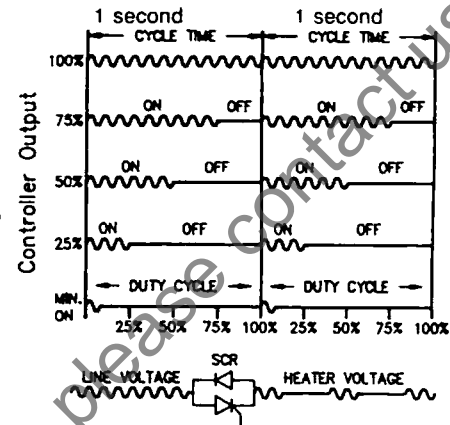
ENGINEERS TECHNICAL OVERVIEW CHROMALOX SOLID STATE SCR POWER CONTROLLERS

SCR power control: the basics

Zero-crossover firing

Chromalox SCR Power Controllers are zero-crossover fired, also referred to as burst firing. Zero-crossover fired power controllers are ideal for control of pure resistive loads that can accommodate rapid, full power, ON/OFF cycling. Zero-crossover firing does not create RFI (Radio Frequency Interference) and will not adversely affect sensitive electronic equipment (computers, other SCR power controllers, logic controllers) located in the same area. Additionally, Chromalox SCR's are protected from line voltage transients, making them more reliable in a wide variety of applications.

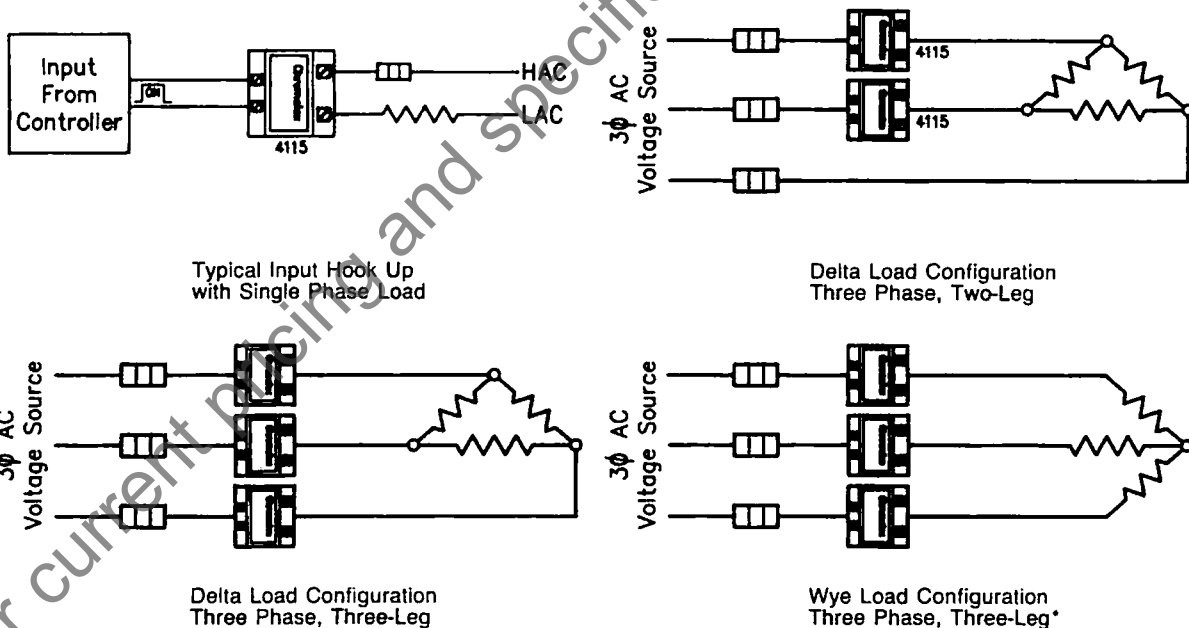
Zero-crossover fired SCR's, when coupled with a time proportioning control (firing package) such as the Vari-Watt, operate in a series of full ON and OFF cycles known as time proportional burst firing. The time proportioning control accepts the control output signal and converts it into a time proportional signal, determining the amount of ON time and OFF time per duty cycle. The continuous, highly repetitious rate of full ON and full OFF cycles produces a smooth power output to the load (heater) and a stable process temperature.



Time Proportional Burst Firing

Load connection diagrams

These suggested connection diagrams illustrate common load connections for resistive heaters.



*Wye connected loads are not recommended for applications with more than one element per leg per circuit. An element failure in any leg increases the probability of further element failure in that leg.

TEMPERATURE CONTROLLERS

SOLID STATE SCR POWER CONTROLLERS

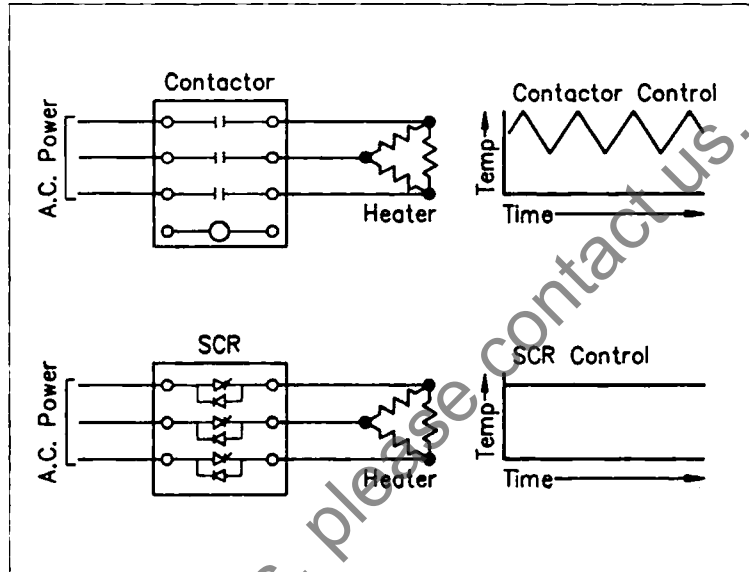
Selecting power control: SCR or contactor?

SCR vs. contactor power control

Mechanical contactors switch power in full ON and OFF cycles. For this reason, they should be used at cycle times of 15 seconds or longer for reasonable service life. Because of the full ON and OFF switching, and the limited cycle time, contactor controlled processes must have a higher tolerance for process temperature overshoot and undershoot (as illustrated at right).

An SCR (Silicon Controlled Rectifier) power switch differs from other switches in its fast action. For example, while a contactor may cycle three times per minute, a Chromalox SCR cycles approximately once per second. This fast SCR cycle time results in process temperature maintenance much closer to the desired set point. The SCR controller modulates small increments of power to the load, unlike traditional mechanical control, and eliminates the overshoot and undershoot associated with contactor control.

Other factors such as ambient temperature, electrical noise and air contaminants should be considered when selecting a power controller.

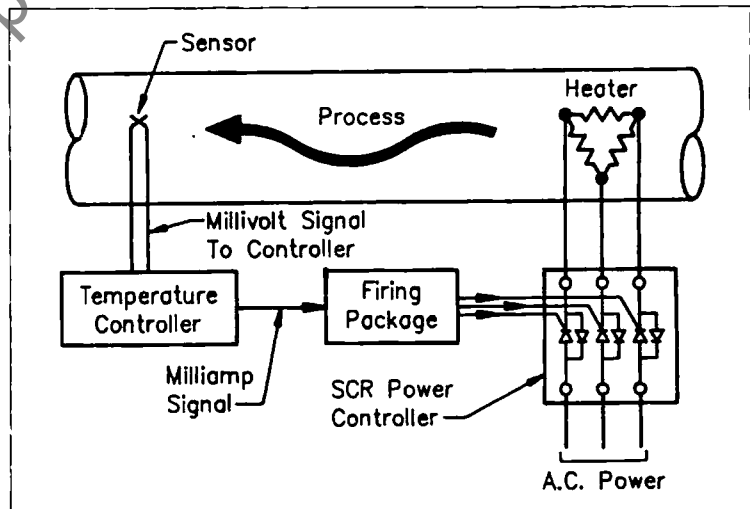


SCR power control system

A typical power control system consists of: RTD or Thermocouple; Temperature Controller; Firing Package; SCR Power Controller. Often the Firing Package is part of the temperature controller and is not a separate component.

These components work together to control the heating of the process:

1. The temperature sensor provides a signal to the temperature controller.
2. The temperature controller compares the sensor signal to the predetermined set point and generates an output signal that represents the difference between the actual process temperature and the set point.
3. The firing package uses this control output to generate a time proportional signal for the SCR power controller, switching the SCR on and off, thus regulating the power to the heater.



TECH-TIP: DIGITAL CONTROLLERS

TUNING YOUR TEMPERATURE CONTROLLER

(TUNING PROCEDURES BASED ON A STANDARD PID (3-MODE) CONTROLLER)

Tuning a temperature controller involves setting the proportional, integral, and derivative values to get the best possible control for a particular process. If the controller does not include an autotune algorithm or the autotune algorithm does not provide adequate control for the particular application, the unit must then be tuned using a trial and error method.

There are other tuning procedures which can also be used, but they all use a similar trial and error method. Note that if the controller uses a mechanical relay (rather than a solid state relay) a longer cycle time (20 seconds) should be used when starting out.

The following definitions may be needed:

- 1) Cycle time -- Also known as duty cycle; the total length of time for the controller to complete one on/off cycle. Example: with a 20 second cycle time, an on time of 10 seconds and an off time of 10 seconds represents a 50 percent power output. The controller will cycle on and off while within the proportional band.
- 2) Proportional band -- A temperature band expressed in % of full scale or degrees within which the controllers' proportional band the greater the area around the setpoint in which the proportional action takes place. It is sometimes referred to as gain, which is the reciprocal of proportional band.
- 3) Integral, also known as reset, is a function which adjusts the proportional bandwidth with respect to the setpoint, to compensate for offset (droop) from setpoint, that is, it adjusts the controlled temperature to setpoint after the system stabilizes.
- 4) Derivative, also known as rate, senses the rate of rise or fall of system temperature and automatically adjusts the proportional band to minimize overshoot or undershoot.

A PID (three mode) controller is capable of exceptional control stability when properly tuned and used. The operator can achieve the fastest response time and smallest overshoot by following these instructions carefully. The information for tuning this three-mode controller may be different from other controller tuning procedures. Normally a SELF TUNE feature will eliminate the necessity to use this manual tuning procedure for the primary output, however, adjustments to the SELF TUNE values may be made if desired.

After the controller is installed and wired:

1. Apply power to the controller.
2. Disable the control outputs if possible.
3. For time proportional primary output, set the cycle time. Enter the following value:

CYCLE TIME 1

5 SEC (Only appears if output is a time proportional output, a smaller cycle time may be required for systems with an extremely fast response time).

Then select the following parameters:

PR BAND 1 5% (PB)

RESET 1 0 R/M (TURNS OFF RESET FUNCTION)

RESET 2 0 R/M

RATE 1 0 MIN (TURNS OFF RATE FUNCTION)

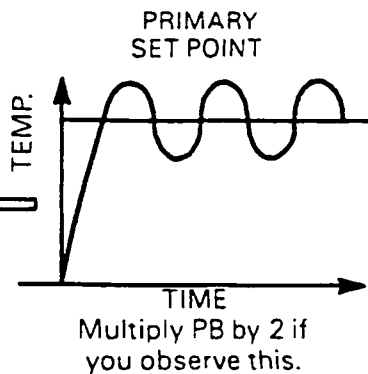
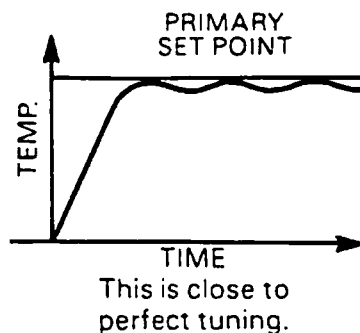
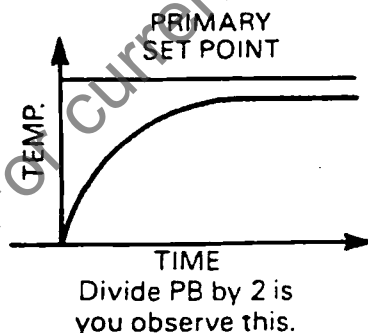
RATE 2 0 MIN

NOTE

On units with dual three mode outputs the primary and secondary tuning parameters are independently set and must be tuned separately. The procedure used in this section is for a HEATING primary output. A similar procedure may be used for a primary COOLING output or a secondary COOLING output.

A. TUNING OUTPUTS FOR HEATING CONTROL

1. Enable the OUTPUT(s) and start the process.
2. The process should be run at a setpoint that will allow the temperature to stabilize with heat input required.
3. With RATE and RESET turned OFF, the temperature will stabilize with a steady state deviation, or droop, between the setpoint and the actual temperature. Carefully note whether or not there are regular cycles or oscillations in this temperature by observing the measurement on the display. (An oscillation may be as long as 30 minutes).
The tuning procedure is easier to follow if you use a recorder to monitor the process temperature.



8

cont.



TUNING YOUR TEMPERATURE CONTROLLER (cont.)

4. If there are no regular oscillations in the temperature, divide the PB by 2 (see Figure 1). Allow the process to stabilize and check for temperature oscillations. If there are still no oscillations, divide the PB by 2 again. Repeat until cycles or oscillations are obtained. Proceed to Step 5.

If oscillations are observed immediately, multiply the PB by 2. Observe the resulting temperature for several minutes. If the oscillations continue, increase the PB by factors of 2 until the oscillations stop.

5. The PB is now very near its critical setting. Carefully increase or decrease the PB setting until cycles or oscillations just appear in the temperature recording. If no oscillations occur in the process temperature even at the minimum PB setting of 1%, skip Steps 6 through 11 below and proceed to paragraph B.
6. Read the steady-state deviation, or droop, between setpoint and actual temperature with the "critical" PB setting you have achieved. (Because the temperature is cycling abit, use the average temperature.)
7. Measure the oscillation time, in minutes, between neighboring peaks or valleys (see Figure 2). This is most easily accomplished with a chart recorder, but a measurement can be read at one minute intervals to obtain the timing.

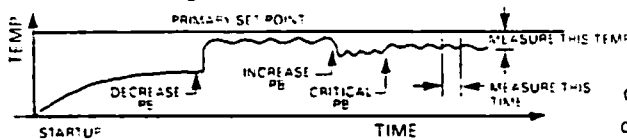


Figure 2. Oscillation Time

8. Now, increase the PB setting until the temperature deviation, or droop, increases 65%. The desired final temperature deviation can be calculated by multiplying the initial temperature deviation achieved with the CRITICAL PB setting by 1.65 (see Figure 3) or by use of the convenient Nomogram (see Figure 4). Try several trial-and-error settings of the PB control until the desired final temperature deviation is achieved.

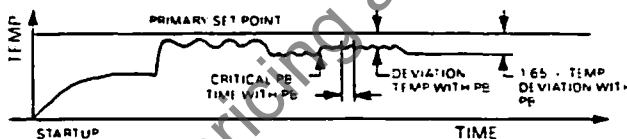


Figure 3. Calculating Final Temperature Deviation

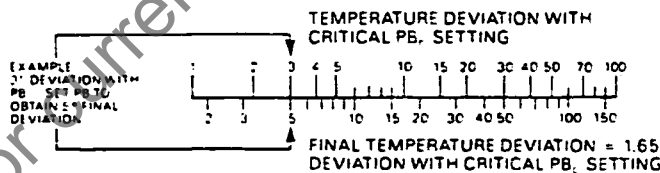


Figure 4. Nomogram I

9. You have now completed all the necessary measurements to obtain optimum performance from the Controller. Only two more adjustments are required -- RATE and RESET.
10. Using the oscillation time measured in Step 7, calculate the value for RESET in repeats per minutes as follows:

$$\text{RESET} = \frac{8 \times 1}{5 T_o}$$

Where T_o = Oscillation Time in Minutes.

OR Use Nomogram II (See Figure 5):

TEMPERATURE CYCLE TIME IN MINUTES

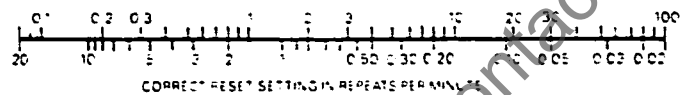


Figure 5. Nomogram II

Enter the value for RESET I.

11. Again using the oscillation time measured in Step 7, calculate the value for RATE in minutes as follows:

$$\text{RATE} = \frac{T_o}{10}$$

Where T_o = Oscillation Time

OR Use Nomogram III (See Figure 6)

TEMPERATURE CYCLE TIME IN MINUTES

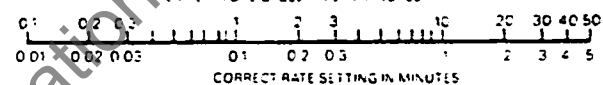


Figure 6. Nomogram III

Enter this value for Rate I.

12. If overshoot occurred, it can be eliminated by decreasing the RESET time. When changes are made in the RESET value, a corresponding change should also be made in the RATE adjustment so that the RATE value is equal to:

$$\text{RATE} = \frac{1}{6 \times \text{Reset Value}}$$

i.e., if reset = 2 R/M, the

RATE = 0.08 min.

13. Several setpoint changes and consequent RESET and RATE time adjustments may be required to obtain the proper balance between "RESPONSE TIME" to a system upset and "SETTLING TIME". In general, fast response is accompanied by larger overshoot and consequently shorter time for the process to "SETTLE OUT". Conversely, if the response is slower, the process tends to slide into the final value with the little or no overshoot. The requirements of the system dictate which action is desired.
14. When satisfactory tuning has been achieved, the cycle time should be increased to save contactor life (applies to units with time proportioning outputs only (TPRI)). Increase the cycle time as much as possible without causing oscillations in the measurement due to load cycling.

TUNING YOUR TEMPERATURE CONTROLLER (cont.)

B. TUNING PROCEDURE WHEN NO OSCILLATIONS ARE OBSERVED

1. Measure the steady-state deviation, or droop, between setpoint and actual temperature with minimum PB setting.
2. Increase the PB setting until the temperature deviation (droop) increases 65%. Nomogram 1 (see Figure 4) provides a convenient method of calculating the desired final temperature deviation.

3. Set the RESET 1 to a high value (10 R/M). Set the RATE 1 to a corresponding value (0.02 MIN). At this point, the measurement should stabilize at the setpoint temperature due to reset action.

Since we were not able to determine a critical oscillation time, the optimum settings of the reset and rate adjustments must be determined by trial and error. After the temperature has stabilized at setpoint, increase the setpoint temperature setting by 10 degrees. Observe the overshoot associated with the rise in actual temperature. Then return the setpoint settings to its original value and again observe the overshoot associated with the actual temperature change. Excessive overshoot implies that the RESET and/or RATE value are set too high. Overdamped response (no overshoot) implies that the RESET and/or RATE value are set too low. Refer to Figure 7. Where improved performance is required, change one tuning parameter at a time and observe its effect on performance when the setpoint is changed. Make incremental changes in the parameter until the performance is optimized.

When satisfactory tuning has been achieved, the cycle time should be increased to save contactor life (applies to units with time proportioning outputs only (TPRI)). Increase the cycle time as much as possible without causing oscillations in the measurement due to load cycling.

3. Draw a line from the point of maximum slope back to the ambient temperature axis to obtain the lumped system time delay T_d (see Figure 8). The time delay may also be obtained by the equation:

$$T_d = \text{time to max. slope} - (\text{PV at max. slope} - \text{Ambient}) / \text{max. slope}$$

4. Apply the following equations to yield the PID parameters:

$$P_r \text{ Band} = T_d \times \text{max. slope} \times 100 / \text{span} = \% \text{ of span}$$

$$\text{Reset} = 0.4 \times T_d \text{ resets/minute}$$

$$\text{Rate} = 0.4 \times T_d \text{ minutes}$$

5. Restart the system and bring the process to setpoint with the controller in the loop and observe response. If the response has too much overshoot, or is oscillating, then the PID parameters can be changed (slightly, one at a time, and observing process response) in the following directions:

When the proportional band, lower the Reset value, and increase the Rate value.

Example:

The chart recording in Figure 8 was obtained by applying full power to an oven. The chart scales are 10°F/cm. and 5 min/cm. The controller range is 100 - 600°F, or a span of 500°F.

$$\text{Maximum slope} = 18^\circ\text{F} / 5 \text{ minutes}$$

$$3.6^\circ\text{F/minutes}$$

$$\text{Time delay} = T_d = \text{approximately } 7 \text{ minutes}$$

$$\text{Proportional Band} = \frac{5 \text{ minutes} \times 3.6^\circ\text{F/minutes} \times 100 / 500^\circ\text{F}}{5\%}$$

$$\text{Reset} = 0.4 / 7 \text{ minutes} = 0.06 \text{ resets/minute}$$

$$\text{Rate} = 0.4 \times 7 \text{ minutes} = 2.8 \text{ minutes}$$



RESET OR RATE TOO HIGH RESET OR RATE TOO LOW.

Figure 7. Setting RESET and/or RATE

C. TUNING THE PRIMARY OUTPUT FOR COOLING CONTROL

The same procedure is used as defined for heating. The process should be run at a setpoint that requires cooling control before the temperature will stabilize.

D. SIMPLIFIED TUNING PROCEDURE FOR PID CONTROLLERS

The following procedure is a graphical technique of analyzing a process response curve to a step input. It is much easier with a strip chart recorder reading the process variable (PV).

1. Starting from a cold start (PV at ambient), apply full power to the process without the controller in the loop, i.e., open loop. Record this starting time.
2. After some delay (for heat to reach the sensor), the PV will start to rise. After more of a delay, the PV will reach a maximum rate of change (slope). Record the time that this maximum slope occurs, and the PV at which it occurs. Record the maximum slope in degrees per minute. Turn off system power.

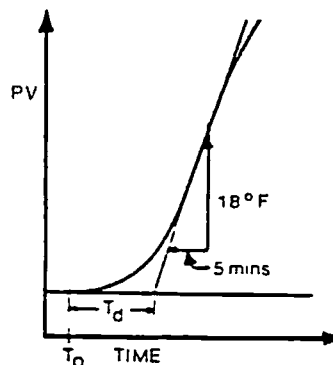


Figure 8. System Time Delay

PLANT ENGINEERS GUIDE TO TUNING YOUR TEMPERATURE CONTROLLER

THERE ARE MANY TUNING METHODS USED TO TUNE A DIGITAL PID CONTROLLER, HOWEVER MOST IF NOT ALL METHODS USE A SIMILAR TRIAL AND ERROR PROCEDURE. WE HAVE FOUND THAT THE FOLLOWING METHODS OF TUNING GENERALLY ACHIEVE THE MAXIMUM RESULTS.

I. Manual Tuning Method:

1. Cycle Time - Time Proportioning Outputs

A. Adjusting the cycle time affects instrument operation

- 1. Shorter Cycle Time**
 - a. More accurate control
 - b. Shorter life span of electro-mechanical components
- 2. Longer Cycle Time**
 - a. Less control accuracy
 - b. Longer life span of electro-mechanical components

2. Proportional Bandwidth

A. Proportional Bandwidth is the inverse of gain.

Increased Bandwidth = Decreased Gain

B. Increase the Proportional Bandwidth if:

1. The process overshoots excessively.
2. The process oscillates excessively.

C. Decrease the Proportional Bandwidth if:

1. The process responds slowly
2. The process fails to reach setpoint

3. Add Automatic Reset

A. Increase the Automatic Reset in steps of .2 repeats per minute until the process becomes unstable, then decrease until stability is restored.

B. Be sure to allow sufficient time for the process and the instrument to react.

4. Rate Adjustment

A. Rate can cause process instability. Typically add Rate as 1/10th of the automatic reset value.

B. Decrease rate if:

1. The process overshoots/undershoots
2. If the process oscillates excessively

5. Manual Reset

A. After making all other adjustments, use if an offset exists between the setpoint and the process variable.

B. If the process is:

1. Below setpoint use a positive Manual Reset value equal to the difference.
2. Above the setpoint use a negative Manual reset value equal to the difference.

II. SYSTEMATIC TUNING METHOD:

Proportional output control may require the adjustment (tuning) of the PID and other related parameters. This provides a means for the instrument's control algorithm to be adjusted to meet specific application requirements.

1. Changes in tuning parameters should be made one at a time.
2. After making any changes in tuning parameters, a disturbance should be introduced into the process so that the process reaction may be observed. This process reaction, or recovery, will tell whether the tuning parameters provide the desired control. It is usually easiest to make a step change in setpoint to introduce this disturbance.
3. The change in setpoint, or disturbance, referenced above should be large enough to cause an observable deviation of process from setpoint. However, this change should not be so large that it will cause the controller output to proceed to either extreme limit.
4. Controller tuning for optimal control is not hard and fast, BE PATIENT. The process will take a certain amount of time to react to the setpoint changes during tuning. The amount of time depends upon the specific process, however, a period of 8 to 12 minutes should be allowed between changes. The important thing to remember is to allow the process to react completely, do not rush through tuning of the controller. If the complete process reaction is not observed, optimum control may never be achieved.
5. Time Proportioning control output(s) require(s) the cycle time to be adjusted for the application. Short cycle times typically result in the most accurate process control, but will cause the quickest wear out of any mechanical components.
6. Leave all other tuning parameters (except for the alarm settings, if used) at the factory default settings. Obtain the best possible process reaction by adjusting the Proportional Bandwidth Parameter. The setting that achieves the best response for the process should be left in the controller programming.
7. If there are to be no setpoint or load changes in the process, the Proportional Band adjustment may be all that is necessary for proper control. If an offset still exists (the process does not settle out at setpoint with the best possible proportional band adjustment) Manual Reset may be added to eliminate this offset.
8. Auto Reset may be added to eliminate offsets and improve response to setpoint and load changes. Increase Auto Reset from 0 to 0.2 increments. Start with a small amount. Increase this increment if there is no apparent reaction. Remember to allow the process 8 to 12 minutes to react.
9. If necessary, Rate may be added. Rate is a dynamic tuning parameter. Rate may be required to compensate for process lags or to help inhibit reset windup when a large amount of Auto Reset (4 or 5 repeats per minute) is being used.
10. Controller tuning is not hard and fast. It may be necessary to adjust the tuning parameters over a period of time to obtain optimal control of the process.



III. ZIEGLER NICHOLS TUNING METHOD:

This procedure has been determined empirically to yield 1/4 amplitude decay tuning parameters that are determined by watching the system in a sustained oscillation and then using these values from this sustained oscillation to calculate ideal parameters.

Determining Ultimate Proportional Band and Ultimate Time Period

1. Set Manual Reset rSet to 0.0, set ArSt to 0.0 and set rAtE to 0.0
2. Enter the Control mode of operation. observe the process reaction.
3. Set the Proportional Band (PB) at 100 and upset the process and observe the response. One easy method for imposing the upset is to move the setpoint for a few seconds and then return it to its original value.
4. Achieve a response curve similar to the sustained oscillation (curve C), this is the Ultimate Proportional Band (UPB) and Ultimate Time Period (UTP).
 - A) If the response curve from step 3 does not damp out, as in Curve A from the drawing, the PB is too low. The PB should be increased and step 3 repeated.
 - B) If the response in step 3 damps out, the PB is too high. The PB should be decreased and step 3 repeated.

These values obtained for Ultimate Proportional Band (UPB) and Ultimate Time Period (UTP) are used to calculate ideal P, PI, PD, PID tuning parameters using the following Ziegler-Nichols equations:

Proportional only control (P) -

$$P (Pb) = 2 \times UPB \text{ (degrees or units)}$$

Proportional plus automatic reset (PI) -

$$P (Pb) = 2.2 \times UPB \text{ (degrees or units)}$$

$$I(ArSt) = 1.2 / UTP \text{ (repeats per minute)}$$

Proportional plus derivative (or rate) (PD) -

$$P (Pb) = 1.7 \times UPB \text{ (degrees or units)}$$

$$D (rAtE) = UTP / 8 \text{ (minutes)}$$

Proportional plus automatic reset plus derivative (PID)

$$P (Pb) = 1.7 \times UPB \text{ (degrees or units)}$$

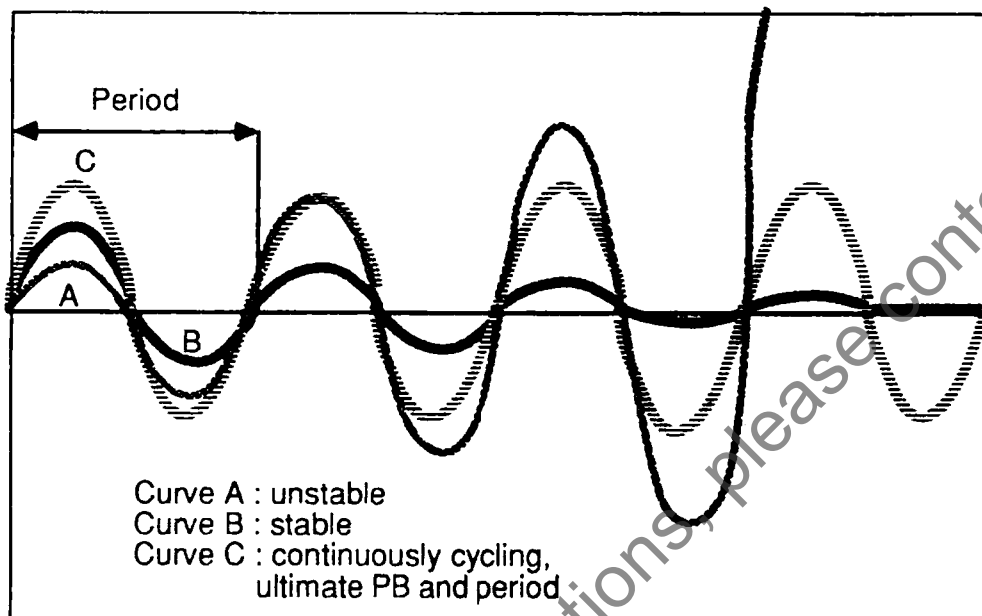
$$I(ArSt) = 2 / UTP \text{ (repeats per minute)}$$

$$D (rAtE) = UTP / 8 \text{ (minutes)}$$

METHOD CONTINUED ON NEXT PAGE

ZIEGLER NICHOLS METHOD (CONTINUED)

If an overdamped response is desired, multiply the proportional band by two.



IV. AUTO-TUNE METHOD:

The Auto Tune function will select the tuning parameters for a proportional control heating application assigned to Output 1. For the Auto Tune to properly calculate the Tune mode parameters, the Program and Tune mode parameters listed below must be correctly selected.

PROGRAM MODE PARAMETERS THAT AFFECT AUTO TUNING:

1. Output 1 out1 must be set for proportioning reverse (heating) output action.
2. Output 1 upper limit o1u1 can be used to limit the maximum heating output percentage. This will affect the process response curve used to calculate the tuning parameters. If overshooting or Er56 occurs, reducing the maximum output percentage may be necessary.
3. Output 1 lower limit o1l1 can be used to select a minimum output value. The instrument can be directed to output this minimum value if the Auto Tune aborts (fails) by use of the Auto Tune Abort Aao option.
4. Output 2 out2 can not be selected as time or current proportioning reverse. If out1 = 7, then out2 must be 7. Out2 may be used for direct cooling action.
5. Auto Tune can only be initiated when Setpoint Configuration SPC is 0, 1, 2, 3 and SP1 is active. In other words, when SP2 or remote setpoint is active, Auto Tune can not be initiated and the AUTO TUNE key is ignored. If SPC is 4, Auto Tune can not be initiated.
6. The Auto Tune will not function if the Setpoint Ramp Rate is selected other than 0.0.

8

cont.



AUTO-TUNE METHOD (CONTINUED)

7. The Auto Tune Deviation upper limit $AduL$ serves 2 functions: (which depend upon the Auto Tune Select option parameter selected.)
- A. If the Auto Tune Select option $Aso = 0$, then the process value (temperature) must be less than the setpoint value minus the $AduL$ value in order for the Auto Tune to function. Auto Tune will not function if the $PV > SP - AduL$. Example: if $PV = 200$, $SP = 230$ and $AduL = 50$, the Auto Tune will not function.
 - B. If $Aso = 1$ and the process value is greater than the setpoint value minus $AduL$, the heating output control output will be turned off when the AUTO TUNE key is pressed. When the process value drops below the setpoint value minus the $AduL$ value, the heating control output will be turned on so the Auto Tune function can begin.
- Note: In order for $AduL$ to have an effect on Auto Tune, the $AduL$ value must be greater than 20 degrees or 5% of the setpoint value, whichever is greater, initiating the Auto Tune function.
8. Auto Tune Deviation lower limit $AdLL$:
- A. If $AdLL = 0$ when the Auto Tune key is pressed the Auto Tune process response calculations will begin when the process value reaches the point 1/2 way between the setpoint value and the process value at the time when the AUTO TUNE key was pressed. Example: If $SP = 1200$ and $PV = 400$, then the response calculations will be considered when the $PV > 800$.
 - B. If $AdLL > 0$, when the Auto Tune key is pressed, the Auto Tune process response calculations will begin when the process value rises above the point that is the result of subtracting 1/2 of the $AdLL$ value from the setpoint value.
9. Auto Tune setpoint upper limit $ASuL$ sets a maximum setpoint limit over which the auto tune will not initiate. Typically selected at application maximum setpoint value plus 10%.
10. Auto Tune setpoint lower limit $ASLL$ sets a minimum setpoint limit under which the Auto Tune will not work. $ASLL$ must be lower than $ASuL$.
11. The Control Response Criteria CrC is used to select the desired type of control response for the process. Selecting 1.0 will provide good response to system upsets but may allow overshooting of the setpoint. Selecting a value of 2.0 may result in a slow response to system upsets but provide a stable process control. Selecting values between 1.0 and 2.0 will result in process control somewhere between the two extremes described. Actual process response will depend upon the application.
12. Control algorithm choice CAC allows selection of the type of control that best suits the process. For example, if the process acts a little unstable after Auto Tuning with PID selected, changing to the CAC PI and re-Auto Tuning may improve process stability.
13. Auto Tune abort option Aao is used to select what the controller will do if the Auto Tune function can not complete. Select the Aao parameter code that is best for your application.
14. Auto Tune time limit Atl selects a time limit that will cause the Auto Tune to abort if the process response calculations have not been completed. Start at 0, no time limit, if unfamiliar with the process reaction time needed.
15. The Auto Tune on demand Aso parameter, if selected as 0, will disable the Auto Tune function when the process variable is within the $AduL$ value below setpoint. If Aso is selected as 1, the Auto Tune will work when the process variable is within the $AduL$ value below setpoint as described in number 6 previously.

AUTO-TUNE METHOD (CONTINUED)

TUNE MODE:

1. Manual Reset rSt should be set to 0 when performing the initial Auto Tune. This parameter may be adjusted later, if desired.
2. Cycle Time for Output 1 Ctl may need to be adjusted when using time proportioning control. Typically the lowest cycle time settings result in the smoothest process control. However, low cycle time will reduce the life of mechanical relays. For motor modulation control, the cycle time setting must be the stroke time of the motor. Adjusting the cycle time affects the instrument operation. Shorter cycle time causes more accurate control and shorter life span of electro-mechanical components. Longer cycle time causes less control accuracy and longer life span of electro-mechanical components.
3. First Output Position deviation from setpoint FoP should be set to 0 when performing the initial Auto Tune. This may be adjusted later, if desired.
4. Second Output Position deviation from setpoint SoP, depending upon the application, may affect the process control response curve that is used by the Auto Tune calculations. Set SoP to 0 when performing Auto Tune.

AUTO TUNE OPERATION:

1. Select the Program and Tune mode parameters as necessary for the application as described in this section.
2. Use the UP or DOWN key to select the setpoint I value for the application.
3. Press the AUTO TUNE key.
4. The lower display will show Atun to indicate that the Auto Tune function is operating. When the Auto Tune function is complete, Atun will not be displayed.
5. If you wish to abort (stop) the Auto Tune, press the AUTO TUNE key once more. This will cause Er58 to be displayed and the controller will operate as selected by the Aao parameter.
6. For optimum control, some applications may require manual adjustments of the Tune mode parameters.
7. When the Auto Tune function has completed and the process control is satisfactory, you may wish to disable the Auto Tune function and the Tune mode to prevent inadvertent changes to the tuning parameters.

COMPLETE AND HANDY TROUBLE SHOOTING GUIDE FOR DIGITAL TEMPERATURE CONTROLLERS

Message	When does it occur?	What to do:
DEFAULTS	Whenever the memory is cleared and all parameters revert to factory default settings. This may be done by purposely clearing the memory or when the unit is powered up for the first time or if the software version is changed.	Entering the set up mode will clear the message. If due to something other than the user purposely clearing the memory, call CAPP for assistance, 800-356-8000.
LOST CAL	Indicates that the calibration data has been lost. Occurs when there is a total wipeout of the memory.	Should never happen. Must correct the situation and recalibrate. Call CAPP for assistance, 800-356-8000.
PV UNDER/ PV OVER	When the process variable value travels outside the boundaries of the instrument span. Does not apply to thermocouple or RTD inputs.	May not need to do anything. May want to check the transmitter accuracy and check to see if range of transmitter matches the range of the controller.
LOST PV	When the controller senses a lost process variable signal or the input signal travels well beyond the instrument span.	Check wiring and sensor / transmitter.
LOST RSP	When the remote setpoint is in use and the controller senses that the signal has been lost or has traveled well outside the range.	Check wiring and remote setpoint source.
COMM SHED	When the communications is lost for longer than the communications shed time.	Check communications wiring, etc. To clear message, must make on auto / manual change.
ROM ERROR	On power up a problem with the ROM is detected. This is a fatal error and requires a EPROM change. Controller locks up until fixed.	CONSULT CAPP, 800-356-8000.
OUT1 / CONF OUT2 / CONE	Upon power up, controller senses that the modules needed for control as determined by software configuration aren't present.	Must power down and install correct module combination or must reconfigure the controller to match the current module combination. Need to press ACK key before entering configuration.
LOST F/B	If the slidewire feedback is sensed to be lost.	Check the slidewire wiring.
LOST CJC	If the cold junction is sensed to be lost.	CONSULT CAPP 800-356-8000.

COMPLETE AND HANDY TROUBLE SHOOTING GUIDE **FOR DIGITAL TEMPERATURE CONTROLLERS (cont.)**

Symptom	Problem	Solution
Display will not light up	Defective power source.....	Check power source and wiring
	Improper wiring.....	Correct wiring
	Blown in-line fuse.....	Check wiring, replace fuse
	Unit not inserted in case properly.....	Remove unit from case and reinsert properly
Improper/lost PV reading		
• Voltage/current	Input jumper selection improperly set.....	Move jumper to proper location
	Input range improperly selected in software.....	Select proper range
	Reverse polarity.....	Check and correct sensor wiring
	If controller powered, improperly wired.....	Check and correct wiring
	Loop power module not installed.....	Install module
	Defective transmitter.....	Replace transmitter
• Thermocouple	Transmitter signal out of range.....	Select proper range in software
	Defective thermocouple.....	Replace thermocouple
	Input jumper selection improperly set.....	Select proper input
	Wrong TC type selected in software.....	Select proper thermocouple type in software
• RTD	Improper wiring.....	Wire properly
	Defective RTD.....	Replace RTD
	Input jumper selection improperly set.....	Move jumper connector to proper location
No control output	Improper wiring.....	Wire properly
	Output module not installed.....	Install proper output modules
	Output wiring and module location do not match.....	Check and correct wiring or module location
	If SSR, SSR Drive or Millamp output, jumper.....	Set jumper connector to proper location
	J1, J2, and J3 are not set properly.....	Set jumper connector to proper location
	Software configuration does not match hardware.....	Reconfigure software to match hardware
Cannot switch to auto control	PID values not set properly.....	Set PID values properly
	Input sensor signal is not connected or valid.....	See "PV LOST" message
Erratic display	Resetting section due to electrical noise on powerline.....	Filter power line
	PID values not set properly.....	Retune controller

COMPLETE ENGINEERS DICTIONARY ON PROCESS INSTRUMENTATION TERMS

adaptive control: Control in which automatic means are used to change the type or influence (or both) of control parameters in such a way as to improve the performance of the control system.

auto tune: A component function which continuously monitors the process and natural disturbances and makes adjustments in the tuning parameters to compensate or improve the performance of the control system.

alarm: A condition, generated by a controller, indicating that the process has exceeded or fallen below the set or limit point.

alarm, band: A type of alarm set up where a band is created around the control setpoint.

alarm, deviation: An alarm similar to a band alarm except it only creates a band on one side of the alarm setpoint.

alarm, low process variable: A type of alarm that is set up to occur when the process variable goes below the alarm setpoint.

alarm, high process variable: A type of alarm that is set up to occur when the process variable goes above the alarm setpoint.

alarm, manual: A type of alarm set up to occur when the controller is put into manual mode of operation.

alarm, power up: A type of alarm that determines alarm condition on power up of the controller.

alarm, rate-of-change: A type of alarm set up to occur when there is an excessive change in the process variable (PV) value.

baud rate: Any of the standard transmission rates for sending or receiving binary coded data.

bezel: The flat portion surrounding the face of the controller, which holds the keys and display.

bump: A sudden increase in the output power initiated by the controller in order to determine the system response during a self tune procedure.

binary coded decimal (BCD): A notation in which the individual decimal digits are represented by a group of binary bits. e.g., in the 8-4-2-1 coded decimal notation each decimal digit is represented by four binary bits.

calibration: The act of adjustment or verification of the controller unit by comparison of the unit's reading and standards of known accuracy and stability.

cascade control: Control in which the output of one controller is the setpoint for another controller.

closed loop: Control system that has a sensing device for process variable feedback.

cold junction: Point of connection between thermocouple metals and the electronic instrument.

configuration: Also called "set up", selection of hardware devices and software routines that function together.

cold junction compensation: Electronic means used to compensate for the effect of temperature at the cold junction.

contact: In hardware, a set of conductors that can be brought into contact by electromechanical action and thereby produce switching. In software, a symbolic set of points whose open or closed condition depends on the logic status assigned to them by internal or external conditions.

control action: The slope of the output of the instrument in reference to the input. e.g., direct output increases on rise of input. Typical cooling response or reverse output decreases on rise of input (typical heating response).

control action, derivative (rate) (D): The part of the control algorithm that reacts to rate of change of the process variable.

control action, integral (reset) (I): The part of the control algorithm that reacts to offset between setpoint and process variable.

control action, proportional (P): Control action in which there is a continuous linear relation between the output and the input.

control action, proportional plus derivative (PD): A control algorithm that provides proportional control with the addition of derivative action to compensate for rapid changes in process variable.

control action, proportional plus integral (PI): A control algorithm that provides proportional control with the addition of integral action to compensate for offsets between setpoint and process variable.

control action, proportional plus integral plus derivative (PID): A control algorithm that provides proportional control with both integral and derivative action.

control, adaptive: (see adaptive control)

control algorithm: A mathematical representation of the control action to be performed.

control, cascade: (see cascade control)

control output: The end product which is at some desired value that is the result of having been processed or manipulated.

control mode, automatic: A user selected method of operation where the controller determines the control output.

control mode, manual: A user selected method of operation where the operator determines the control output.

control parameters: User defined values that specify how the process is to be controlled.

controlled variable: A process variable which is to be controlled at some desired value by means of manipulating another process variable.

CRC (cyclic redundancy check): An error checking technique in which a checking number is generated by taking the remainder after dividing all the bits in a block (in serial form) by a predetermined binary number.

CSA: Acronym for Canadian Standards Association.

cycle time: The time necessary to complete a full ON-through-OFF period in a time proportioning control system.

dampin: The decrease in amplitude of an oscillation due to the dissipation of energy.

damped, 1/4 amplitude: The loss of one-quarter of the amount of amplitude with every oscillation.

dead band: A temperature band between heating and cooling functions; the range through which an input can be varied without initiating observable change in output.

dead time: The interval of time between initiation of an input change or stimulus and the start of the resulting observable response.

default settings: Parameters selections that have been made at the factory.

derivative: Anticipatory action that senses the rate of change of temperature, and compensates to minimize overshoot and undershoot. Also "rate".

derivative action: (See control action, derivative)

deviation: The difference between the value of the controlled variable and the value at which it is being controlled.

digital input: A term used to indicate the status of a dry contact; also called "gate".

DIN: Deutsche Industrial Norms, a German agency that sets standard for engineering units and dimensions.

display, 1st: The top, largest display of controller face that is used to display the process variable value.

display, 2nd: The middle display of the controller face used to indicate: Operation Mode—setpoint, deviation or output.; Tuning and Set Up Mode—parameter or parameter menu.

display, 3rd: The bottom display of the controller face that is used to indicate:

Operation Mode—alarm or error message; Tuning of Set up Mode—the value or choice of the parameter.

disturbance: An undesired change that takes place in a process that tends to affect adversely the value of a controlled variable.

duty cycle: Percentage of "load ON time" relative to total cycle time.

earth ground: A terminal used to ensure, by means of a special connection, the grounding (earthing) of part of the controller.

engineering unit: Terms of data measurement such as degrees Celsius, pounds, grams, etc.

feedback: Process signal used in control as a measure of response to control action; the part of a closed-loop system which automatically brings back information about the condition under control.

FM: Factory Mutual Research Corporation; an organization which sets safety standards.

gain: The ratio of the change in output to the change in input which caused it.

heat/cool control: Control method where the temperature of the end product is maintained by controlling two final elements using two outputs.

hysteresis: In ON/OFF control, the temperature change necessary to change the output from full ON to full OFF.

hunting: Oscillation or fluctuation of process temperature between setpoint and process variable.

icons: Indicators on the face of the controller.

input: Process variable information being supplied to the instrument.

integral: Control action that automatically eliminates offset, or "drop", between setpoint and actual process temperature. Also "reset."

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cont.



isolation: Electrical separation of sensor from high voltage circuitry. Allows for application of grounded or ungrounded sensing element.

offset: Adjustment to actual input temperature and to the temperature values the controller uses for display and control.

JIS: Japanese Industrial Standards. Also Japanese Industrial Standards Committee (JISC). Establishes standards on equipment and components.

jumper: A wire that connects or bypasses a portion of a circuit on the printed circuit board.

jumper connectors: The connecting device that straddles a jumper to connect or bypass a portion of a circuit on a printed circuit board.

linearization: A function used to automatically linearize a non-linear signal, either from thermocouple or RTD temperature sensors, through the use of look up tables. The relationship that exists between two variables when the ratio of the value of one variable to the corresponding value of the other is constant over an entire range of possibilities.

linearization, custom: User-definable linearization.

linearization, square root: A function used to linearize a non-linear signal corresponding to the flow being measured by flow transmitters.

load line out: A start up output value which is to bring initial output closer to actual steady state output.

loop power: An internal 24-volt current limited power supply used to power 2 or 4 wire transmitter on the input of the controller.

load: The demand for input to a process.

low pass input filter: A method to block fast acting signals (typically noise), while allowing slow acting signals (actual process variable) to pass.

manipulated variable: A quantity or condition which is varied so as to change the value of the controlled variable. (see also control output)

mechanical relay: (see relay)

menu: (see menu block)

menu block: Groups of parameters arranged in the software.

microcontroller: A large scale integrated circuit that has all the function of a computer, including memory and input/output systems.

NEMA 4X: A National Electrical Manufacturers Association standard for specifying a product's resistance to water and corrosion.

normally open: A switched output (i.e., relay, etc.) whose unpowered state has no connection.

normally closed: A switched output (i.e., relay) whose unpowered state provides connection.

noise: An unwanted component of a signal or variable.

noise band: A measurement of the amount of random process "noise" affecting the measurement of the process variable.

offset: The difference in temperature between the setpoint and the actual process temperature.

ON/OFF control: Control of temperature about a setpoint by turning the output full ON below setpoint and full OFF above setpoint in the heat mode.

open loop: Control system with no sensory feedback.

optimization: The act of controlling a process at its maximum possible level of performance, usually as expressed in economic terms.

output modules: Plug in devices that provide power handling to enable process control. These modules are either binary (on/off) such as a relay, or analog (continuously variable) for current loop control.

output: Action in response to difference between setpoint and process variable.

overshoot: Condition where temperature exceeds setpoint due to initial power up or process changes.

P control: Proportioning control.

parameter(s): A user-defined variable that specifies how a particular function in the controller will operate.

PD control: Proportioning control with rate action.

PI control: Proportioning control with auto-reset.

PID control: Proportioning control with auto-reset and rate.

pretune algorithm: A method by which the controller initiates an output value change, monitors the manner of the corresponding process variable change, and then determines the appropriate PID control parameters.

position proportioning: A type of control output that utilizes two relays to control an electric motorized actuator.

primary loop: The outer loop in a cascade system.

process variable: In the treatment of material, any characteristic or measurable attribute whose value changes with changes in prevailing conditions. Common variables are level, pressure and temperature.

proportional band: The change in input required to produce a full range change in output due to proportional control action.

ramping: (see setpoint, ramping)

rate: An action that senses the rate of change of temperature and compensates to minimize overshoot. Also "derivative."

rate action: The derivative function of a controller.

rate time: The time interval over which the system temperature is sampled for the derivative function.

regulate: The act of maintaining a controlled variable at or near its setpoint in the face of load disturbances.

relay (mechanical): An electromechanical device that completes or interrupts a circuit by physically moving electrical contacts into contact with each other.

relay (solid state): A solid state switching device which completes or interrupts a circuit electrically with no moving parts.

reset: Control action that automatically eliminates offset, or "droop", between setpoint and actual process temperature. Also "integral"

reset term: (see reset)

RTD: Resistance Temperature Detector. Resistive sensing device displaying resistance versus temperature characteristics. Displays positive temperature coefficient.

relative gain: An open-loop gain determined with all other manipulated variables constant, divided by the same gain determined with all other controlled variables constant.

retransmission: a feature which allows the transmission of a milliamp signal corresponding to the process variable, target setpoint or actual setpoint to another device, typically a chart recorder.

sample interval: The time interval between measurements or observations of a variable.

secondary loop: The inner loop of a cascade system.

self tune: A method of automatically calculating and inserting optimum PID parameters by testing system response and timing.

serial communications: The sending or receiving of binary coded data to a supervisory device such as a personal computer or programmable logic controller.

setpoint: An input variable which sets the desired value of a controlled variable.

setpoint, actual: The desired value of a controlled variable that the controller is currently acting upon.

setpoint, deviation from: The number of units difference between the current process variable and the setpoint.

setpoint, ramping: A setpoint which is determined by the ramp function of the controller where over time the controller variable reaches a desired value.

setpoint, target: The end point of the ramp function.

set up: Also called configuration, selection of hardware devices and software routines that function together.

sheds: In serial communications, when the signal is lost.

slidewire position proportioning: An output algorithm that utilizes a slidewire feedback signal to determine the actual position of the actuator being controlled.

solid state relay: (see relay, solid state)

SSR drive: A.D.C. on/off signal output for controlling a solid state relay.

staged outputs: The set up of two analog outputs, where one analog output varies its signal over a portion of the PID output range, and the second analog output then varies its signal over the remainder of the PID output range.

static discharge: Undesirable current resulting from the discharge of electrostatic energy.

station address: The unique identifier assigned to a device for communications.

thermocouple: Temperature sensing device that is constructed of two dissimilar metals wherein a measurable, predictable voltage is generated corresponding to temperature.

thermocouple break protection: Fail-safe operation that assures desired output upon an open thermocouple condition.

thermocouple upscale burnout (▲): Jumper position that determines whether, when a thermocouple fails, its output is replaced by a millivoltage which will match the thermocouple's maximum value. The jumper connector should be placed in the TC ▲ position.

thermocouple downscale burnout (▼): Jumper position that determines whether, when a thermocouple fails, its output is replaced by a millivoltage which will match the thermocouple's minimum value. The jumper connector should be placed in the TC ▼ position.

three mode control: (See control action PID)

time proportioning control: A control algorithm that expresses output power (0-100%) as a function of percent ON versus percent OFF within a preset cycle time.

time proportioning output: A controller output assigned by software to facilitate time proportional control (typically a relay, SSR, or SSR Drive output).

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cont.



tracking: A function that defines whether the local setpoint will track the remote setpoint. When the controller is transferred to a local setpoint, that local setpoint value will match the remote process value when the transfer occurs.

transmitter (2-wire): A device used to transmit data via a two wire current loop. A two-wire transmitter is loop powered.

transmitter (4-wire): A device used to transmit data via a current loop or a DC voltage. A 4-wire transmitter uses 2 wires for data and 2 wires for power.

triac: Solid state switching device used to switch alternating current signals on and off. Triac circuits are sometimes referred to as solid state relays (SSR).

trip point: Value which determines when that set of PID values becomes active.

velocity position proportioning: This is a control technique where valve position is determined by calculating the amount of time it takes to open/close a valve by moving the valve for a portion of that time.

windup: Saturation of the integral mode of a controller developing during times when control cannot be achieved, which causes the controlled variable to overshoot its setpoint when the obstacle to control is removed.

wild stream: In mixing application that require materials to be mixed to a desired ratio, this is the one part of the material that is uncontrolled.

**SEE OUR COMPLETE 31 PAGE GLOSSARY
OF TERMS BEGINNING ON PAGE 295**

STANDARDS & APPROVAL AGENCY SYMBOLS



FACTORY MUTUAL



UNDERWRITERS LABORATORIES



UNDERWRITERS LABORATORIES (CANADA)



**UNDERWRITERS LABS., RECOGNIZED
COMPONENT MARK (CANADA)**



DEUTSCHLAND ENGINEERING NORMALIZATION



AMERICAN GAS ASSOCIATION (AGA)



CANADIAN STANDARDS ASSOCIATION

NATIONAL ELECTRICAL CODE (NEC)



**AMERICAN SOCIETY OF MECHANICAL
ENGINEERS (ASME)**



**AMERICAN SOCIETY OF HEATING,
REFRIGERATING, and AIR-CONDITIONING
ENGINEERS (ASHRAE)**

NEMA enclosure descriptions:

Electrical equipment (1000 volts maximum)

Non-classified locations

Type 1 Enclosures

Type 1 enclosures are 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

Type 2 enclosures are 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

Type 3 enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, and sleet; and to be undamaged by the formation of ice on the enclosure. 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

Type 3R enclosures are intended for outdoor use primarily to provide a degree of protection against falling rain; and to be undamaged by the formation of ice on the enclosure. 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

Type 3S enclosures are 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

Type 4 enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water; and to be undamaged by the formation of ice on the enclosure. They shall meet hosedown, 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

Type 4X enclosures are 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; and to be undamaged by the formation of ice on the enclosure. They shall meet the hosedown, 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

Type 5 enclosures are intended for indoor 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

Type 6 enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against the entry of water during temporary submersion at a limited depth, and to be undamaged by the formation of ice on the enclosure. 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

Type 6P enclosures are 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; and to be undamaged by the formation of ice on the enclosure. 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

Type 11 enclosures are intended for indoor use primarily to provide a degree of protection against the corrosive effects of liquids and gases. In addition, they protect the enclosed equipment against the corrosive effects of fumes and gases by providing for immersion of the equipment in oil. 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.

The following descriptions are excerpts from NEMA's "Standards Publication/No. 250 1985."

Type 12 Enclosures

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

Type 12K Enclosures

Type 12K enclosures with knockouts are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping noncorrosive liquids other than at knockouts. They shall meet drip, dust, and rust-resistance design tests. Knockouts are provided only in the top or bottom walls or both. After installation of the enclosure, 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

Type 13 enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and noncorrosive 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

Type 7 enclosures are 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

Type 8 enclosures are 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

Type 9 enclosures are intended for indoor use in locations classified as Class II, Groups E, or G, as defined in the *National Electrical Code*. (Group F was reinstated in the 1987 NEC).

Type 10 Enclosures (MSHA)

Type 10 enclosures shall be capable of meeting the requirements of the Mine Safety and Health Administration, 30 C.F.R., Part 18

Hazardous locations:

Interpretation of NEC Definitions of Hazardous Locations:

Class I, II and III, Groups A, B, C, D, E, F and G, Div. 1 and 2

CLASSES I, II and III: NEC 500-5, 500-6 and 500-7.

Class I Locations (Gases)

An area where flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Class II Locations (Dust)

An area where presence of combustible dust presents a fire or explosion hazard.

Class III (Fibers)

An area made hazardous because of the presence of easily ignitable fibers of flyings, but in which such fibers of flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.

GROUPS A, B, C, D, (Class I); E, F and G (Class II): NEDC 500-3

Groups A, B, C and D (Class I)

Combustible and flammable gases and vapors are divided into four groups, the classification involving determinations of maximum explosion pressures, maximum safe clearance between parts of a clamped joint in an enclosure and the minimum ignition temperature of the atmospheric mixture.

There is no consistent relationship between the Group A, B, C or D classification and flash point/ignition temperature/explosive limits. Instead, the Groups are classified by chemical families. Certain chemicals create higher explosive pressures and heat when ignited. Generally speaking, Group A gas creates the most pressure during an explosion—and therefore is the most difficult to control. Group B is next highest in pressure; then Group C; and last Group D. This explains why a Group A or B listing is more difficult to obtain than a Group C or D listing for electrical equipment.

Groups E, F and G (Class II)

Groups E, F and G (Class II)

Combustible dusts are divided into these three Groups, the classification involving the tightness of the joints of assembly and shaft openings, the blanketing effect of layers of dust on the equipment that may cause overheating, the electrical conductivity of the dust and the ignition temperature of the dust.

Group E Atmospheres contain metal dust, including aluminum, magnesium, and their commercial alloys, and other metals of similar hazardous characteristics having resistivity of less than 10^5 ohm-cm.

Group F Atmospheres contain combustible carbonaceous dusts, or other atmospheres containing these dusts sensitized by other hazardous materials, and having resistivity greater than 10^2 thru 10^5 ohm-cm.

Group G Atmospheres contain combustible dusts having resistivity of 105 ohm-cm. or greater. Equipment to be used in these atmospheres must not only be approved for Class I, II or III, but also for the specific group (Class I and II).

DIVISIONS 1 and 2 (Class I, II, and III).

Division 1

NEC 500-5 (a), 500-6 (a) and 500-7 (a).

Class I, Division 1 is an area where the hazard exists under *normal* operating conditions. These situations include transferring flammable or combustible liquids from one container to another, open vats, paint spray booths or any location where ignitable mixtures are used. This also includes locations where the hazard is caused by *frequent* maintenance or repair work or *frequent* equipment failure.

Class II, Division 1 is an area where combustible dust is normally in the air in sufficient quantities to produce ignitable mixtures or where mechanical failure or abnormal operation of equipment might produce ignitable mixtures. These locations also include (1) operations where this hazard exists because of *frequent* mechanical failure or machinery or equipment and (2) where electrically conductive combustible dusts (all Group E and some Group F) are present in hazardous quantities.

Class III, Division 1 is an area where easily ignitable fibers or materials producing combustible flyings are handled, manufactured or used.

Division 2

NEC 500-5 (b), 500-6 (b), 500-7 (b).

Class I, Division 2 is an area where ignitable gases or vapors are handled, processed or used, but which are normally in closed containers or closed systems from which they can only escape through accidental rupture or breakdown of such containers or systems.

Class II, Division 2 is an area where combustible dust is not normally in the air in sufficient quantities to produce ignitable mixtures or interfere with the operation of electrical equipment, or where dust is present as a result of *infrequent* malfunctioning of processing or handling equipment. These locations also include situations where combustible dust accumulations may interfere with the safe dissipation of heat from electrical equipment. NOTE: No electrically conductive dusts, as defined by NEC 502-1 (last sentence), are included in Class II, Div. 2 atmospheres.

Class III, Division 2 is an area where easily ignitable fibers are stored or handled.

The Role of Partitions in Div. 1 and Div. 2 Locations

In most indoor areas with adequate partitions, Div. 1 and Div. 2 are self-contained areas. With partitions, a Div. 1 area may, for example, exist adjacent to a non-hazardous area.

However, in outdoor areas or large indoor areas where there are few or no partitions, Class I, Div. 1 and Class I, Div. 2 areas characteristically exist adjacent to each other the Div. 1 location being near the point of vapor release and Div. 2 being at a given distance from the point of release from the flammable liquid. In these areas where the spread of flammable vapors and gases is not contained by adequate partitions, Class I, Div. 2 can be thought of as "transition zone" between Class I, Div. 1 and the non-hazardous area. Class I, Div. 1 is a hazardous area where flammable gases or vapors are released from the liquid. Further away from the point of release, the gases or vapors are not normally of sufficient concentration to produce an ignitable mixture and so such an area is designated Class I, Div. 2. This Class I, Div. 2 area is sometimes referred to as the "transition zone." Outside this Div. 2 "transition zone" is the non-hazardous area.

NOTE: Electrical Equipment Approved for Div. 1 is Also Suitable for Div. 2 per NEC 500-3 (a).

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**(NEC) NATIONAL ELECTRICAL CODE CLASSIFICATIONS
FOR EXPLOSIVE ATMOSPHERES:**

CLASS I:

- Group A: Acetylene
Group B: Butadiene, hydrogen, ethylene oxide, propylene oxide, and any gases that are manufactured which contain more than 30% hydrogen by volume.
Group C: Acetaldehyde, ethylene, diethyl ether, & cyclopropane.
Group D: Acetone, ammonia, acrylonitrile, butane, benzene, ethanol, ethylene dichloride, gasoline, hexane, methane, methanol, naphtha, natural gas, propane, propylene, styrene, toluene, vinyl chloride, xylene.

CLASS II:

- Group E: Aluminum & magnesium.
Group F: Carbon black, coal dust, and coke.
Group G: Flour, starch & grain dust.

CLASS III:

Flammable and ignitable fibers such as rayon, oakum, cotton sisal, and other similar materials of that liking.

NOTE: For the complete listing of NEC Codes, see the NFPA (Nat'l Fire Protection Association) publication No. 497M; OR write CAPP/USA, c/o: Quality Control/Safety, P.O. Box 127, Clifton Heights, PA 19018.

CAPP/USA GLOSSARY OF TERMS

A/D	See "ADC"
Absolute Pressure	The Sum Of Both Atmospheric Pressure And Gauge Pressure(Psig); Example: If A Pneumatic Gauge Indicates 8 Psig, The Absolute Pressure Will 22.7 Psia (8+14.7).
Absolute Zero	Absolute Zero Is Also Defined As "0-Kelvin", Which Is The Temperature At Which Thermal Energy Is At Its Minimum.
AC	Stands For "Alternating Current" Which Is The Most Common Type Used Because It Constantly Reverses Its Direction At Recurring Intervals.
ACCA	Stands For Air Conditioning Contractors Of America
Accuracy	The Percentage (%) Of Deviation Between The Actual Position And The Theoretical Position Of Each Bit Edge.
Action	The Direction Of Magnitude Change Of The Output Of A Controller With Respect To The Change In The Variable Being Sensed; Example: Direct Acting....Variable Increases/Output Increases; Reverse Acting.....Variable Increases/Output Decreases.
Actual Setpoint	See "Setpoint, Actual"
Actuator	A Control Device Which Is Used To Regulate The Flow Of Air Of Dampers: And/Or Used To Regulate The Flow Of Steam, Air, Water, And Other Types Of Mediums Through Valves. Actuators Are Also Often Referred To As Motors Or Operators.
Adaptive Control	When Automatic Means Are Used To Change The Type Or Influence Of Control Parameters In Such A Way As To Improve The Performance Of The Control System
ADC	Stands For "Analog-To-Digital Converter:."
AGA	Stands For American Gas Association
AHU	Refer To "Air Handling Unit"
Air Handling Unit	A Mechanical System Consisting Of A Supply-Air Fan(S), Heating Or Cooling Coils, Filters, And Outdoor Air & Return Dampers. It May Deliver Air To A Single Space, To Multiple Zones. Or To Multiple Constant-Volume Or Variable-Volume Air Terminal Units.
Alarm Band	An Alarm Scenario Where A Band Is Created Around The Control Setpoint

cont.

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Alarm Deviation	Similar To Alarm Band Except It Only Creates A Band On One Side Of The Alarm Setpoint
Alarm, High Process Variable	An Alarm That Signals When The Process Variable Goes Above The Alarm Setpoint
Alarm, Low Process Variable	An Alarm That Signals When The Process Variable Goes Below The Alarm Setpoint
Alarm, Manual	An Alarm That Is Set-Up To Occur When The Temperature Controller Is Placed Into A Manual Mode Of Operation
Alarm, Power-Up	A Type Of Alarm That Determines An Alarm Condition On Power-Up Of The Controller
Alarm, Rate-Of-Change	An Alarm That Will Signal When There Is An Excessive Change In The Process Variable Value (PV)
Algorithm	See "Control Algorithm"
Alternating Current	See "AC"
ALU	Stands For "Arithmetic Logic Unit".
Alumel	An Alloy Which Is Made Up Of Aluminum-Nickel And Is Used In Type "K" Thermocouples.
Ambient	Also Referred To As "Ambient Temperature" Which Is The Temperature Of The Surrounding Air That Comes In Contact With Thermostats, Humidistats, Etc.
Ambient Conditions	See "Ambient"
Ambient Temperature	See "Ambient"
American Wire Gage	See "AWG"
Ammeter	An Indicator/Meter Which Is Used To Measure Current.
Amp	See "Ampere"
Ampere	Also Referred To As An "Amp", Which Is Used To Define The Flow Of Electrical Current In A Circuit
Analog	A Proportional Type Of Signal Whose Level Varies Continuously And Smoothly In Frequency Or Amplitude.
Analog Output	A Circuit Whose Output Is An Exact Reproduction Of Its Input.

Anemometer	Measures The Speed Or Force Of An Air Stream
ANSI	Stands For "American National Standards Institute"
ARI	Stands For The Air Conditioning & Refrigeration Institute
ASCII	The American Standard Code Which Uses Either A Seven Or Eight Bit Code Which Is Used To Represent Alpha-Numeric Characters.
ASME	Stands For " American Society Of Mechanical Engineers"
ASTM	Stands For "American Society For Testing And Materials"
ATC	Stands For "Automatic Temperature Compensation"
Auto Tune	The Function Of Some Process Temperature Controllers That Continuously Monitors The Process And Natural Disturbances And Makes Adjustments In The Tuning Parameters To Compensate Or Improve Performance
Auxiliary Device	A Control Module That Is Usually Placed Between The Actuator & Controller That Modifies The Controller Signal In Some Manner Before The Signal Reaches The Actuator; For Example: Relays & Switches.
Averaging Element	A Sensing Device That Extends Across The Whole Duct And Senses The Average Temperature.
AWG	Stands For "American Wire Gage", And Is Most Commonly Used When Specifying The Gage Of A Thermocouple.
Axial Fan	A Multiple Impeller- Blade Fan That Moves Air Along The Length Of Its Axle. Axial Fans Are Usually Flanged, Heavy-Gauged Cylindrical Enclosures Which Mount Directly Into Round Ductwork.
B & S Gauge	The Same As AWG, American Wire Gauge.
Bakelite	See "Phenolic"
Bandwidth	An "Area" Around The Setpoint Of A Controller At Which Proportional Control Occurs.

Baud Rate	Standard Transmission Rates For Sending Or Receiving Data, And The Data Transmission Speed Is Equal To The Number Of Bits Per Second. For Example: 400 Baud = 400 Bits Per Second
BCD	See "Binary Coded Decimal"
BHP	Brake Horsepower
Bimetal	Two Metals That When Either Heated Or Cooled Warp And Can Cause Other Devices Or Valves To Open Or Close
Binary Coded Decimal	Also Referred To In-Short As "BCD", Which Is A Notation In Which The Individual Decimal Digits Are Represented By A Group Of Binary Bits. For Example: 8-4-2-1 Coded Decimal Notation Each Decimal Digit Is Represented By Four Binary Bits
BIOS	Stands For "Basic Input/Output Signal"
Bipolarity	Occurs When A Meter Displays Both Positive And Negative Readings
Bit	Stands For "Binary Digit", Almost Always Associated With Computers Or Computer-Based Programs. Example: 8 Bits = 1 Byte.
Boiler	A Closed Vessel Where Gas Or Oil Is Burned In Order To Generate Steam Or Hot Water.
BPS	Stands For "Bits Per Second"
Brake Horsepower	The Total Horsepower Applied To The Drive Shaft Of Any Piece Of Rotating Equipment; The Actual Power Required To Drive A Fan Or A Pump.
Branch Lines	The Tubing In A Pneumatic Control System Which Carries The Output Signal From The Controller To The Auxiliary Devices Or Actuators/Operators.
Bridge	A Control Device That Receives The Resistance Change From The Sensor And Produces A Low-Voltage Change That Is Amplified To A Higher Level Which Becomes The Controller Output. The "Bridge" Is Usually Part Of The Controller, Or Can Be A Separate Module.
BTU	Stands For "British Thermal Unit", Which Is The Energy Or Heat That Is Required To Raise The Temperature Of One Pound Of Water 1 Degree (F) Under Standard Pressure.

Bump	A Sudden Increase In The Output Power Initiated By A Temperature Controller In Order To Determine The System Response During A Self-Tuning Procedure
Butterfly Valve	A Valve Which Normally Serves As A Fluid-Flow Regulating Device. Also, Normally Has An Internal Rotatable Disc.
Bypass Control Damper	A Damper Which Is Mounted Inside Of A Duct That Provides An Alternate Path For Air To Flow.
C/D	See "Controlled Device"
Calibration	Adjusting, Verifying, Or Tuning A Device In An Effort To Reinstall The Devices Accuracy And Stability
Calibration Point	The Output Voltage Of A Controller When The Setpoint And Control Points Are Equal.
Canadian Standards Association	See "CSA"
CAPP/USA	Your National Supplier For All Name Brands Of Process Instrumentation, Combustion Flame-Safeguard, And Heating, Ventilating, & Air Conditioning (HVAC) Parts, Controls, And Devices (800) 356-8000
Cascade Control	When The Output Of One Device Is The Setpoint For Another Device
Cavitation	Occurs In Flowing Liquid When The Pressure Falls Below The Vapor Pressure Of The Liquid Causing The Liquid To Vaporize And Bubble. The Bubbles Are Carried Through The Pump Or Valve Inlet To With Great Force.
CCW	Stands For Counter Clockwise
Celsius	Stands For "Centigrade" And Is Measured By 0 Degrees At The Icier Point And 100 Degrees At The Boiling Point Of Water.
Cfm	Stands For "Cubic Feet Per Minute". The Rate Of Air-Volume Delivery Which Is A Standard Measure For Hvac Ducted Systems.
Close-Off	The Maximum Amount Of Pressure Drop That A Valve Can Be Subjected To When It's Fully Closed.
Closed Loop	A Control System That Has A Sending Device For Process Variable Feedback
CMR	Stands For "Common Mode Rejection".



CMV	Stands For "Common Mode Voltage"
Cold Deck	The Part Of The Duct That Contains The Chilled Water Coil Or The DX Coil.
Cold Junction	The Point Of Connection Between The Thermocouple's Metals And An Electronic Device/Instrument
Cold Junction Compensation	An Electronic Means Used To Compensate For The Effect Of Temperature At The Cold Junction
Comfortability Zone	Also Referred To As The "Comfort Zone". Which Is The Range Of Temperatures & Humidities Which Make The Majority Of People Feel Comfortable. This Is Usually Between 67f And 79f. And 20% To 60% Relative Humidity
Common Mode	See "Control Mode"
Conduction	Heat Energy Which Is Transmitted By Direct Contact.
Conductor Wire	Wire That Is Designed To Carry Electrical Current But Is Not Insulated
Configuration	Can Also Be Referred To As Set-Up. Which Is The Selection Of Hardware Devices And Software Routines That Function Together
Constant Volume Control	A System That Changes The Supply Air Temperature In Response To Space Load, While Maintaining Constant Air Flow.
Constantan	The Alloy Which Is Made-Up Of Copper & Nickel And Is Primarily Used In Type J, E, & T Thermocouples
Control Action	The Slope Of The Output Of An Instrument Or Device In Reference To The Input. For Example: Direct Output Increases On Rise Of Input. Typical Cooling Response Or Reverse Output Decreases On Rise Of Input (Typical Heating Response)
Control Action, Adaptive	See "Adaptive Control"
Control Action, Derivative (Rate)	Part Of The Controls Algorithm That Reacts To The Rate Of Change Of The Process Variable
Control Action, Integral (Reset)	Part Of The Controls Algorithm That Reacts To Offset Between Setpoint & Process Variable
Control Action, Pid	Pid Is The Control Action Of Proportional + Integral + Derivative Which Is The Control Algorithm That Provides Proportional Control With Both Integral & Derivative Actions

Control Action, Proportional (P)	When There Is A Continuous Linear Relation Between The Output And The Input
Control Action, Proportional + Derivative	A Control Algorithm That Provides Proportional Control With The Addition Of Derivative Action In Order To Compensate For Offsets Between Setpoint & Process Variable
Control Action, Proportional + Integral	A Control Algorithm That Provides Proportional Control With The Addition Of Integral Action In Order To Compensate For Offsets Between Setpoint & Process Variable
Control Algorithm	A Mathematical Representation Of The Control Action To Be Performed
Control Mode	The Control Mode, Output, Or Action Used By A Process Temperature Controller Such As PID, On/Off, Time-Proportioning, Etc.
Control Mode, Automatic	A Method Of Operation Which The User Selects, Where The Controller Determines The Control Output
Control Mode, Manual	A Method Of Operation Which The User Selects, Where The Operator Determines The Controller Output
Control Output	The End Product Which Is At Some Desired Value That Is The Result Of Having Been Processed Or Manipulated
Control Point	The Value Of The Controlled Variable In Which A Controller Operates To Maintain.
Control Point	The Temperature At Which A System Is Maintained
Control, Cascade	See "Cascade Control"
Control, On/Off	The Control Of Temperature About A Setpoint By Turning The Output Full On Below Setpoint And Full Off Above Setpoint In The Heat Mode
Controlled Device	A Device/Unit That Receives A Signal From A Controller And Positions The Damper Or Valve To Match The Capacity To The Load: Example Of This Is A Motorized Valve Or Motorizes Damper.
Controlled Variable	A Process Variable That Is To Be Controlled At Some Desired Value By Means Of Manipulating Another Process Variable
Controller	A Control/Device That Monitors A Controlled Variable And Changes The Position Of Such Final Control Devices As Valves, Dampers, Etc., And, Maintains The Value Of The Controlled Variable At Or Very Close To The Controller's Setpoint.

Convection	Heat That Moves From One Place To Another By Currents Which Are Set-Up Within Either A Fluid Medium, Liquid, Or Vapor.
CPS	Stands For "Cycles Per Second", Which In Hertz (Hz) Represents The Number Of Periodic Events In One Second.
CPS	Stands For "Cycles Per Second", The Number Of Events In A One (1) Second Period Of Time, Usually Expressed In Hertz.
CPU	Central Processing Unit. The "Brains" Of The Computer Which Directs, Executes, And Performs All Commands And Processing Functions.
CR	Stands For Condensate Return
Cryogenics	Temperatures Which Are Extremely Low, Such As Minus 180 Degrees Celsius.
CSA	"Canadian Standards Association." The National Standards Of Canada Which Are Normally Used In The Fields Of Safety, Building, Construction, Health, And The Environment.
CSA	Stands For "Canadian Standards Association", Similar To The U.S. Equivalent UL (Underwriters Laboratories)
CT	Stands For Current Transformer
Cubic Feet Per Minute	See "Cfm."
Current	The Flow Rate Of Electricity
Current Proportioning	Normally Associated With Process Temperature Controllers, Provides A Current Proportional To The Amount Of Control That Is Required
Cv	Stands For "Flow Coefficient," Which Is The Flow Of Water Gallons Per Minute (Gpm) At A Temperature Of Approx. 60f, That Causes A 1 Psi Pressure Drop Across A Fully-Opened Valve.
CW	Stands For Clockwise
Cycle Time	The Time That Is Necessary To Complete A Full On-Thru-Off Period In A Time Proportioning Control System
D/A Converter	See "Digital-To-Analog Converter"

Damping	The Decrease In Amplitude Of An Oscillation Which Is Due To The Dissipation Of Energy
Db	Stands For Decibels
DDC	A Microprocessor-Based Computer Control System That Provides Direct Control Of The Many Individual Components Of An Hvac System, Without The Use Of Conventional Devices Such As Thermostats.
DDC Names	The Two Predominant DDC Systems In The HVAC Industry Today Are: Johnson Controls' "Metasys" System, And Honeywell's "Delta" & "Excel" Systems.
Dead Time	The Interval Of Time Between The Initiation Of An Input Change Or Stimulus And The Start Of The Resulting Observable Response
Deadband	This Is An Area That Represents "No Change"; In Other Words, A Point's Value Must Either Go Above Or Below The Deadband In Order To Trigger Control Action Or An Alarm.
Decibel	See "dB"
Default Settings	Parameters and/or Selections That Have Been Made At The Factory
Degree	Incremental Values On A Temperature Scale. Example: 0 To 240 Degrees F Or C.
Degree Day (Basic Definition)	A Unit Based On Temp. & Time Which Is Used In The Estimating Of Fuel Consumption As Well As For Specifying The Nominal Heating Load Of Buildings In The Winter Time.
Degree Day (Technical Definition)	For Any One Day, When The Mean Temp. Is Less Than 65 Deg. (F) (18 Deg. C), There Exist As Many Degree Days As There Are Fahrenheit Or Celsius Degrees Difference In Temp. Between The Mean Temp. For The Day And 65 Deg. (F).
Delta System	A Direct Digital Control (DDC) System Developed By Honeywell That Provides Complete HVAC-Building Automation

Density	Mass Per Unit Of Volume, Such As Pounds/Cubic Feet
Derivative	Action That Senses The Rate Of Change Of Temperature, And Also Compensates To Minimize Overshoot & Undershoot
Derivative Action	See "Control Action, Derivative"
Deviation From Setpoint	See "Setpoint, Deviation From"
Dew Point	The Saturation Point Of A Mixture Of Air And Water Vapor
Dialapak	Same As The Dialatrol, But Is A Smaller, More
Dialatrol	A Temperature Control Manufactured By Honeywell That Either Indicates and/or Controls A Process/Loop, And Also Accepts A Thermocouple Input(S)
Differential Pressure Control	When Two Pressure Sensors Transmit Their Signals To A Controller, And The Controller Then Produces An Output To The Controlled Device That Varies In Accordance With The Difference Of The Two Sensed Pressures
Differential Pressure Switch	A Switch Which Is Activated By Air Pressure, And Is Often Used In Supply Ducts To Detect Flow Of Pressure Drops Across Filters
Digital	An On/Off Or Two Position Signal Usually Associated With A Digital Controller
Digital Input	The Term Used To Describe The Status Of A Dry Contact, Also Referred To As A "Gate"
Digital-To-Analog Converter	A Circuit That Accepts Digital Input Signals And Converts Them To Analog Output Signals.
DIN	Mainly Associated With The Size & Panel Cut-Out Of A Process Temperature Controller; Din Is A German Standard And Stands For: "Deutsche Industrial Norm". Measurement Examples Of Din Are 1/8 & 1/4" Din To Name A Few
Dip Switch	Stands For "Dual In-Line Package Switch". Multiple Switches On One Circuit Board, Each Switch Having The Capability Of Being Set To Either One Of Two Positions.
Direct Acting	An Increase In Branch Line Pressure In Response To A Rise In Temperature
Direct Digital Control System	See "DDC"

Direct Reset	On Typically Two Input Applications. When A Decrease At The Second Open-Loop Sensor Causes The Controller Setpoint To Decrease
Discharge Damper	A Damper Or Dampers Which Are Directly Located In The Discharge Of Either A Fan Or A Duct
Disk Operating System	Also Referred To As "DOS". Controls The Transferring Of Information To And From A Disk.
Diverting Valve	A Three-Way Valve That Directs Flow To Either Outlet Or Can Proportion The Flow Between The Two Outlets. Many Three-Way/Diverting Valves Are Used For Water-Mixing.
DoD	Stands For Department Of Defense
DOS	See "Disk Operating System"
Downscale Burnout	See "Thermocouple Downscale Burnout"
DP	Stands For Drip-Proof
DPDT	Stands For Double-Pole/Double-Throw
Droop	Normally Occurs In Time-Proportional Temperature Controllers. It Is The Difference In Temperature Between Setpoint And Where The Temperature Of The System Stabilizes.
Dry Bulb Temperature	The Air Temperature Measured By A Thermometer
Dry Contact	A Contact That Does Not Impose An Electronic Signal From An Outside Source. A Direct Short Of Normally-Open Contacts.
Dual In-Line Package Switch	See "Dip Switch"
Duplex	Two-Way Data Communication In Both Directions; Pertaining To Duplex Thermocouples Having Two Elements
Duplex	Usually Associated With Thermocouples. Means That There Are Two (2) (Dual) Elements Instead Of One (1).
Duty Cycling	Reduces Electrical Consumption By Periodically Turning-Off Equipment For Short Periods Of Time During Normal Operating Hours. Duty Cycling Is Normally A Function Of An Energy Management System.

E-P Switch	See "Electric-Pneumatic Switch"
EA	Stands For Exhaust Air, and/or The Unit Of Measure: "Each"
Earth Ground	A Specific Terminal Used To Ensure By Means Of Special Connection, The Grounding Of Part Of A Device/Control
Economizer Band	The Range Of Temperatures Within Which An Air Handler Is In Economizer Mode.
Economizer Deadband	The Range Of Temperatures Between The High End Of An Economizer Band And The First Stage Of Mechanical Cooling.
Economizer Mode	A Control Mode In Which Relief Dampers And Outside Return Air Dampers Are Controlled By Air Temperature In Order To Provide The Most Economical Heating and/or Cooling
Electric-Pneumatic Switch	An Air Flow Switch, Electrically Operated With Normally-Opened & Normally-Closed Inputs Which Lead To A Common Output
Electro Motive Force	See "EMF"
Electronic Controls	Generally Use Low Voltages And Currents Such As 20 Volts Or Even Less.
Electronic Devices	See "Electronic Controls"
EMF	Stands For Electromotive Force, Which Is A Rise In Electrical Energy
EMI	Stands For Electromagnetic Interference
Encoder	An Electro-Mechanical Device That Translates Mechanical Motion Or Position Into Electrical Signals.
Energy Management	A Term Developed In The 1970's Which Provides Several Techniques For Reducing Energy Consumption Throughout A Building(s) While At The Same Time Maximizing Operating Efficiency.
Engineering Units	Terms And Abbreviations That Represent "Measured Units"; Some Examples Include: (Vac) Volts Alternating Current; (Kw) Kilowatts; (Gpm) Gallons Per Minute; (F) Fahrenheit; Etc., Etc.

Enthalpy	Measure Of Total Heat Of Air (Sensible + Latent) That Is Measured Above An Arbitrary Datum. The Specific Enthalpy Of Dry Air Is Assigned A Value Of Zero Deg. (F) And U.S. Atmospheric Pressure (29.92" Of Mercury), Is Measured In Btu Per Lb. Of Dry Air
EP Switch	See "Electric-Pneumatic Switch"
EPROM	Mainly Found On Or Associated With Electronic Circuitry/Circuit Boards, Stands For "Erasable Programmable Read-Only Memory"
Eutectic Temperature	Occurs Whenever A Mixture Of Alloys Or Metals Reaches Its Lowest Possible Melting Point
Evaporative Cooling	The Adiabatic Exchange Of Heat Between Air And Water Spray Or Wetted Surface. The Wet Bulb Temperature Of The Air Remains Constant. But The Dry Bulb Is Decreased
Excel System	A Direct Digital Control (DDC) System Developed By Honeywell That Provides Complete HVAC-Building Automation
Exhaust Damper	This Type Of Specific Damper Normally Opens As The Outdoor Air Damper Opens And The Return Air Damper Closes. Exhaust Dampers Are Usually Found On Or As Part Of Air Handling Units, And Can Also Be Referred To As "Relief Dampers"
Factory Mutual	See "Fm Approved"
Fahrenheit	The Most Commonly Used Temperature Scale Which Is Measured In Degrees At 32 Degrees At Ice Point And 212 Degrees At The Boiling Point Of Water.
Fall Time	The Time Interval Between The Points At Which The Instantaneous Value Falls From 90% To 10% Of The Specified Upper Limit.
Feedback	The Process Signal That Is Used In Control As A Measure Of Response To Control Action: The Part Of A Closed-Loop System Which Automatically Brings Back Data About The Condition That Is Under Control
Feet Per Minute	See "Fpm"
Finish Point	See "Pneumatic Finish Point"
Flash Point	The Temperature At Which A Flammable Liquid Can Give Off Enough Vapor To Ignite Or Cause Explosion



Floating Control	When A Two-Position Controlled Device Can Stop At Any Point In Its Stroke At Loss Of Control Signal. The Controlled Device Will Hold This Position Until The Controller Senses Another Signal To Reposition The Controlled Device.
Floating Control Action	See "Floating Control"
Flow Coefficient	SEE "Cv"
Flutter	Variation In Cycle Width From Cycle To Adjacent Cycle.
Fm Approved	Stands For "Factory Mutual Research Corp." Which Sets Safety Standards
FPM	Stands For "Feet Per Minute", Which Quantifies The Velocity Of Air Flow
FPM	Stands For Feet Per Minute
FPS	Stands For "Feet Per Second"
Frequency-To-Voltage Converter	An Electronic Device Which Directly Converts A Frequency Input To A Voltage Output.
FS	Stands For Full Scale
Gain	The Ratio Of The Change In Output To The Change In Input That Caused It
Gallons Per Minute	See "GPM"
Galvanometer	Detects Extremely Small Electrical Currents
Gauss	Electromagnetic Unit Of Magnetic Induction
GPH	Stands For "Gallons Per Hour"
GPM	Stands For "Gallons Per Minute", Which Quantifies Water Flow
Head	A Measure Of Pressure Which Is Expressed In Feet: Typically Applies To Centrifugal Pumps. And Indicates The Column Height Of Water That Is Being Lifted By The Pump
Heat Pump	A Unit That Either Heats Or Cools A Building By Using Heat From The Condenser Section Or By Using Cooling From The Evaporator Section

Heat Sink	Usually Found On Circuit Boards And Printed Wire Boards (PWB's), A Heat Sink Acts To Dissipate The Heat Of Components That Are Mounted On The Solid State Boards.
Heat/Cool Control	The Method Of Control When The Temperature Of The End Product Is Maintained By Controlling Two Final Elements Using Two Outputs
Hertz	Units Which Express Frequency; Abbreviation Is "Hz"
Hot Leg	See "Measuring Junction"
Humidistat	Measures Humidity In % Of Relative Humidity While Sensing And Controlling The Moisture Content Of The Air
Hunting	When A Controller Causes A Motor Or Actuator Device To Continuously Travel From One End Of Its Stroke To The Other
Hunting	The Oscillation Or Fluctuation Of The Process Temperature Between Setpoint & Process Variable
HVAC	Stands For "Heating, Ventilating, & Air Conditioning"
HVAC/R	Stands For "Heating, Ventilating, Air Conditioning, & Refrigeration"
Hydraulic Actuator	An Actuator That Either Operates Valves Or Dampers By Producing A Linear Motion As A Result Of The Fluid Pressure Developed From A Continuously Running Motor Pumping Oil Through A Transducer
Hydronics	The Control & Use Of Water As A Heat Transfer Medium In Air Conditioning Systems And Boilers
Hygroscopic	Water Absorbing
Hysteresis	In On/Off Control, The Temperature Change That Is Necessary To Change The Output From Full On To Full Off
IC	Stands For Integrated Circuit
Immersion Sensor	A Control With An Extended Element (Bulb & Capillary) That Is Used To Sense The Temperature Of Steam, Water, Etc. In Liquid Lines And Tanks. Immersion Sensors/Controls Mount Remotely And Are Also Available In Strap-On Mounting
Impedance	Opposition To The Flow Of Electricity, Resistive + Reactive

In. W.C.	See "Inches Of Water Column"
Inches Of Water Column	A Term Of Measurement That Is Primarily Used To Measure & Control Low Differential Pressures. Low Differential Pressures Include Those Of Duct Static Pressure; Space Static Pressure; And The Velocity Pressure Of Flowing Air In Ducts.
Infiltration	Air Leakage Through The Joints & Cracks, And Windows & Doors Of A Building Or Structure Due To Either The Adverse Pressure Effects Of Wind, Or The Difference In The Indoor & Outdoor Air Density
Infrared	Exceeds Red Light From 750 Nanometers To 1,000 Microns And Is Used To Detect Temperature & Flame Without Making Physical Contact. Mostly Used In The Detection Of Infrared In Flame In Boilers, Burners, Ovens, Kilns, & Incinerators.
Inlet Vane	Restricts Air Flow Into Centrifugal Fan Housings, And Restricts Refrigerant Flow On Centrifugal Chillers
Input	Process Variable Data Being Supplied To The Device. For Example: For A Process Temperature Controller The Most Common Forms Of Input Are Thermocouple & R.T.D.
Integral	The Control Action That Automatically Eliminates Offset, Or "Drop". Between Setpoint And Actual Process Temperature, And Also "Reset"
Integral Control	A Control Action That Is Specifically Designed To Either Reduce Or Even Eliminate Offset In A Proportional Control
Intelligent Automation	Also Referred To As "I/A", Is A Process Control Automation System Developed By Foxboro Co. (Siebe) That Provides Computer-Based Monitoring, Controlling, & Automation To An Industrial Plants Process Control Loop(S)/System
Interpolation	A Mathematical Process That Estimates A Missing Functional Value By Taking A Weighted Average Of Known Functional Values At Neighboring Points. (This Is Done Electronically In Some Devices).
Interval Timer	A Timer That Has Its Output Occur During The Timing State

IPCEA	Stands For The Insulated Power Cable Engineers Association
IR	Stands For Infra-Red
ISA	Stands For Instrument Society Of America
Isolation	The Electrical Separation Of The Sensor From High Voltage Circuitry. Allows For Application Of Grounded Or Ungrounded Sensing Element
Isothermal	Means Constant Temperature.
ITS90	Means The International Temperature Scale Of 1990 Which Is The Present Standard Defined By 17 Fixed Points Which Are Assigned Standard Values. ITS90 Supersedes IPTS68.
Jumper	A Wire That Is Used To Either Connect Or Bypass A Portion Of A Circuit Or Printed Wire Board
K	See "Kelvin"
Kelvin	Kelvin. Whose Symbol Is K, Is Defined As The Unit Of Thermodynamic Temperature. Physical Quantity. Of Absolute Temperature Whose Magnitude Is 1/273.15 Of The Thermodynamic Temp. Of Ice Point.
KHz	Stands For "Kilo Hertz". A Measure Of Frequency.
Kilowatt	A Kilowatt Or Kw Is Equal To 1000 Watts
Kilowatt Hour	Kilowatt Hour Or Kwh Is Equal To 1000 Watt Hours
kva	Stands For Kilovolt Amperes And Is Equal To 1000 Volt Amps
Lag	The Part Of The Well That Is Below The Hex And Above The Threads. Its Purpose Is To Extend Throughout The Lagging Of The Vessel.
Latent Heat	The Amount Of Heat That Is Needed In Order To Change An Amount Of Water At 212 Degrees (F) (100c) From Liquid To Vapor At Constant Barometric Pressure
LCD	Stands For Liquid Crystal Display
LED	Stands For Light Emitting Diode



Linearization	The Function That Is Used To Automatically Linearize A Non-Linear Signal Either From A Thermocouple Or R.T.D. Through The Use Of Look-Up Tables
Linearization, Square Root	The Function That's Used To Linearize A Non-Linear Signal Corresponding To The Flow Being Measured By Transmitters
Load	The Demand For Input To A Process
Load Line Out	A Start-Up Output Value Which Is To Bring Initial Output Closer To The Actual Steady State Output
Load Shedding	To Turn Off Electrical Loads In Order To Limit Peak Electrical Demand
Loop Power	An Internal 24-Volt Current Limited Power Supply Used To Power 2 Or 4 Wire Transmitters On The Input Of A Controller
Low Pass Input Filter	A Method Used To Block Fast Acting Signals Such As Noise, While Allowing Slow Acting Signals (Actual Process Variable) To Pass
LPG	Stands For Liquefied Petroleum Gas
LSIC	Stands For "Large Scale Integrated Circuit"
Lux Meter	Measures Illuminance
M	Stands For "Mega", Or One Million
Magnetic Feedback Transducer	Any Transducer Which Relies On Changes In Its Magnetic Field To Send Its Output.
Mains	The Term "Mains" In A Pneumatic HVAC System Are Lines That Carry Air At A Constant Supply Pressure Which Is Generally 15 To 25 Psig
Make-Up Air	Outdoor Air That Is Brought Into A Building For Ventilation
Make-Up Water	Water Which Is Supplied To Replenish The Water That Is Lost By Either Evaporation Or Leaks
Manometer	Measures Pressures Of Vapors & Gases
Manual Reset I	A Feature On A Digital Temperature Controller That Adjusts Its Proportioning Band In Relationship To Its Set Point In An Effort To Eliminate Errors.

Manual Reset II	A Switch On A Limit Control, Relay, Or Safety Device That Manually Resets After The Limit Has Been Exceeded Or Broken.
Mean Temperature	The Maximum & Minimum Temperature Of A Process Equilibrium Which Is Averaged.
Measuring Junction	The Junction Of A Thermocouple That Is Subject To The Temperature. Also Referred To As The "Hot Leg" Of The Thermocouple. There Are Three (3) Basic Types: Grounded, Ungrounded, And Remote.
Mechanical Relay	See "Relay (Mechanical)"
Menu Block	Groups Of Parameters Arranged In The Software Of A Controller
Metasys	A Direct Digital Control (DDC) System Developed By Johnson Controls That Provides Complete HVAC-Building Automation
Microamp	Measured As 1 Millionth Of An Ampere
Microcontroller	A Large-Scale Integrated Circuit That Has All The Functions Of A Computer Including Memory And Input/Output Systems
Microfarad	Measured As 1 Millionth Of A Farad
Micron	Measured As 1 Millionth Of A Meter
Microvolt	Measured As 1 Millionth Of A Volt
Milliamp	Measured As 1 Thousandth Of An Amp; Abbreviation For Milliamp Is: Ma
Millivolt	Measured As 1 Thousandth Of A Volt; Abbreviation Is: Mv
Mixing Box	A Box Or Enclosure That Has Dampers In The Hot & Cold Air Stream That Mixes The Two (Hot & Cold). And Delivers The Mixed Air Into A Space At A Specified Temperature
MOP	Stands For "Motor Operated Potentiometer"
MOV	Stands For "Metal Oxide Varistor", Used To Prevent Power Surges & Power Spikes.
MS-DOS	See "Disk Operating System"
MSDS	Stands For Material Safety Data Sheets
MTBF	Stands For "Mean Time Between Failure", Which Is An Indication Of The Average Life Expectancy Of A Unit When Operated Within Its Design Limitations.

Multidrive	An Application Where More Than One Motor Is Being Controlled By One Controller. There Are Three (3) Types: Parallel, Progressive, & Cascaded.
N.C.	See "Normally Closed"
N.O.	See "Normally Open"
NBS	Stands For National Bureau Of Standards
NEC	Stands For National Electric Codes
NEMA	Stands For National Electrical Manufacturers' Association
Network 8000	A Direct Digital Control (DDS) System Developed By Barber-Colman Co. (Siebe Co.) That Provides Complete HVAC-Building Automation
NFPA	Stands For The National Fire Protection Association
Night Setback	A Condition Generally Associated With Thermostats, That Is When The Setpoint Of The Thermostat Is Set/Shifted To A Lower Temperature During Unoccupied Hours, Especially During The Heating Season
Night Setup	Generally Associated With Thermostats, When The Setpoint Is Set/Shifted To A Higher Temperature During Unoccupied Hours, Especially During The Cooling Season
NIST	Stands For National Institute For Standards And Technology.
Noise	An Unwanted Component Of A Signal Or Variable
Normally Closed	A Term/Condition That Applies To A Controlled Device Which Closes When Either A Power Failure Occurs, Or When Control Pressure Is Removed
Normally Open	A Term/Condition That Applies To A Controlled Device That Is Open When All Operating Force Is Lost, Such As In A Power Failure
NPT	Stands For National Pipe Thread
O.D.	Stands For Outside Diameter
OA	Stands For Outdoor Air
Occupied Mode	A Control Mode That Is Used To Heat Or Cool Buildings While They Are Occupied

Offset	The Amount Of Difference Between Control Point And Setpoint In A Proportional Control System
Offset	The Adjustment To The Actual Input Temperature And To The Temperature Values That The Controller Uses For Display & Control
Ohmmeter	Used To Measure Electrical Resistance
On/Off Control	See "Control, On/Off"
Open Loop	A Control System With No Sensory Feedback
OSHA	Stands For Occupational Safety And Health Administration
Output	An Action Caused In Response To The Difference Between Setpoint And Process Variable
Output Modules	Generally Plug-In Devices Such As Relays That Provide Power Handling To Enable Process Control; Modules Can Be Either Binary (On/Off) Or Analog (Continuously Variable) For Current Loop Control
Overshoot	The Condition When Temperature Exceeds Setpoint Due To Initial Power-Up Or Process Changes
Oxidizing	An Atmosphere That Contains Significant Amounts Of Active Oxygen.
P Control	Stands For "Proportioning" Control
Parameter	Any Specific Characteristic Of A Device/Control
Parity	Addition Of All The Bits In A Word Is Compared To The Parity Bit (Even Or Odd). If They Are Both The Same, The Data Is Accepted, Otherwise It Is Rejected.
PB	Stands For Proportional Band
PCB	Stands For Printed Circuit Board
PD Control	Stands For "Proportioning Control With Rate Action
Peak Load	The Maximum Electrical Load Or Thermal Load Reached During A Specific Period Of Time
Percent Authority	Generally Common With The Adjustment Of Receiver Controllers Which Determines The Effect Of The Reset Signal Of The Secondary Transmitter As A Percentage (%) Of The Signal Of The Primary Transmitter

Phenolic	A Resin Based Type Of Hard Rugged Plastic That Is Usually Used In Insulating. Phenolic Is The Same As Bakelite.
PI Control	Stands For "Proportioning Control With Auto-Reset"
PID Control	Stands For "Proportioning Control With Auto-Reset And Rate"
Platinum	The Noble Metal Generally Used In Types R & S Thermocouples
Pneumatic Controls	Controls That Run On Low-Pressure Compressed Air
Pneumatic Finish Point	The Maximum Amount Of Pressure (Psi) That Will Completely Compress An Actuator's Spring To Complete Its Stroke. Example: An Actuator With A Spring Range Of 3 To 8 Psi; "8" Would Be Considered The "Finish Point"
Position Proportioning	Control Output That Utilizes Two Relays To Control An Electric Or Motorized Actuator Motor
Potentiometer	A Balancing Bridge Which Is Used To Measure Voltage; Also Through The Use Of A Resistor Is Used To Control A Circuit(S)
PPM	Stands For Parts Per Million
PPR	See "Pulses Per Revolution"
Pressure Drop	The Difference In Pressure Between Two Points In A Flow System. The Pressure Differences Are Usually Caused By Frictional Resistance To Fluid Flow In A Conduit, Filter, Or Other Flow System
Primary Loop	The Outer Loop In A Cascade System
Process Variable	Any Characteristic Or Measurable Attribute Whose Value Changes With Changes In Prevailing Conditions; Some Common Variables Are Temperature, Level, Pressure, Flow, Humidity, Etc.
PROM	Stands For "Programmable Read Only Memory".

Proportional Band

The Change In Input That Is Required To Produce A Full Range Change In Output Due To Proportional Control Action

Protection Tube

A Tube Which Is Closed At One End In Which A Thermocouple Is Inserted Into In Order To Protect The Thermocouple From Excessive Heat Or Abrasive Medium. Protection Tubes Come In Many Varieties & Materials. See Protection Tube Selections Starting On Pg. 64.

PSIA

Stands For Pounds Per Square Inch Absolute

PSID

Stands For Pounds Per Square Inch Differential

PSIG

Stands For Gauge Pressure Which Is The Amount Of Pressure Above Atmospheric Pressure

PSIS

Stands For Pounds Per Square Inch Standard

Psychrometer

Measures Relative Humidity

Pulse Width Error

The Deviation In Electrical Degrees Of The Pulse Width From The Ideal Value Of 180 Degrees.

Pulses-Per-Revolution

The Number Of Pulse Intervals Of An Output Signal For Each Revolution Of The Input Shaft.

PWB

Stands For Printed Wire Board

Pyrometer

Typically Measures High Temperatures Up To 2,000 Degrees F.

Pyrometry

See "Thermocouple" Or "RTD"

Quadrature

The Term For Two (2) Nearby Identical Periodic Signals When The Phase Displacement Is Nominally 90 Electrical Degrees.

RAM

Stands For Random Access Memory

RAM

Stands For "Random Access Memory"

Ramping Setpoint

See "Setpoint, Ramping"

Rate

An Action That Senses The Rate Of Change Of Temperature And Compensates To Minimize Overshoot. Also "Derivative"

Rate Action

The Derivative Function Of A Process Temperature Controller



Rate Time	The Time Interval Over Which The System Temperature Is Sampled For The Derivative Function
RC	Resistive / Capacitive Circuit, Used In Digital Circuits To Establish A Time Base.
Regulate	To Maintain A Controlled Variable At Or Near Its Range Or Setpoint, Depending Upon The Device
Reheat	When Heat Is Added To Cooled Or Humidified Primary Air Or Recirculated Room Air
Relative Gain	An Open-Loop Gain Determined With All Other Manipulated Variables Constant, Divided By The Same Gain Determined With All Other Controlled Variables Constant
Relay (Mechanical)	An Electromechanical Device That Completes Or Interrupts A Circuit By Physically Moving Electrical Contacts Into Contact With Each Other
Relay (Solid State)	A Solid State Switching Device That Completes Or Interrupts A Circuit Electrically With No Moving Parts At All
Relief Damper	See "Exhaust Damper"
Reset	To Reset Or To "Clear"; Automatically Eliminates Offset Or Droop Between Setpoint And Actual Process Temperature; Also "Integral"
Resistance Temperature Detector	See "RTD"
Resistive/Capacitive Circuit	See "RC"
Restrictor (Pneumatic)	A Small Fitting-Like Part That Changes The Velocity Pressure Of The Air Line To Static Pressure. The General Size Of Restrictors Are 0.005" Or 0.0075"
Retransmission	Allows The Transmission Of A Milliamp Signal Corresponding To The Process Variable, Target Setpoint, Or Actual Setpoint To Another Device Such As A Chart Recorder
Return Air	Air That Is Being Returned From The Heated Or Air-Conditioned Space/Room, Back To The Heater Or Air Conditioner
Reverse Acting	A Decrease In The Media That Is Being Sensed Causes An Increase In Output
RF	Stands For Radio Frequency

Rheostat	Variable Resistor
RMS	Stands For Root Mean Squared
ROM	Stands For Read Only Memory
Rooftop Unit	A Packaged HVAC Unit Which Is Specifically Designed To Be Mounted On The Rooftop Of A Building. Rooftop Units Range In Size From Small-Single Zone Units, To Large Capacity Units Which Supply Air To Multiple VAV Terminals, Etc.
Rot	Stands For Rotation
RPM	Stands For Revolutions Per Minute
RS	Stands For Rotary Scale
RS 485/422/232	Standards Recommended By The EIA For Serial Data Transmission Between Digital Devices And Process Instruments.
RTD	Stands For Resistance Temperature Detector; An RTD Is A Resistive Sensing Device That Displays Resistance Vs. Temperature Characteristics, And Positive Temperature Coefficient. See A Wide-Variety Of RTD's Starting On Pg. 105 Of This Catalog
Run Time	The Total Amount Of Running Hours Which An HVAC System Has Been Running Since Either Its Installation, Or Its Last Preventative Maintenance Date
SAMA	Stands For The Scientific Apparatus Makers Association.
SCR	Stands For "Silicon Controlled Rectifier".
Secondary Loop	The Inner Loop Of A Cascade System
Sensible Heat	Sensible Heat Is Heat That Changes Only The Temperature Of The Air Without A Change In The Moisture Content. Generally A Change In Dry-Bulb Thermometer Readings Usually Indicate Changes In Sensible Heat
Sensor. Immersion	See "Immersion Sensor"



Serial Communications

The Sending Or Receiving Of Binary Coded Data To A Supervisory Device Such As A PC (Personal Computer) Or PLC (Programmable Logic Controller)

Setpoint, Actual

The Value Of A Controlled Variable That The Control/Controller Is Currently Acting Upon

Setpoint, Deviation From

The Number Of Units Difference Between The Current Process Variable And The Setpoint

Setpoint, Ramping

A Setpoint That Is Determined By The Ramp Function Of A Controller Where Over Time The Controller Variable Reaches A Desired Value

Setpoint, Target

The End Point Of The Ramping/Ramp Function

Sheds

When The Signal Is Lost---In Serial Communications

Single-Pole/Double-Throw

See "SPDT"

Slidewire Position Proportioning

An Output Algorithm That Utilizes A Slidewire Feedback Signal To Determine The Actual Position Of The Actuator/Motor Being Controlled

Solid State Relay

See "Relay (Solid State)"

Span

The Difference Between The Start & Finish Point Of A Range. For Example: A Range Of 50 Deg. To 100 Deg. = Span Of 50 Deg.; 60 To 9 Volts = Span Of 3 Volts; 3 To 8 Psi = Span Of 5 Psi.

SPDT

SPDT Or Single-Pole/Double-Throw Is A Switching Action That "Makes" One Circuit Immediately Upon Breaking The Other

Spring-Return

A Spring Mechanism Inside An Actuator Which Upon A Loss Of Power (Power Failure) Immediately Will Drive The Actuator Either To An Open Or Closed Position

Squarewave

A Repetitive Waveform. Usually AC, Whose Shape Is Essentially Square Or Rectangular Usually With An Equal Duty Cycle.

SS

Stands For Steam Supply. and/or The Alloy Stainless Steel

SSR Drive

A.D.C. On/Off Signal Output For Controlling A Solid State Relay

Staged Outputs	The Set-Up Of Two Analog Outputs, Where One Analog Output Varies Its Signal Over A Portion Of The PID Output Range, And The Second Analog Output Then Varies Its Signal Over The Remainder The PID Output Range
Stand-Alone Control	A Control/Controller That Does Not Require Support From Another Device Or System
Static Discharge	Undesirable Current Resulting From The Discharge Of Electrostatic Energy
Station Address	A Unique Identifier Assigned To A Device Or Devices For Communications Purposes
Status-Pressure Control	Regulating The Air Pressure Inside Of A Duct Or A Room In Relation To A Reference Pressure. Generally Controlled In Terms Of Inches Of W.C. (Water Column)
Stratification	Layers Of Air At Different Temperatures Of Different Velocities Flowing through A Duct Or Plenum
Stroke Length	The Linear Distance In Which An Actuator Shaft Moves
Target Setpoint	See " Setpoint, Target"
TDC	TDC 2000 & TDC-3000 Are Complete Computer-Based Process Control Systems Developed By Honeywell That Provide The Monitoring, Controlling, & Automation Of An Industrial Plant's Process Control Loop(S)/Systems
TE	Stands For Totally Enclosed
TEAO	Stands For Totally Enclosed, Air Over
TEFC	Stands For Totally Enclosed, Fan Cooled
Teflon	Manufactured By Dupont, Teflon Is A Fluorocarbon-Based Polymer That Is Used For The Insulation Of Wires.
Tempco	Stands For "Temperature Coefficient".
TENV	Stands For Totally Enclosed, Non-Ventilated

Thermocouple	A Temperature Sensing Device That Is Constructed Of Two Dissimilar Metals Wherein A Measurable & Predictable Voltage Is Generated Corresponding To Temperature: See Our Wide-Variety Of Thermocouples Starting On Pg. 1.
Thermocouple Break Protection	A Fail-Safe Operation That Assures Desired Output Upon An Open Thermocouple Condition
Thermocouple Downscale Burnout	The Jumper Position That Determines Whether, When A Thermocouple Fails, Its Output Is Replaced By A Millivoltage Which Will Match The Thermocouple's Minimum Value
Thermocouple Upscale Burnout	The Jumper Position That Determines Whether, When A Thermocouple Fails, Its Output Is Replaced By A Millivoltage Which Will Match The Thermocouple's Maximum Value
Thermostat	Measures Ambient Temperature And Controls Other Devices In An HVAC System. Thermostats Come In A Wide Variety And Are Generally Either Electric-Delivered Or Pneumatic
Three Mode Control	See "Control Action, PID"
Throttling Range (Controls)	The Change In Any Variable Such As Temperature, Pressure, Etc. Required To Cause A Controller's Output To Vary A Pre-Defined Range.
Throttling Range (System)	The Amount Of Change Of Any Variable Such As Temperature, Pressure, Etc. Necessary For The Controller To Drive The Actuator(S) Through Their Complete Stroke(S)
Time Proportioning Control	A Control Algorithm That Expresses Output Power (0-100%) As A Function Of Percent "On" Vs. Percent "Off" Within A Preset Cycle Time
Time Proportioning Output	A Controller Output That Is Assigned By Software To Facilitate Time Proportional Control (Generally A Relay, SSR, Or SSR Drive Output)
Torque	Typically Produces Rotation Or Twisting Such As In Motors
Total Pressure	Total Pressure Is Measured By The Sum Of Static And Velocity Pressure

Tracking	A Process Controller Function That Defines Whether The Local Setpoint Will Track The Remote Setpoint; When The Controller Is Transferred To A Local Setpoint, That Local Setpoint Value Will Match The Remote Process Value When The Transfer Occurs
Transducer	A Device That Converts One Signal To Another; Example: Converting A 4 To 20 Ma Signal To A 3 To 15 Psi Signal. And Vice-Versa
Transmitter (2-Wire)	Used To Transmit Data Via A Two Wire Current Loop; A 2-Wire Transmitter Is Loop Powered. See Our Large Transmitter Sections For Honeywell, Foxboro, Rosemount, & Dwyer Transmitters
Transmitter (4-Wire)	Used To Transmit Data Via A Current Loop Or A Dc Voltage; A 4-Wire Transmitter Uses 2 Wires For Data & 2 Wires For Power; See Our Large Transmitter Sections For Honeywell, Foxboro, Rosemount, & Dwyer Transmitters
Triac	A Solid State Switching Device Used To Switch Alternating Current Signals On & Off; Triac Circuits Are Also Referred To As Solid State Relays Or SSR's
Trip Point	The Value That Determines When That Set Of PID Values Becomes Active
Triple Point	Term Used To Describe Solid, Liquid, And Vapor Phases Which Are All In Equilibrium At The Same Time So That There Is A "Fixed-Point" Temperature Of The Material That Is Being Measured.
True Rms	Often Used In Determining The Power Of A Signal By A Multimeter. It Stands For The True Root-Mean-Square Value Of An Ac Or Ac + Dc Signal.
UDC	Stands For "Universal Digital Controller". Which Is A Process Temperature Controller Manufactured By Honeywell. UDC's Come In Series 2000, 3000, 5000, 6000, & 9000
UL	Stands For Underwriters Laboratories, Inc., Establishes Standards For Products
Ultraviolet	Approximately 380 Nanometers Below Blue Light, Ultraviolet Or "UV" Is Often Detected As A Part Of The Flame In Boilers, Burners, Ovens, Kilns, And Incinerators.
Upscale Burnout	See "Thermocouple Upscale Burnout"
UV	Stands For Ultra-Violet



VA	Volt Ampere
VAC	Volts Alternating Current
Vacuum	A Pressure That Is Less Than Atmospheric Pressure
Variable Air Volume	Also Referred To As "VAV". Which Is A System That Controls Space Temperature By Varying The Quantity Of Supply Air Rather Than By Varying The Temperature Of The Supply Air
Variable Frequency Drive	A Device Often Referred To As A Speed Drive Which Varies The Voltage To An Electric Motor To Vary The Speed Of The Motor
VAV	See "Variable Air Volume"
VDC	Volts Direct Current
Velocity Position Proportioning	A Control Method Where Valve Position Is Determined By Calculating The Amount Of Time It Takes To Open Or Close A Valve By Moving The Valve For A Portion Of That Time
Velocity Pressure	Pressure That Is Caused By Air Being In Motion. And Has A Direct Relation To The Velocity Of The Air
Venturi	Creates Negative Pressure And Increased Gas Flow Velocity Due To The Way It Narrows And Then Flares-Out: A Section Of The Burner
VFD	Stands For Variable Frequency Drive
Viton	Extremely Chemically Resistant Fluoropolymer Using Plasticizing Agents To Increase Flexibility.
Watt Density	Measured In Units Of Watts Per Square Inch. Such As The Wattage Which Comes From A Sq. Inch Of The Surface Of An Electric Heater Or Heater Element.
Wet-Bulb Temperature	Air Temperature That Is Measured By A Wet-Bulb Thermometer And That Is Lower Than Dry-Bulb Temperature In Inverse Proportion To The Humidity. However, This Does Not Apply When/If The Air Is Saturated
Wild Stream	In Mixing Applications That Require Materials To Be Mixed To A Desired Ratio. This Is The One Part Of The Material That Is Uncontrolled
Windup	Saturation Of The Integral Mode Of A Temperature Controller Developing During Times When Control Cannot Be Achieved. Which Causes The Controlled Variable To Overshoot Its Setpoint When The Obstacle To Control Is Removed

Zone

A Space Or Multiple Spaces (Usually Rooms) Within A Building With Heating and/or Cooling Requirements That Are Very Similar So That The Comfort Conditions Can Be Maintained Throughout By One Single Controlling Device

Zone Control

When A Building Is Divided Into Several Zones. And Each Zone Can Be Controlled Independently

Zoned Reheat

Provides Zone Control For Areas Of Unequal Loading & Simultaneous Heating Or Cooling Of Perimeter Areas With Different Exposures. Heat Is Added To (As A Secondary Process) To Preconditioned Primary Air Or Recirculated Room Air

For current pricing and specifications, please contact us.

ENGINEERING DATA

EQUIVALENTS AND CONVERSIONS:

Table of equivalent temperatures

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-50	-58	75	167	205	392	325	617	450	842	575	1067	700	1292	825	1517
-45	-49	80	176	205	401	330	626	455	851	580	1076	705	1301	830	1526
-40	-40	85	185	210	410	335	635	460	860	585	1085	710	1310	835	1535
-35	-31	90	194	215	419	340	644	465	869	590	1094	715	1319	840	1544
-30	-22	95	203	220	428	345	653	470	878	595	1103	720	1328	845	1553
-25	-13	100	212	225	437	350	662	475	887	600	1112	725	1337	850	1562
-20	-4	105	221	230	446	355	671	480	896	605	1121	730	1346	855	1571
-15	5	110	230	235	455	360	680	485	905	610	1130	735	1355	860	1580
-10	14	115	239	240	464	365	689	490	914	615	1139	740	1364	865	1589
-5	23	120	248	245	473	370	698	495	923	620	1148	745	1373	870	1598
0	32	125	257	250	482	375	707	500	932	625	1157	750	1382	875	1607
5	41	130	266	255	491	380	716	505	941	630	1166	755	1391	880	1616
10	50	135	275	260	500	385	725	510	950	635	1175	760	1400	885	1625
15	59	140	284	265	509	390	734	515	959	640	1184	765	1409	890	1634
20	68	145	293	270	518	395	743	520	968	645	1193	770	1418	895	1643
25	77	150	302	275	527	400	752	525	977	650	1202	775	1427	900	1652
30	86	155	311	280	536	405	761	530	986	655	1211	780	1436	905	1661
35	95	160	320	285	545	410	770	535	995	660	1220	785	1445	910	1670
40	104	165	329	290	554	415	779	540	1004	665	1229	790	1454	915	1679
45	113	170	338	295	563	420	788	545	1013	670	1238	795	1463	920	1688
50	122	175	347	300	572	425	797	550	1022	675	1247	800	1472	925	1697
55	131	180	356	305	581	430	806	555	1031	680	1256	805	1481	930	1706
60	140	185	365	310	590	435	815	560	1040	685	1265	810	1490	935	1715
65	149	190	374	315	599	440	824	565	1049	690	1274	815	1499	940	1724
70	158	195	383	320	608	445	833	570	1058	695	1283	820	1508	945	1733

Values for interpolation in above

1°C = 1.8°F

4°C = 7.2°F

7°C = 12.6°F

1°F = 0.55°C

4°F = 2.22°C

7°F = 3.88°C

2°C = 3.6°F

5°C = 9.0°F

8°C = 14.4°F

2°F = 1.11°C

5°F = 2.77°C

8°F = 4.44°C

3°C = 5.4°F

6°C = 10.8°F

9°C = 16.2°F

3°F = 1.66°C

6°F = 3.33°C

9°F = 5.00°C

All decimals are exact.

All decimals are repeating decimals.

Heating elements are frequently used at voltages other than those shown in our catalog. The percentages shown above are used to determine the resulting wattage. Should you wish to use a heater on a voltage not shown above, you may calculate the resultant wattage with this formula:

$$\text{Actual Wattage} = \text{Rated Wattage} \times \frac{\text{Applied Voltage}^2}{\text{Rated Voltage}^2}$$

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

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

Percent of rated wattage for various applied voltages

Applied Voltage	Rated Voltage													
	110	115	120	208	220	230	240	277	380	415	440	460	480	550
110	100%	91%	84%	28%	25%	23%	21%	16%	8.4%	7%	6.2%	5.7%	5.2%	4%
115	109%	100%	92%	31%	27%	25%	23%	17%	9.0%	7.6%	6.7%	6.2%	5.7%	4.3%
120	119%	109%	100%	33%	30%	27%	25%	19%	10%	8.4%	7.4%	6.8%	6.3%	4.8%
208			300%	100%	89%	30%	75%	56%	30%	25%	22%	20%	19%	14%
220				112%	100%	89%	84%	63%	34%	28%	25%	23%	21%	16%
230				122%	109%	100%	92%	69%	37%	31%	27%	25%	23%	17%
240				133%	119%	109%	100%	75%	40%	33%	30%	27%	25%	19%
277							133%	100%	53%	45%	40%	36%	33%	25%
380								188%	100%	84%	74%	68%	63%	47%
415									188%	100%	89%	81%	75%	57%
440										112%	100%	91%	84%	64%
460										123%	109%	100%	92%	70%
480											119%	109%	100%	76%
550												156%	143%	100%

EQUIVALENTS AND CONVERSIONS:

Metric System Length

Unit		Metric Equivalent		U.S. Equivalent
millimeter	(mm)	= 0.001	meter	= 0.03937 inch
centimeter	(cm)	= 0.01	meter	= 0.3937 inch
decimeter	(dm)	= 0.1	meter	= 3.937 inches
METER	(m)	= 1.0	meter	= 39.37 inches
dekameter	(dkm)	= 10.0	meters	= 10.93 yards
hectometer	(hm)	= 100.0	meters	= 328.08 feet
kilometer	(km)	= 1000.0	meters	= 0.6214 mile

Metric system/weight or mass

Unit		Metric Equivalent		U.S. Equivalent
milligram	(mg)	= 0.001	gram	= 0.0154 grain
centigram	(cg)	= 0.01	gram	= 0.1543 grain
decigram	(dg)	= 0.1	gram	= 1.543 grains
GRAM	(g)	= 1.0	gram	= 15.43 grains
dekagram	(dkg)	= 10.0	grams	= 0.3527 ounce avoirdupois
hectogram	(hg)	= 100.0	grams	= 3.527 ounces avoirdupois
kilogram	(kg)	= 1000.0	grams	= 2.2 pounds avoirdupois

Metric system/capacity

Unit		Metric Equivalent		U.S. Equivalent
milliliter	(ml)	= 0.001	liter	= 0.034 fluid ounce
centiliter	(cl)	= 0.01	liter	= 0.338 fluid ounce
deciliter	(dl)	= 0.1	liter	= 3.38 fluid ounces
LITER	(l)	= 1.0	liter	= 1.05 liquid quarts
dekaliter	(dld)	= 10.0	liters	= 0.284 bushel
hectoliter	(hl)	= 100.0	liters	= 2.837 bushels
kiloliter	(kl)	= 1000.0	liters	= 264.18 gallons

Metric system/area

Unit		Metric Equivalent		U.S. Equivalent
square millimeter	(mm ²)	= 0.000001	centare	= 0.00155 square inch
square centimeter	(cm ²)	= 0.0001	centare	= 0.155 square inch
square decimeter	(dm ²)	= 0.01	centare	= 15.5 square inches
CENTARE also	(ca)	= 1.0	centare	= 10.76 square feet
square meter	(m ²)			
are also	(a)	= 100.0	centares	= 0.0247 acre
square dekameter	(dkm ²)			
hectare also	(ha)	= 10,000.0	centares	= 2.47 acres
square hectometer	(hm ²)			
square kilometer	(km ²)	= 1,000,000.0	centres	= 0.386 square mile

Metric system/volume

Unit		Metric Equivalent		U.S. Equivalent
cubic millimeter	(mm ³)	= 0.001	cubic centimeter	= 0.016 minim
cubic centimeter	(cc, cm ³)	= 0.001	cubic decimeter	= 0.061 cubic inch
cubic decimeter	(dm ³)	= 0.001	cubic meter	= 61.023 cubic inches
STERE also	(s)	= 1.0	cubic meter	= 1.308 cubic yards
cubic meter	(m ³)			
cubic dekameter	(dkm ³)	= 1000.0	cubic meters	= 1307.943 cubic yards
cubic hectometer	(hm ³)	= 1,000,000.0	cubic meters	= 1,307,942.8 cubic yards
cubic kilometer	(km ³)	= 1,000,000,000.0	cubic meters	= 0.25 cubic mile

Pressure

Unit	Atm.	kg./cm.2	lb./in.2	bar	mm. Hg.	in. Hg.	ft. H2O
1 Atmosphere	1"	1.033228	14.6959	1.01325	760"	29.921	33.934
1 kg./cm.2	0.967841	1"	14.2233	0.980665	735.559	28.959	32.843
10 lb./in.2	0.68046	0.70307	10"	0.689476	517.149	20.36	23.091
1 bar	0.986923	1.019716	14.5038	1"	750.062	29.53	33.490
1 meter Hg. (0°C)	1.31579	1.35951	19.3368	1.333224	1000"	39.37	44.65
10 in. Hg. (32°F)	0.33421	0.34532	4.9115	0.33864	254"	10"	11.341
100 ft. H2O (60°F)	2.9469	3.0448	43.308	2.9859	2239.6	88.175	100"

1 inch of Hg (mercury) = 13.6 inch H₂O

1 PSI = 2.31 inches of H₂O

Conversion table

1 Btu = 251.996 international calories

Multiply	By...	To Obtain...
Number of...		
British	778.3	Foot-pounds
thermal	3.929 x 10 ⁴	Horsepower-hours
units	2.930 x 10 ⁴	Kilowatt-hours
	2930	Watts-hours
Foot-pounds	1.285 x 10 ⁻³	British thermal units
	5.05 x 10 ⁻⁷	Horsepower-hours
	3.766 x 10 ⁻⁷	Kilowatt-hours
	3.766 x 10 ⁻⁴	Watt-hours
Horsepower-hours	2545	British thermal units
	1.98 x 10 ⁴	Foot-pounds
	7457	Kilowatt-hours
	745.7	Watt-hours
Kilowatt-hours	3.412	British thermal units
	2.655 x 10 ⁴	Foot-pounds
	1.341	Horsepower-hours
Watt-hours	3.413	British thermal units
	2655	Foot-pounds
	1.341 x 10 ⁻³	Horsepower-hours
	.001	Kilowatt-hours

Conversion Factors

Length	Weight
1 in. = 2.54 cm	1 kg. = 2.205 lb.
1 ft. = .3048 m	
1 yd. = .9144 m	Volume
1 m = 39.37 in.	1 cu. in. = 16.39 cm ³
	1 cu. ft. = .02832 m ³
Area	1 cu. ft. = 62.43 lb. water
1 sq. in. = 6.452 cm ²	1 cu. ft. = 7.5 gal. water
1 sq. ft. = .0929 m ²	1 cu. ft. = 28.32 liters
	1 U.S. gal. = 133.7 cu. in.
Horsepower	1 U.S. gal. = 8.345 lb. water
1 hp. = 746 kW	1 U.S. gal. = 3.785 liters
1 boiler hp. = 9.8 kW	

Natural gas equivalent

One therm = 1000,000 BTU

One cu. ft. of gas = 1040 BTU (range 1020-1055)

One therm (Rounding off) = 1000 cu. ft. gas

One MCF = 1,040,000 BTU

Multiply No. of	By	To Obtain
bar	987	atmosphere
bar	100,000	pascal
barrel (42 US gal.)	.159	Cu. meters
calorie	4.184	Joule
Joule	.00095	BTU
Kilojoule	3.600	kilowatt-hour
Kilograms/sq. cm.	14.2	Pound/sq. inch

ENGINEERING DATA

Metric Conversion Guide

Quantity	To Convert From	To	Multiply By
Area	Square inches (in ²)	Square Centimeters (cm ²)	6.4516
	Square Feet (ft ²)	Square Meters (m ²)	9.2903 x 10 ⁻²
Enthalpy (Heat)	BTU Per Pound-Mass	Kilojoule Per Kilogram (kJ/kg)	2.3260
Entropy (Heat)	BTU Per Pound-Mass-°F (BTU/lb m x °F)	Kilojoule Per Kilogram--Kelvin (kJ/kg.K)	4.1840
*Flow	Cubic Inches Per Minute (in. ³ /min.)	Cubic Centimeters Per Second (cm ³ /s)	0.2731
	Cubic Feet Per Minute (ft. ³ /min.)	Cubic Centimeters Per Second (cm ³ /s)	471.9474
	Cubic Feet Per Minute (ft. ³ /min.)	Cubic Decimeters Per Second (dm ³ /s)=l/s***	0.4719
	Cubic Feet Per Minute (ft. ³ /min.)	Cubic Meters Per Second (m ³ /s)	0.4719 x 10 ⁻³
	Cubic Feet Per Minute (ft. ³ /min.)	Cubic Meters Per Hour (m ³ /h)	1.6990
	Standard Cubic Feet Per Minute SCFM 60°F, 14.7 psia	Cubic Meters Per Hour (m ³ /h) 0°C, 1.01325 bar	1.607
	Standard Cubic Feet Per Minute SCFM 60°F, 14.7 psia	Cubic Meters Per Hour (m ³ /h) 15°C, 1.01325 bar	1.695
	Gallons Per Minute (U.S. liquid) (gal./min.)	Cubic Decimeters Per Second (dm ³ /s)=(l/s)	0.0631
Force	Pound (Force) (lb.)	Newtons (N)	4.4482
Length	Inches (in.)	Millimeters (mm)	25.4000
	Inches (in.)	Centimeters (cm)	2.5400
	Feet (ft.)	Centimeters (cm)	30.4800
	Feet (ft.)	Meters (m)	0.3048
Mass** (Weight)	Pound (lb.)	Kilogram (kg)	0.4536
Power	BTU Per Hour (BTU/hr.)	Watts (W)	0.2929
	Horsepower (H.P.)	Watts (W)	746.0000
Pressure (Stress)	Pounds Per Square Inch (PSI)	Kilopascals (kPa)	6.8947
	Kilograms Per Square Centimeters (Kg/cm ²)	Kilopascals (kPa)	98.0665
	Inches of Water ("W.G.) @ 60°F	Pascals (Pa)	1248.84
	Inches of Mercury ("Hg)@ 60°F	Pascals (Pa)	3376.85
Temperature	Degrees Fahrenheit (°F)	Degrees Celcius (°C)	tC = (tF - 32) / 1.8
	Degrees Fahrenheit (°F)	Kelvin (K)	tK = (tF+459.67) / 1.8
Torque (Bending)	Pound Force-Inch (lb-in)	Newton-Meter (Nm)	0.1129
	Pound Force-Foot (lb-ft)	Newton-Meter (Nm)	1.3558
Velocity	Feet Per Second (ft./sec.)	Meters Per Second (m/s)	0.3048
	Feet Per Minute (ft./min.)	Meters Per Second (m/s)	5.0800 x 10 ⁻⁴
	Miles Per Hour (MPH)	Meters Per Second (m/s)	0.4470
Volume	Cubic Inches (in ³)	Cubic Centimeters (cm ³)	16.3871
	Cubic Feet (ft ³)	Cubic Meters (m ³) = Stere	2.8317 x 10 ⁻²
	Gallons U.S. (gal.)	Cubic Meters (m ³) = Stere	3.7854 x 10 ⁻³
	Oz (U.S. fluid)	Cubic Meters (m ³) = Stere	2.9573 x 10 ⁻⁵
Work (Energy)	BTU (BTU)	Kilojoule (kJ)	1.0551
	Foot Pound (ft-lb)	Joule (J)	1.3558
	Watt-hour (W-hr.)	Kilojoule (kJ)	3.6000

- * Since standard and normal cubic meters (STD m³ and Nm³) do not have a universally accepted definition, their reference pressure and temperature should always be spelled out.
- ** In commercial and everyday use, the term weight almost always means mass.
- *** Air consumption for pneumatic control devices should be expressed in milliliters per sec. (ml/s). Allowable leakage rates for pneumatic control devices should be expressed in milliliters per second (ml/s) or microliters per second (ul/s)

Physical Properties of Liquid:

Substance	Density*	Melt. pt. °C	Latent ht.		Boil pt. °C	Latent ht. vaporization		Viscosity Poises [†]	Spec. ht.
			fusion	BTU/lb		BTU/lb			
Acetaldehyde (aldehyde)	50.30	-120.00	-	-	20.80	244.8	-	0.00231	-
Acetic acid	65.50	16.70	77.7	-	118.50	174.2	-	0.01222	0.522
Acetone	49.42	-94.60	35.3	-	56.10	224.0	-	0.00310	0.506
Allyl alcohol	52.85	-129.00	-	-	97.00	293.4	-	0.01363	0.665
Amyl alcohol	50.98	-78.50	-	-	137.90	216.4	-	-	-
Aniline	64.58	-6.24	37.7	-	183.90	198.0	-	0.04467	0.512
Benzene (benzol)	54.85	5.56	54.6	-	80.12	169.6	-	0.00654	0.34
Bromine	198.87	-7.20	29.2	-	58.80	86.4	-	0.01005	0.107
Butyl alcohol	50.54	-89.80	54	-	117.70	254.0	-	0.02948	0.687
Butyric acid	59.53	-5.55	54.2	-	163.50	205.0	-	0.01540	0.515
Carbolic acid (phenol)	66.70	41.00	52.3	-	182.20	-	-	0.12740	0.561
Carbon disulfide	80.70	-111.80	-	-	46.26	151.0	-	0.00376	0.24
Carbon tetrachloride	99.47	-22.80	74.8	-	76.75	83.5	-	0.00975	0.201
Castor oil	59.92	-63.50	-	-	-	-	-	9.86000	0.434
Chloroform	92.90	-32.00	-	-	61.20	106.0	-	0.00571	0.226
Decane	46.61	-116.30	-	-	174.00	-	-	0.00770	0.500
Di-ethyl ether	44.55	-198.20	-	-	34.50	151.0	-	0.00245	0.529
Ether	31.38	-114.60	-	-	35.00	-	-	-	0.503
Ethyl acetate	56.10	-119.00	-	-	77.10	-	-	0.00450	0.457
Ethyl alcohol	49.23	-138.70	44.8	-	78.32	367.7	-	0.01200	0.548
Ethyl bromide	90.50	-119.00	-	-	38.40	107.8	-	0.00402	0.215
Ethyl chloride	57.28	-138.70	-	-	12.20	166.5	-	-	0.367
Ethyl iodide	121.30	-108.50	-	-	72.10	82.0	-	0.00592	0.161
Ethylene bromide	135.40	10.01	-	-	181.70	83.2	-	0.01721	0.173
Ethylene chloride	77.75	-35.30	-	-	83.70	139.2	-	0.00838	0.299
Formic acid	76.13	8.40	106	-	100.80	216.0	-	0.01784	0.525
Gasoline	41.18	-	-	-	70.0-90.0	-	-	-	0.5
Glycerin	78.69	18.10	85.5	-	290.00	-	-	8.30000	0.576
Heptane	42.68	-90.70	-	-	98.40	137.3	-	0.00416	0.49
Hexane	41.18	-95.40	-	-	68.70	142.7	-	0.00326	0.6
Kerosene	48.70	-	-	-	-	-	-	-	0.5
Linseed oil	58.28	-20.00	-	-	287.00	-	-	0.33100	-
Methyl acetate	57.84	-98.10	-	-	57.10	176.6	-	0.00388	0.468
Methyl alcohol	49.42	-97.80	39.6	-	64.70	473.0	-	0.00596	0.601
Methyl iodide	142.58	-64.00	-	-	42.30	82.6	-	0.00500	-
Naphthalene	71.88	80.20	64	-	218.00	136.0	-	0.04000	0.396
Neatsfoot oil	56.97	-	-	-	-	-	-	-	-
Nitric acid (100%)	94.41	-47.00	17.2	-	86.00	207.0	-	-	-
Nitrobenzene	75.63	5.85	40.5	-	210.90	142.4	-	0.02100	0.35
Nonane	44.80	-51.00	-	-	150.60	-	-	0.00620	0.503
Octane	44.12	-56.90	-	-	124.60	127.7	-	0.00542	0.578
Olive oil	57.28	20.2	-	-	300.2	-	-	0.84000	0.471
Paraffin	44.30	-	-	-	400.00	-	-	-	0.71
Pentane	39.37	-129.90	-	-	36.00	-	-	0.00240	-
Petroleum	54.79	-	-	-	-	-	-	-	0.511
Propionic acid	61.77	-20.80	-	-	111.10	177.8	-	0.01102	0.56
Propyl alcohol	50.16	-127.00	-	-	97.50	296.0	-	0.02256	0.57
Rapeseed oil	56.97	-3.50	-	-	-	-	-	1.18000	-
Soya bean oil	57.35	-	-	-	-	-	-	0.40600	-
Sperm oil	54.91	-	-	-	98.3%	-	-	0.42000	-
Sulfur, melted	14.60	-	-	-	445.00	1174.0	-	-	0.234
Sulfuric acid (100%)	114.25	10.49	43.3	-	330.00	219.7	-	0.50000	0.344
Tallow	58.66	27.41	-	-	-	-	-	0.17600	-
Toluene	55.04	-95.00	-	-	110.30	155.7	-	0.00590	0.44
Turpentine	54.48	-10.00	-	-	160.00	123.5	-	0.01487	0.411
Water	62.40	0.00	79.7	-	143.50	970.0	-	0.01005	1
Xylene O	53.85	-27.10	-	-	142.00	149.2	-	0.00881	0.411

*Where the temperature is not given, ordinary temp. is understood

[†]Dyne sec/cm²

ENGINEERING DATA

Physical properties of solids:

Metals

Substance	Density*		Latent ht.		Spec. ht.	
	lb/cu ft	Melt. pt. °C	fusion BTU/lb	Boil pt. °C	vaporization BTU/lb	g-cal/g/°C or BTU/lb/°F
Aluminum	168.5	659.8	167.4	1800	3510	0.226
Antimony	413	630.5	70.2	1380	971	0.0504
Arsenic	357.6	Volatilizes	-	615*	133	0.078
Barium	218.4	850	-	1140	1130	0.068
Beryllium	112.3	1350	572.4	1500	-	0.425
Bismuth	610.3	271.3	22.5	1450	398	0.0294
Brass	-	1700	-	-	-	0.092
Cadmium	539.6	320.9	23	766	410	0.0552
Calcium	96.7	810	140	1170	-	0.149
Cerium	430.5	640	-	1400	-	0.0511
Cesium	116.9	26.0	6.8	670	237	0.0482
Chromium	432.4	1765	126	2200	27	0.111
Cobalt	543.5	1480	115.2	3000	-	0.1001
Copper	554.7	1083	88.7	2300	3161	0.0928
Gold	1204.3	1063	28.6	2600	803	0.0312
Iridium	1399	2454±3	47	4800	612	0.0323
Iron (99.97%)	491	1535	117	3200	1998	0.1075
Lead	707.7	327.4	10.8	1620	581	0.0297
Lithium	33.3	186	217	1200	-	0.96
Magnesium	108.6	651	126	1097	2340	0.249
Manganese	845.3	1260	-	1900	1879	0.1211
Mercury	449.3	-38.87	4.98	356.9	128	0.0333
Molybdenum	636.5	2620	-	3700	318	0.0589
Nickel	552.2	1440	131.4	2900	1818	0.1032
Osmium	1402.7	2700	-	5300	630	0.0311
Palladium	748.8	1553	64.7	2200	1098	0.0538
Platinum	1333.5	1773.5	48.4	4300	1147	0.0319
Potassium	54.3	62.3	26.3	760	923	0.177
Rhodium	776.3	1966	-	>2500	1116	0.058
Silver	665.2	960.5	46.6	1950	982	0.0557
Sodium	57.2	97.5	48.6	880	2106	0.283
Steel	487	1398	-	-	-	0.12
Strontium	162.2	800	-	1150	1881	0.0735
Tantalum	1035.8	2850	-	>4100	-	0.036
Tellurium	390	452	13.1	1390	286	0.0483
Thallium	745.7	303.5	-	1650	396	0.0326
Thorium	686.4	1845	-	>3000	-	0.0276
Tin	431.9	231.89	25.9	2260	1179	0.0548
Titanium	280.8	1800	-	>3000	2376	0.1125
Tungsten	1185.6	3382	-	5900	2129	0.032
Uranium	1168.9	<1850	-	-	-	0.0280
Vanadium	349.4	1710	-	3000	-	0.1153
Zinc	445.5	419.45	47.9	905±2	767	0.0931
Zirconium	407.5	1900	-	>2900	-	0.066

*Where temperature is not given, ordinary temperature is understood.

Non-metallic

Substance	Latent ht.		Weight		Spec. ht.
	Melt. pt. °C	fusion BTU/lb	lb/ft³		
Asphalt	121.1	40	81		.40
Bakelite	-	-	-		3-4
Basalt	-	-	150		.20
Beeswax	62.2	75	60		
Brickwork	-	-	144		.20
Carbon, graphite	-	-	140		.126
diamond	-	-	-		.1044
Calc spar	-	-	-		.2005
Cellulose	-	-	-		.35
Chalk	-	-	120		.214
Clay	-	-	115		.22
Coal	-	-	90		.3
Coke	-	-	62		.265
Concrete	-	-	175		.156
Ebonite	-	-	-		.40
Glass	-	-	185		.1988
crown	-	-	-		.161
flint	-	-	200		.117
Granite	-	-	165		.192
Graphite	-	-	130		.20
Ice (-20° C)	-	-	-		.465
Ice (0° C)	-	-	-		.487
India rubber, Para	-	-	-		.481
Limestone	-	-	125		.22
Marble	-	-	165		.21
Mica	-	-	165		.10
Paper	-	-	58		.45
Plastics:					
ABS	-	52	62.2		3-4
Cellulosic	-	83	82.9		3-5
Epoxy	-	78	77.8		.25
Fluoroplastic	-	133	133.1		.28
Nylon	-	69	69.1		.4
Phenolic	-	83	82.9		82.9
Polyethylene	-	57	57.0		.55
Polystyrene	-	64	63.9		.32
Vinyl	-	86	86.4		2-3
Porcelain	-	-	145		.26
Quartz	1732	-	138		.17
Rock salt	-	-	136		.188
Rubber	-	-	75		.48
Sand	-	-	90		.19
Selenium	-	-	301		.077
Silicon	-	-	151		.181
Sugar	160	320	105		.30
Sulfur, rhombic	-	-	125		.176
monoclinic	-	-	-		.181
Woods, general	-	-	-		.3-7

Physical properties of gases:

Substance	Density*	Melt.	Latent ht. fusion**	Boil pt.	Latent ht. vaporization	Spec. ht.**
	lb./ft. ³	pt., °C	BTU/lb ¹	°C	BTU/lb	
Acetylene	068	-81.3	-	-83.6	-	0.3832
Air	080	-	-	-	92	0.2377
Ammonia	048	-75	194.4	-33.5	589	0.5202
Argon	1033	-189.2	12.1	-185.7	67.9	0.1233
Arsine	202	-113.5	-	-54.8	-	-
Butane-iso	16	-145.0	-	-10.2	157.3	-
Butane-n	15	-135.0	-	0.6	164.7	-
Carbon Dioxide	11.44	-57	81.5	-80 sub ¹	248.2	0.2025
Carbon monoxide	725	-207	14.4	-191.5	90.7	0.2425
*Carbon oxychloride (phosgene)	270	-118	-	8.3	-	-
Carbon oxy-sulfide	170	-138	-	-48	-	-
Chlorine	1853	-101.6	44.4	-34.7	145.8	0.1125
Chlorine monoxide	247	-20	-	3.8 (explodes)	-	-
Cyanogen	14	-27.90	-	-21.17	-	0.4095
Ethane	084	-172.0	-	-88.3	464.4	0.3861
Ethyl Chloride	179	-138.7	-	12.2	166.5	0.2750
Ethylene	078	-169.4	-	-103.8	-	0.399
Fluorine	1059	-223	-	-187	72.9	0.192
Helium	0103	-272	-	-269.94	10.7	1.25
Hydrogen	0056	-259.14	25.2	-252.8	192	3.429
Hydrogen bromide	2275	-86.7	13.8	-68.7	87.7	0.082
Hydrogen chloride	1023	-111.3	24.1	-83.1 (755 mm)	190.6	0.194
Hydrogen fluoride	0535	-92.3	-	-36.7 (755 mm)	-	0.343
Hydrogen iodide	355	-51.3	10.2	-35.7	51	0.06
Hydrogen selenide	223	-64	-	-42	-	-
Hydrogen sulfide	096	-86	-	-62	237.4	0.2451
Hydrogen telluride	360	-48	-	-1.8	-	-
Krypton	230	-169	-	-151.8	50.4	-
Methane	0446	-182.5	26.2	-161.4	248.4	0.5929
Methyl chloride	142	-103.6	-	-23.73	184.1	0.24
Methyl ether	131	-138	-	-24.9	-	-
Methyl fluoride	096	-	-	-78.0	-	-
Mono-methylamine	087	-92.5	-	-6.8	-	-
Neon	056	-248.67	5.1	-245.9	-	-
Nitric oxide	0777	-167	33.1	-153	-	0.232
Nitrogen	073	-209.86	71	-195.8	86	0.2438
Nitrosyl chloride	186	-64.5	-	-5.5	-	-
Nitrous oxide	123	-102.4	-	-89.8	-	0.2126
Oxygen	083	-218.4	6	-183.0	91.8	0.2175
Phosphine	095	-133.5	-	-87.4	-	-
Propane	126	-189.9	-	-44.5	-	-
Silicon tetrafluoride	292	-	-	-68	-	-
Sulfur dioxide	166	-76	-	-10	170.6	0.1544
Xenon	365	-140	6.71	-109.1	43.9	-

*WT in lbs/cu. ft. at approx. 70°F and atmospheric pressure

**where temperature is not given, ordinary temperature is understood

†all properties are at a pressure equivalent to 760mm of mercury unless otherwise stated

Cryogenic Properties of Gases

Properties	He	Ne	A	Kr	Xe	H ₂	CH ₄	NH ₃	N ₂	O ₂
Density, 32°F Atm. lb/ft. ³	0.1114	0.562	1.113	2.34	3.68	0.0561	0.448	0.481	0.781	0.892
Boiling pt. 1 Atm. °F	-452.0	-410.6	-302.4	-243.2	-162.6	-423.0	-258.7	-28.03	-320.4	-297.4
Melting pt. 1 Atm. °F	-458.0	-415.7	-308.7	-250.8	-159.2	-434.6	-299.2	-107.9	-345.6	-361.1
Vapor dens. at 62°F lb/ft. ³	999	593	368	518	606	0.630	1.124	0.556	288	296
Liquid dens. at B.P. lb/ft. ³	7.803	74.91	86.77	149.8	193.5	4.37	26.47	42.58	50.19	71.29
Vapor press. Solid at M.P. in mm. Hg	< .02	323	516	549	612	54	70	45.2	96.4	2.0
Heat of Vapor at B.P. Btu/lb	< .03	37.4	70.0	46.4	41.4	194.4	248.4	588.6	85.7	91.6
Ht. of Fusion at M.P. Btu/lb	< 1.8	7.2	12.1	7.0	5.9	25.2	25.1	151.2	11.0	5.3
CP 50°F 1 Atm. Btu/lb	-292°F	Ap	Ap	Ap	Ap	3.39	528	523	248	218
Sp. Cv. 59-68°F 1 Atm.	-292°F	1.65	1.64	1.67	1.68	1.41	1.31	1.31	1.40	1.40
Critical temp. °F	-450.2	-379.7	-188.5	-82.7	51.9	-399.8	-116.5	270.3	-232.8	-181.1
Critical pressure Atm.	2.26	26.8	48.0	54.2	58.2	12.8	45.8	111.5	33.5	50.1

ENGINEERING DATA

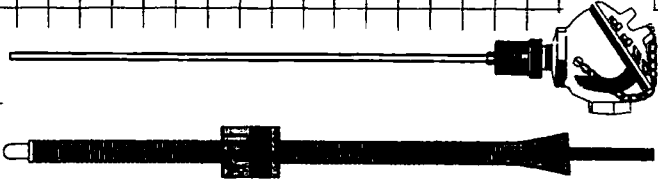
Steam Tables

Heat Content Above 32 Degrees Fahrenheit					
Gauge Pressure (PSIG)	Saturation or Boiling Temperature (Degrees F)	Specific Volume (Cu. Ft./Lb.)	Sensible Heat or Heat of Liquid (BTU/Lb.)	Latent Heat or Heat of Evaporation (BTU/Lb.)	Total Heat (BTU/Lb.)
0	212.0	26.80	180.1	970.3	1150.4
1	215.5	25.13	183.6	968.1	1151.7
2	218.7	23.72	186.8	966.0	1152.8
3	221.7	22.47	189.8	964.1	1153.9
4	224.5	21.35	192.7	962.3	1155.0
5	227.3	20.34	195.5	960.5	1156.1
6	229.9	19.42	198.2	958.8	1157.0
7	232.4	18.58	200.7	957.2	1157.9
8	234.9	17.81	203.2	955.6	1158.8
9	237.2	17.11	205.6	954.1	1159.7
10	239.5	16.46	207.9	952.5	1160.4
11	241.7	15.86	210.1	951.1	1161.2
12	243.8	15.31	212.2	949.7	1161.9
13	245.9	14.79	214.3	948.3	1162.6
14	247.9	14.31	216.4	946.9	1163.2
15	249.8	13.86	218.3	945.6	1163.9
16	251.7	13.43	220.3	944.3	1164.6
17	253.6	13.03	222.2	943.0	1165.2
18	255.4	12.66	224.0	941.8	1165.8
19	257.1	12.31	225.7	940.6	1166.3
20	258.8	11.98	227.5	939.5	1167.0
21	260.5	11.67	229.2	938.3	1167.5
22	262.2	11.37	230.9	937.2	1168.1
23	263.8	11.08	232.5	936.1	1168.6
24	265.4	10.82	234.1	935.0	1169.1
25	266.9	10.56	235.6	934.0	1169.6
30	274.1	9.45	243.0	928.9	1171.9
35	280.7	8.56	249.8	924.2	1174.0
40	286.8	7.82	256.0	919.8	1175.8
45	292.4	7.20	261.8	915.7	1177.5
50	297.7	6.68	267.2	911.8	1179.0
55	302.7	6.23	272.1	908.1	1180.5
60	307.3	5.83	277.2	904.6	1181.8
65	311.8	5.49	281.8	901.3	1183.1
70	316.4	5.18	286.2	898.0	1184.2
75	320.1	4.91	290.4	894.8	1185.2
80	323.9	4.66	294.4	891.9	1186.3
85	327.6	4.44	298.2	899.0	1187.2
90	331.2	4.24	301.9	886.1	1188.0
95	334.6	4.06	305.5	883.3	1188.8
100	337.9	3.89	308.9	880.7	1189.6
105	341.1	3.74	312.3	878.1	1190.4
110	344.2	3.59	315.5	875.5	1191.0
115	347.2	3.46	318.7	873.0	1191.7
120	350.1	3.34	321.7	870.7	1192.4
125	352.9	3.23	324.7	868.3	1193.0
130	355.6	3.12	327.6	865.9	1193.5
135	358.3	3.02	330.4	863.7	1194.1
140	360.9	2.93	333.1	861.5	1194.6
145	363.4	2.84	335.8	859.3	1195.1
150	365.9	2.76	338.4	857.2	1195.6
155	368.4	2.68	340.9	855.0	1195.9
160	370.8	2.61	343.4	853.0	1196.4
165	372.9	2.54	345.9	850.9	1196.8
170	375.2	2.47	348.3	848.9	1197.2
175	377.4	2.41	350.7	846.9	1197.6
180	379.5	2.35	353.0	845.0	1198.0
185	381.6	2.30	355.2	843.1	1198.3
190	383.7	2.24	357.4	841.2	1198.6
195	385.8	2.19	359.6	839.2	1198.8
200	387.8	2.13	361.9	837.4	1199.3
210	391.7	2.04	366.0	833.6	1199.9
220	395.5	1.95	370.1	830.3	1200.4
230	399.1	1.88	374.1	826.8	1200.9
240	402.7	1.81	377.8	823.4	1201.3
250	406.1	1.74	381.6	820.1	1201.7
260	409.4	1.68	385.2	816.9	1202.1
270	412.6	1.62	388.7	813.7	1202.4
280	415.7	1.56	392.1	810.5	1202.7
290	418.8	1.52	395.5	807.5	1202.9
300	421.8	1.47	398.7	804.5	1203.2
400	448.2	1.12	428.1	776.4	1204.6
500	470.0	0.90	452.9	751.3	1204.3
600	488.8	0.75	474.6	728.3	1202.9

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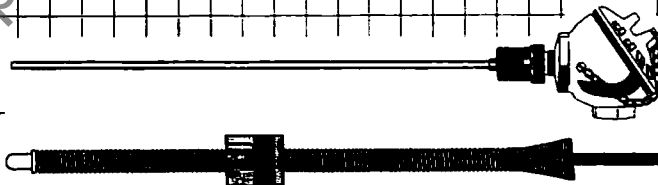


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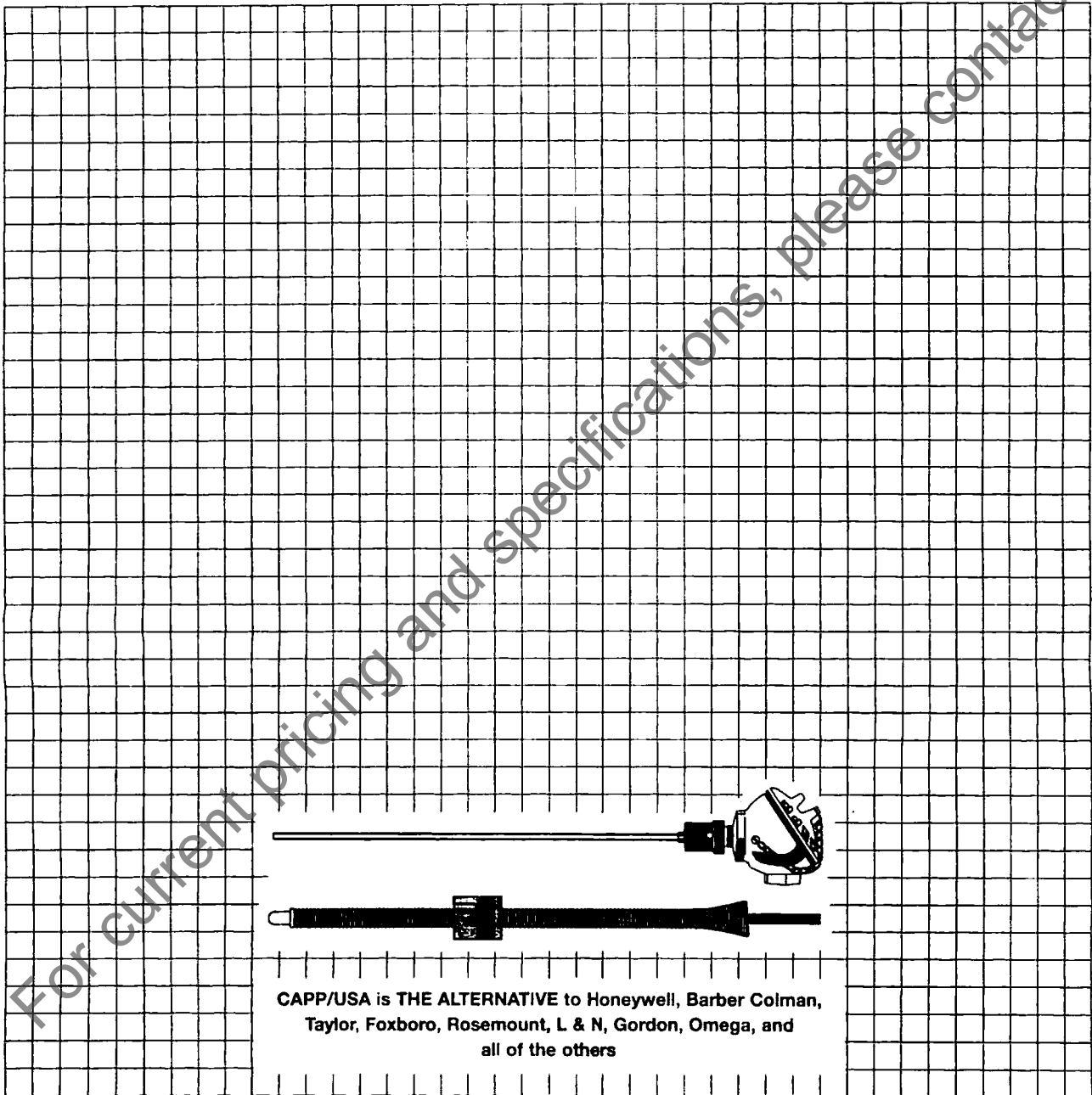
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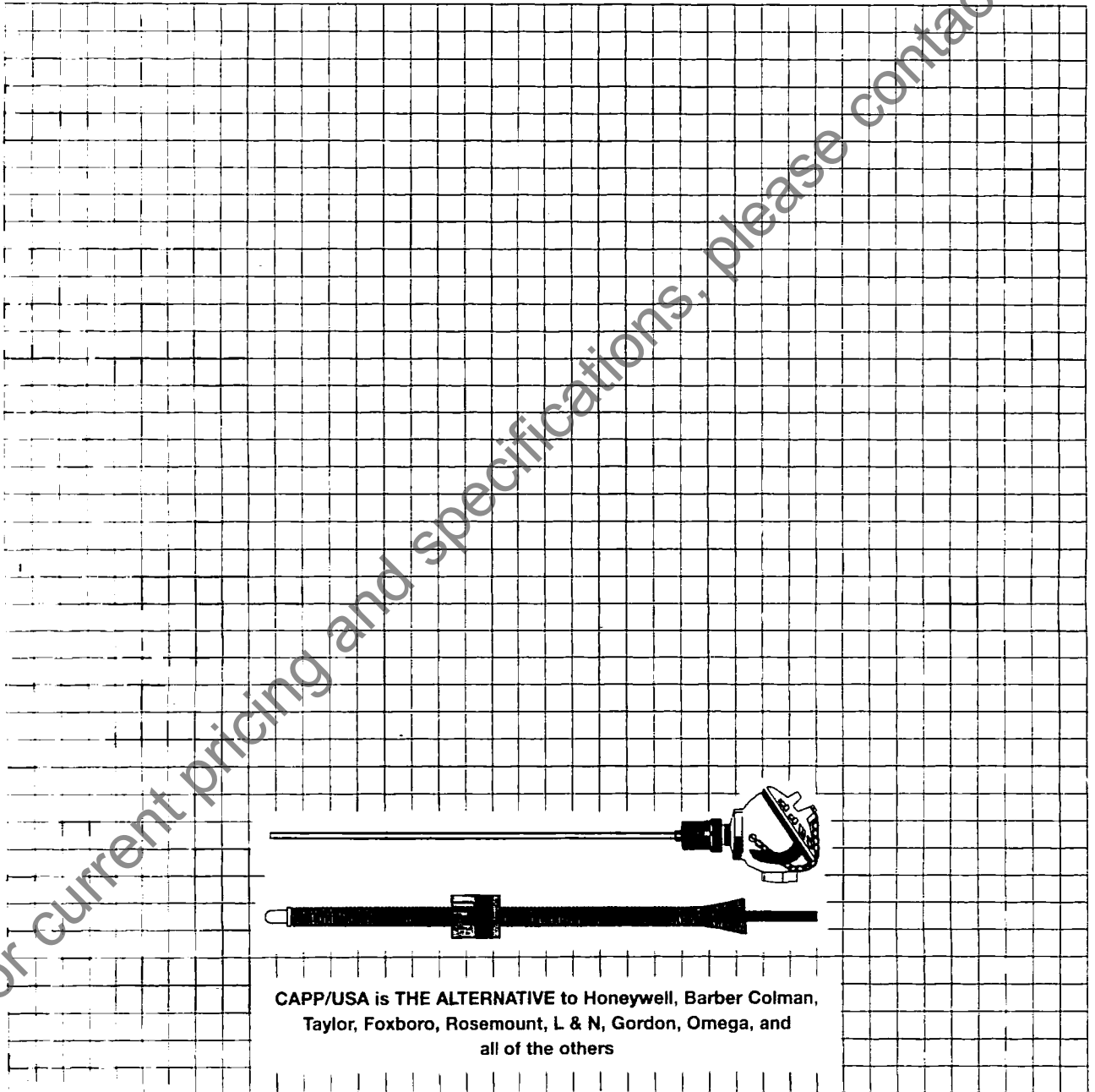
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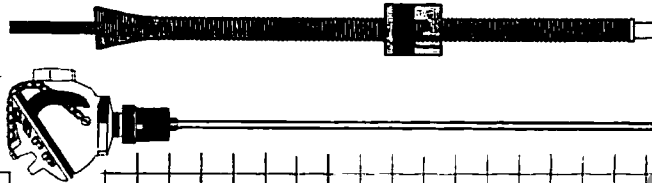
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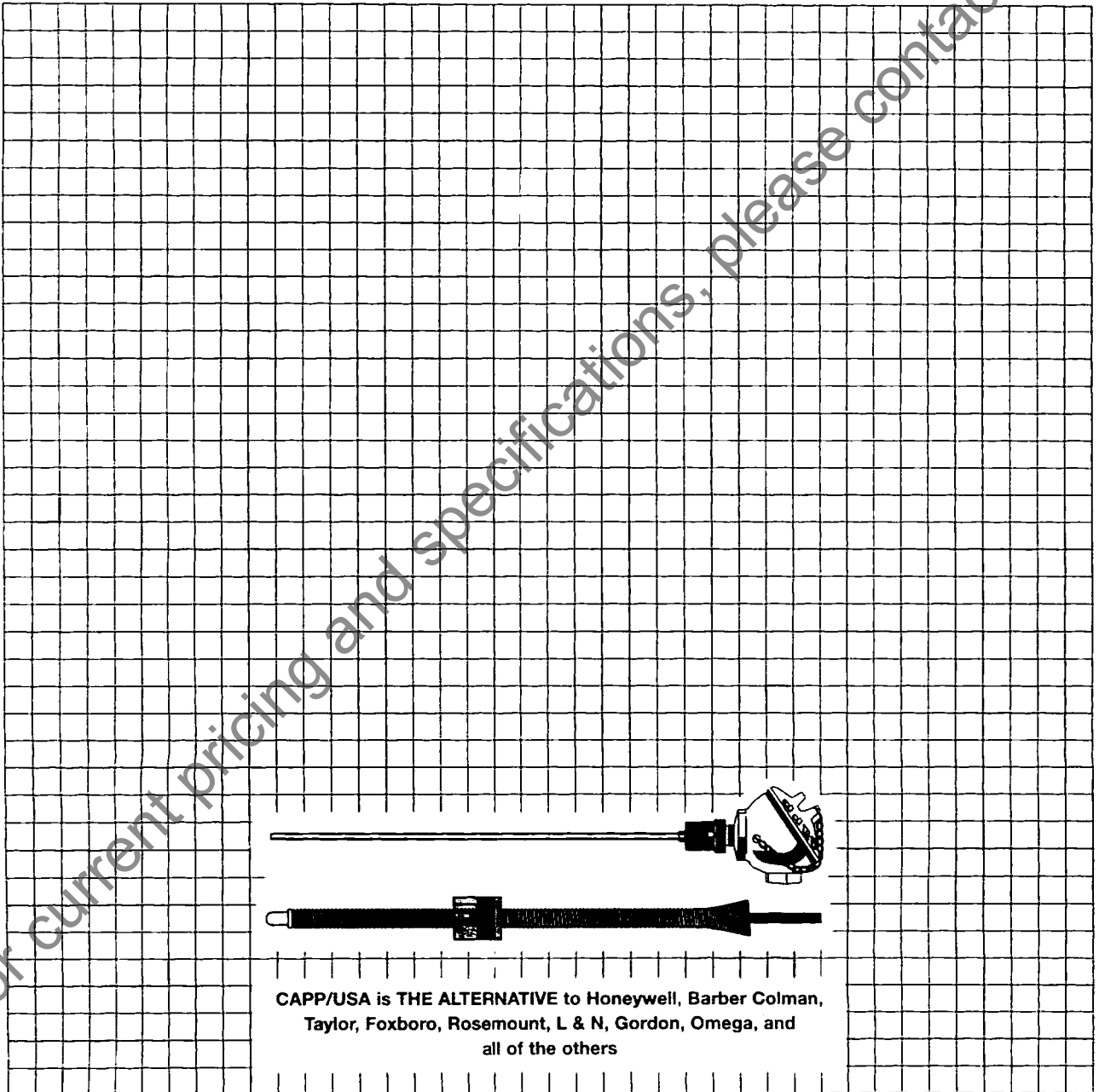
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The grid area contains a technical drawing of a probe assembly. The assembly consists of a long, thin shaft with a handle at one end and a complex, multi-faceted probe head at the other. The handle has a textured grip and a small rectangular label. The probe head is cylindrical with several flat surfaces and a central opening.

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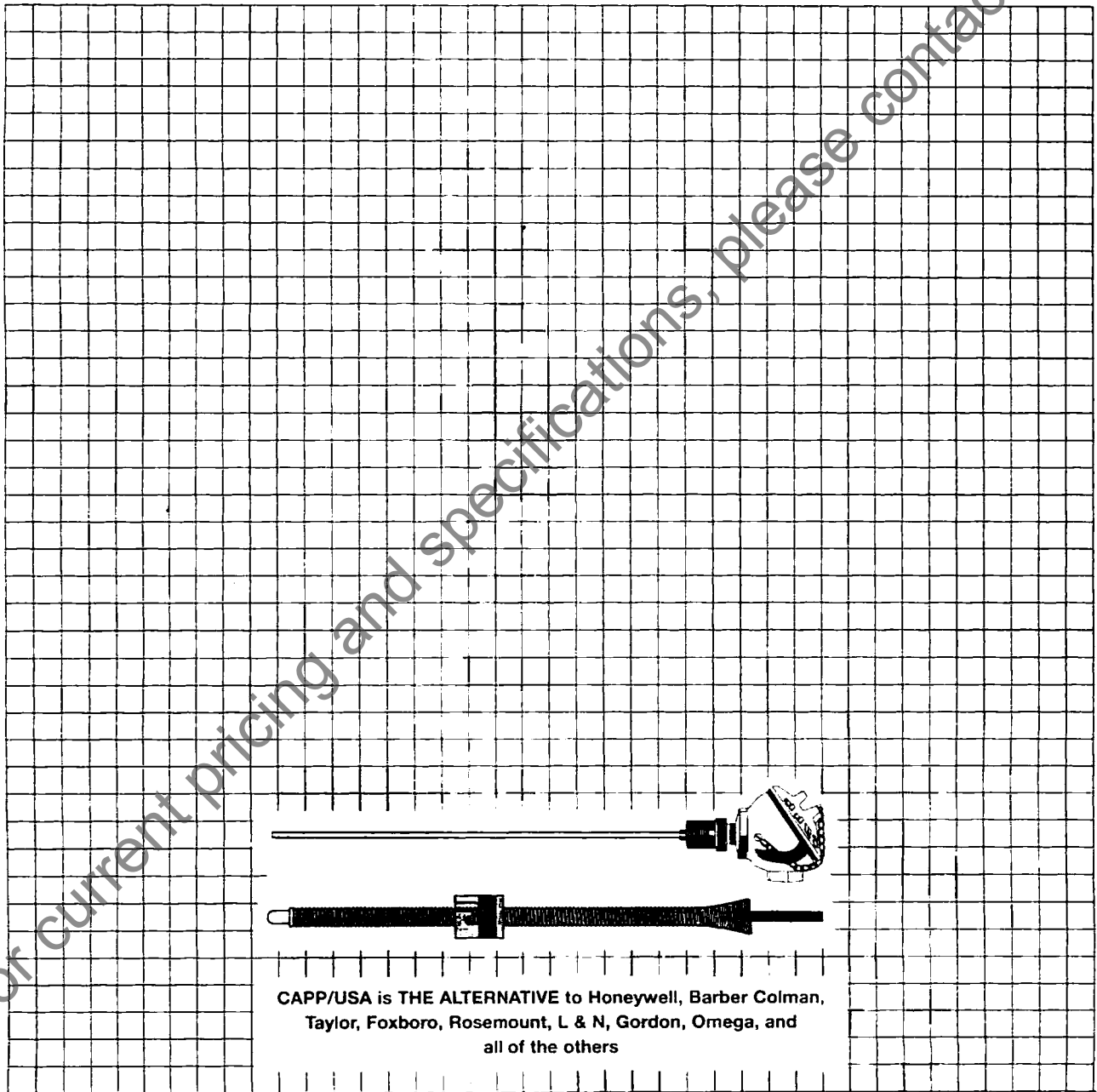
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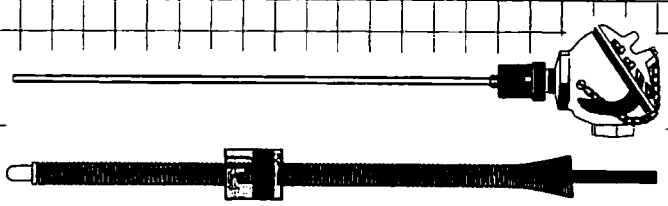
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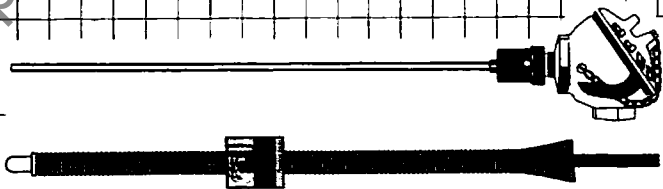


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