

Temperature-EMF Relation for Iron-Constantan Thermocouples

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FOREWORD

Standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining without delay the proper product for his particular need. Existence of a Standard does not in any respect preclude any member or non-member from manufacturing or selling products not conforming with the standard.

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TEMPERATURE-EMF RELATION FOR IRON-CONSTANTAN THERMOCOUPLES

1. Scope and Purpose

1.1 This standard applies to temperature-emf values for the iron-constantan thermocouple.

1.2 The purpose of this standard is to establish standard temperature-emf values for the iron-constantan thermocouple.

Note: Over a period of years, commercial practice in this country has evolved a single (and, in effect, a "standard") conversion table for each of the commonly used thermocouples except iron-constantan. The following is quoted from an article in the NBS Technical News Bulletin (Vol. 34, Page 174, December, 1950) entitled, "Standardization of Iron-Constantan Thermocouple Tables": "The iron-constantan thermocouple is widely used in industry for measurement of temperatures up to 1500°F. Yet it is the only type of thermocouple for which uniformity of commercial practice has not been established in this country.

"Recently, at the request of the Scientific Apparatus Makers Association, the National Bureau of Standards has undertaken to derive a temperature-emf reference table for iron-constantan thermocouples that would be suitable for adoption as a standard."

Based on the above-mentioned investigation made at the National Bureau of Standards, the Recorder-Controller Section, is adopting this iron-constantan table. The values cover the range from -300 F to 1600 F. This new table very closely approximates the table which is in wide commercial use today, the maximum deviation being one degree Fahrenheit up to

1400 F and two degrees Fahrenheit between 1400 F and 1600 F. Sub-zero values are here published for the first time.

*NBS Circular 508 "Reference Tables for Thermocouples"

2. Terminology and General Definitions

2.1 For definitions of terms as used in this standard, see

Thermocouple Thermometers (Pyrometers).

3. Conversion Tables for Iron-Constantan

3.1 Conversion tables are given in degrees C and degrees F, and for even increments of emf, as well as even increments of temperature.

Note: Electromotive force is expressed in absolute units. The change from international to absolute electrical units, which by international agreement, became effective on January 1, 1948, is described in NBS Circular 459.

One absolute volt is equal to 0.99967 international volt (U.S.).

Temperatures are expressed on the International Temperature Scale of 1948, which is discussed in "The International Temperature Scale of 1948", by H. P. Stimson, J. Research NBS 42, 209 (1949) RP1962, and "Differences between the International Temperature Scales of 1948 and 1927" by R. J. Corruccini, J. Research NBS 43, 133 (1949) RP2014.

IRON-CONSTANTAN THERMOCOUPLES

Table 1 - Celsius (Centigrade) Table - Even Increments of emf

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948)
Reference Junctions at 0°C.)

Millivolts	.00	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00	Millivolts
Degrees C												
-7.00	-166	-169	-173	-176	-180	-184	-188	-192	-196			-7.00
-6.00	-136	-138	-141	-144	-147	-150	-153	-156	-159	-163	-166	-6.00
-5.00	-109	-112	-114	-117	-119	-122	-125	-127	-130	-133	-136	-5.00
-4.00	-85	-87	-90	-92	-94	-97	-99	-102	-104	-107	-109	-4.00
-3.00	-62	-65	-67	-69	-71	-74	-76	-78	-80	-83	-85	-3.00
-2.00	-41	-43	-45	-47	-49	-52	-54	-56	-58	-60	-62	-2.00
-1.00	-20	-22	-24	-26	-28	-30	-32	-35	-37	-39	-41	-1.00
(-)0.00	0	-2	-4	-6	-8	-10	-12	-14	-16	-18	-20	(-)0.00
(+)0.00	0	2	4	6	8	10	12	14	16	18	20	(+)0.00
1.00	20	22	24	25	27	29	31	33	35	37	39	1.00
2.00	39	41	43	45	47	48	50	52	54	56	58	2.00
3.00	58	60	62	63	65	67	69	71	73	75	77	3.00
4.00	77	78	80	82	84	86	88	90	91	93	95	4.00
5.00	95	97	99	101	102	104	106	108	110	112	113	5.00
6.00	113	115	117	119	121	123	124	126	128	130	132	6.00
7.00	132	134	135	137	139	141	143	144	146	148	150	7.00
8.00	150	152	154	155	157	159	161	163	164	166	168	8.00
9.00	168	170	172	173	175	177	179	181	182	184	186	9.00
10.00	186	188	190	191	193	195	197	199	200	202	204	10.00
11.00	204	206	208	209	211	213	215	217	218	220	222	11.00
12.00	222	224	226	227	229	231	233	235	236	238	240	12.00
13.00	240	242	244	245	247	249	251	253	254	256	258	13.00
14.00	258	260	262	263	265	267	269	271	272	274	276	14.00
15.00	276	278	280	281	283	285	287	289	290	292	294	15.00
16.00	294	296	298	300	301	303	305	307	309	310	312	16.00
17.00	312	314	316	318	319	321	323	325	327	329	330	17.00
18.00	330	332	334	336	338	339	341	343	345	347	348	18.00
19.00	348	350	352	354	356	357	359	361	363	365	366	19.00
20.00	366	368	370	372	374	376	377	379	381	383	385	20.00

IRON-CONSTANTAN THERMOCOUPLES--Continued

Table 1 - Celsius (Centigrade) Table - Even Increments of emf

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948)
Reference Junctions at 0° C.)

Millivolts	Degrees C											Millivolts
	.00	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00	
20.00	366	368	370	372	374	376	377	379	381	383	385	20.00
21.00	385	386	388	390	392	394	395	397	399	401	403	21.00
22.00	403	405	406	408	410	412	414	416	417	419	421	22.00
23.00	421	423	424	426	428	430	432	434	435	437	439	23.00
24.00	439	441	443	444	446	448	450	452	453	455	457	24.00
25.00	457	459	461	463	464	466	468	470	472	473	475	25.00
26.00	475	477	479	481	482	484	486	488	489	491	493	26.00
27.00	493	495	497	499	500	502	504	506	507	509	511	27.00
28.00	511	513	514	516	518	520	522	523	525	527	529	28.00
29.00	529	530	532	534	536	537	539	541	543	544	546	29.00
30.00	546	548	550	551	553	555	557	558	560	562	564	30.00
31.00	564	565	567	569	571	572	574	576	577	579	581	31.00
32.00	581	583	584	586	588	589	591	593	595	596	598	32.00
33.00	598	600	601	603	605	607	608	610	612	613	615	33.00
34.00	615	617	618	620	622	624	625	627	629	630	632	34.00
35.00	632	634	635	637	639	640	642	644	645	647	649	35.00
36.00	649	650	652	654	655	657	659	660	662	664	665	36.00
37.00	665	667	668	670	672	673	675	677	678	680	681	37.00
38.00	681	683	685	686	688	690	691	693	694	696	698	38.00
39.00	698	699	701	702	704	706	707	709	710	712	713	39.00
40.00	713	715	717	718	720	721	723	725	726	728	729	40.00
41.00	729	731	732	734	736	737	739	740	742	743	745	41.00
42.00	745	747	748	750	751	753	754	756	757	759	761	42.00
43.00	761	762	764	765	767	768	770	772	773	775	776	43.00
44.00	776	778	779	781	782	784	785	787	789	790	792	44.00
45.00	792	793	795	796	798	799	801	803	804	806	807	45.00
46.00	807	809	810	812	814	815	817	818	820	821	823	46.00
47.00	823	824	826	828	829	831	832	834	835	837	839	47.00
48.00	839	840	842	843	845	846	848	850	851	853	854	48.00
49.00	854	856	858	859	861	862	864	866	867	869	870	49.00
50.00	870	872										50.00

IRON-CONSTANTAN THERMOCOUPLES

Table 2 - Celsius (Centigrade) Table - Even Increments of temperature
 (Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948)
 Reference Junctions at 0°C.)

°C	0	1	2	3	4	5	6	7	8	9	10	°C
Millivolts												
-190	-7.66	-7.69	-7.71	-7.73	-7.76	-7.78						-190
-180	-7.40	-7.43	-7.46	-7.49	-7.51	-7.54	-7.56	-7.59	-7.61	-7.64	-7.66	-180
-170	-7.12	-7.15	-7.18	-7.21	-7.24	-7.27	-7.30	-7.32	-7.35	-7.38	-7.40	-170
-160	-6.82	-6.85	-6.88	-6.91	-6.94	-6.97	-7.00	-7.03	-7.06	-7.09	-7.12	-160
-150	-6.50	-6.53	-6.56	-6.60	-6.63	-6.66	-6.69	-6.72	-6.76	-6.79	-6.82	-150
-140	-6.16	-6.19	-6.22	-6.26	-6.29	-6.33	-6.36	-6.40	-6.43	-6.46	-6.50	-140
-130	-5.80	-5.84	-5.87	-5.91	-5.94	-5.98	-6.01	-6.05	-6.08	-6.12	-6.16	-130
-120	-5.42	-5.46	-5.50	-5.54	-5.58	-5.61	-5.65	-5.69	-5.72	-5.76	-5.80	-120
-110	-5.03	-5.07	-5.11	-5.15	-5.19	-5.23	-5.27	-5.31	-5.35	-5.38	-5.42	-110
-100	-4.63	-4.67	-4.71	-4.75	-4.79	-4.83	-4.87	-4.91	-4.95	-4.99	-5.03	-100
-90	-4.21	-4.25	-4.30	-4.34	-4.38	-4.42	-4.46	-4.50	-4.55	-4.59	-4.63	-90
-80	-3.78	-3.82	-3.87	-3.91	-3.96	-4.00	-4.04	-4.08	-4.13	-4.17	-4.21	-80
-70	-3.34	-3.38	-3.43	-3.47	-3.52	-3.56	-3.60	-3.65	-3.69	-3.74	-3.78	-70
-60	-2.89	-2.94	-2.98	-3.03	-3.07	-3.12	-3.16	-3.21	-3.25	-3.30	-3.34	-60
-50	-2.43	-2.48	-2.52	-2.57	-2.62	-2.66	-2.71	-2.75	-2.80	-2.84	-2.89	-50
-40	-1.96	-2.01	-2.06	-2.10	-2.15	-2.20	-2.24	-2.29	-2.34	-2.38	-2.43	-40
-30	-1.48	-1.53	-1.58	-1.63	-1.67	-1.72	-1.77	-1.82	-1.87	-1.91	-1.96	-30
-20	-1.00	-1.04	-1.09	-1.14	-1.19	-1.24	-1.29	-1.34	-1.39	-1.43	-1.48	-20
-10	-0.50	-0.55	-0.60	-0.65	-0.70	-0.75	-0.80	-0.85	-0.90	-0.95	-1.00	-10
(-)0	0.00	-0.05	-0.10	-0.15	-0.20	-0.25	-0.30	-0.35	-0.40	-0.45	-0.50	(-)0
(+)0	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	(+)0
10	0.50	0.56	0.61	0.66	0.71	0.76	0.81	0.86	0.91	0.97	1.02	10
20	1.02	1.07	1.12	1.17	1.22	1.28	1.33	1.38	1.43	1.48	1.54	20
30	1.54	1.59	1.64	1.69	1.74	1.80	1.85	1.90	1.95	2.00	2.06	30
40	2.06	2.11	2.16	2.22	2.27	2.32	2.37	2.42	2.48	2.53	2.58	40
50	2.58	2.64	2.69	2.74	2.80	2.85	2.90	2.96	3.01	3.06	3.11	50
60	3.11	3.17	3.22	3.27	3.33	3.38	3.43	3.49	3.54	3.60	3.65	60
70	3.65	3.70	3.76	3.81	3.86	3.92	3.97	4.02	4.08	4.13	4.19	70
80	4.19	4.24	4.29	4.35	4.40	4.46	4.51	4.56	4.62	4.67	4.73	80
90	4.73	4.78	4.83	4.89	4.94	5.00	5.05	5.10	5.16	5.21	5.27	90
100	5.27	5.32	5.38	5.43	5.48	5.54	5.59	5.65	5.70	5.76	5.81	100

IRON-CONSTANTAN THERMOCOUPLES--Continued

Table 2 - Celsius (Centigrade) Table - Even Increments of temperature

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948)
Reference Junctions at 0°C.)

°C	0	1	2	3	4	5	6	7	8	9	10	°C
	Millivolts											
100	5.27	5.32	5.38	5.43	5.48	5.54	5.59	5.65	5.70	5.76	5.81	100
110	5.81	5.86	5.92	5.97	6.03	6.08	6.14	6.19	6.25	6.30	6.36	110
120	6.36	6.41	6.47	6.52	6.58	6.63	6.68	6.74	6.79	6.85	6.90	120
130	6.90	6.96	7.01	7.07	7.12	7.18	7.23	7.29	7.34	7.40	7.45	130
140	7.45	7.51	7.56	7.62	7.67	7.73	7.78	7.84	7.89	7.95	8.00	140
150	8.00	8.06	8.12	8.17	8.23	8.28	8.34	8.39	8.45	8.50	8.56	150
160	8.56	8.61	8.67	8.72	8.78	8.84	8.89	8.95	9.00	9.06	9.11	160
170	9.11	9.17	9.22	9.28	9.33	9.39	9.44	9.50	9.56	9.61	9.67	170
180	9.67	9.72	9.78	9.83	9.89	9.95	10.00	10.06	10.11	10.17	10.22	180
190	10.22	10.28	10.34	10.39	10.45	10.50	10.56	10.61	10.67	10.72	10.78	190
200	10.78	10.84	10.89	10.95	11.00	11.06	11.12	11.17	11.23	11.28	11.34	200
210	11.34	11.39	11.45	11.50	11.56	11.62	11.67	11.73	11.78	11.84	11.89	210
220	11.89	11.95	12.00	12.06	12.12	12.17	12.23	12.28	12.34	12.39	12.45	220
230	12.45	12.50	12.56	12.62	12.67	12.73	12.78	12.84	12.89	12.95	13.01	230
240	13.01	13.06	13.12	13.17	13.23	13.28	13.34	13.40	13.45	13.51	13.56	240
250	13.56	13.62	13.67	13.73	13.78	13.84	13.89	13.95	14.00	14.06	14.12	250
260	14.12	14.17	14.23	14.28	14.34	14.39	14.45	14.50	14.56	14.61	14.67	260
270	14.67	14.72	14.78	14.83	14.89	14.94	15.00	15.06	15.11	15.17	15.22	270
280	15.22	15.28	15.33	15.39	15.44	15.50	15.55	15.61	15.66	15.72	15.77	280
290	15.77	15.83	15.88	15.94	16.00	16.05	16.11	16.16	16.22	16.27	16.33	290
300	16.33	16.38	16.44	16.49	16.55	16.60	16.66	16.71	16.77	16.82	16.88	300
310	16.88	16.93	16.99	17.04	17.10	17.15	17.21	17.26	17.32	17.37	17.43	310
320	17.43	17.48	17.54	17.60	17.65	17.71	17.76	17.82	17.87	17.93	17.98	320
330	17.98	18.04	18.09	18.15	18.20	18.26	18.32	18.37	18.43	18.48	18.54	330
340	18.54	18.59	18.65	18.70	18.76	18.81	18.87	18.92	18.98	19.03	19.09	340
350	19.09	19.14	19.20	19.26	19.31	19.37	19.42	19.48	19.53	19.59	19.64	350
360	19.64	19.70	19.75	19.81	19.86	19.92	19.97	20.03	20.08	20.14	20.20	360
370	20.20	20.25	20.31	20.36	20.42	20.47	20.53	20.58	20.64	20.69	20.75	370
380	20.75	20.80	20.86	20.91	20.97	21.02	21.08	21.13	21.19	21.24	21.30	380
390	21.30	21.35	21.41	21.46	21.52	21.57	21.63	21.68	21.74	21.79	21.85	390
400	21.85	21.90	21.96	22.02	22.07	22.13	22.18	22.24	22.29	22.35	22.40	400

IRON-CONSTANTAN THERMOCOUPLES--Continued

Table 2 - Celsius (Centigrade) Table - Even Increments of temperature

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948)
Reference Junctions at 0°C.)

°C	Millivolts										°C	
	0	1	2	3	4	5	6	7	8	9		10
400	21.85	21.90	21.96	22.02	22.07	22.13	22.18	22.24	22.29	22.35	22.40	400
410	22.40	22.46	22.51	22.57	22.62	22.68	22.73	22.79	22.84	22.90	22.95	410
420	22.95	23.01	23.06	23.12	23.17	23.23	23.28	23.34	23.39	23.45	23.50	420
430	23.50	23.56	23.61	23.67	23.72	23.78	23.83	23.89	23.94	24.00	24.06	430
440	24.06	24.11	24.17	24.22	24.28	24.33	24.39	24.44	24.50	24.55	24.61	440
450	24.61	24.66	24.72	24.77	24.83	24.88	24.94	25.00	25.05	25.11	25.16	450
460	25.16	25.22	25.27	25.33	25.38	25.44	25.49	25.55	25.60	25.66	25.72	460
470	25.72	25.77	25.83	25.88	25.94	25.99	26.05	26.10	26.16	26.22	26.27	470
480	26.27	26.33	26.38	26.44	26.49	26.55	26.61	26.66	26.72	26.77	26.83	480
490	26.83	26.89	26.94	27.00	27.05	27.11	27.17	27.22	27.28	27.33	27.39	490
500	27.39	27.45	27.50	27.56	27.61	27.67	27.73	27.78	27.84	27.90	27.95	500
510	27.95	28.01	28.07	28.12	28.18	28.23	28.29	28.35	28.40	28.46	28.52	510
520	28.52	28.57	28.63	28.69	28.74	28.80	28.86	28.91	28.97	29.02	29.08	520
530	29.08	29.14	29.20	29.25	29.31	29.37	29.42	29.48	29.54	29.59	29.65	530
540	29.65	29.71	29.76	29.82	29.88	29.94	29.99	30.05	30.11	30.16	30.22	540
550	30.22	30.28	30.34	30.39	30.45	30.51	30.57	30.62	30.68	30.74	30.80	550
560	30.80	30.85	30.91	30.97	31.02	31.08	31.14	31.20	31.26	31.31	31.37	560
570	31.37	31.43	31.49	31.54	31.60	31.66	31.72	31.78	31.83	31.89	31.95	570
580	31.95	32.01	32.06	32.12	32.18	32.24	32.30	32.36	32.41	32.47	32.53	580
590	32.53	32.59	32.65	32.71	32.76	32.82	32.88	32.94	33.00	33.06	33.11	590
600	33.11	33.17	33.23	33.29	33.35	33.41	33.46	33.52	33.58	33.64	33.70	600
610	33.70	33.76	33.82	33.88	33.94	33.99	34.05	34.11	34.17	34.23	34.29	610
620	34.29	34.35	34.41	34.47	34.53	34.58	34.64	34.70	34.76	34.82	34.88	620
630	34.88	34.94	35.00	35.06	35.12	35.18	35.24	35.30	35.36	35.42	35.48	630
640	35.48	35.54	35.60	35.66	35.72	35.78	35.84	35.90	35.96	36.02	36.08	640
650	36.08	36.14	36.20	36.26	36.32	36.38	36.44	36.50	36.56	36.62	36.69	650
660	36.69	36.75	36.81	36.87	36.93	36.99	37.05	37.11	37.18	37.24	37.30	660
670	37.30	37.36	37.42	37.48	37.54	37.60	37.66	37.73	37.79	37.85	37.91	670
680	37.91	37.97	38.04	38.10	38.16	38.22	38.28	38.34	38.41	38.47	38.53	680
690	38.53	38.59	38.66	38.72	38.78	38.84	38.90	38.97	39.03	39.09	39.15	690
700	39.15	39.22	39.28	39.34	39.40	39.47	39.53	39.59	39.65	39.72	39.78	700
710	39.78	39.84	39.91	39.97	40.03	40.10	40.16	40.22	40.28	40.35	40.41	710
720	40.41	40.48	40.54	40.60	40.66	40.73	40.79	40.86	40.92	40.98	41.05	720
730	41.05	41.11	41.17	41.24	41.30	41.36	41.43	41.49	41.56	41.62	41.68	730
740	41.68	41.75	41.81	41.87	41.94	42.00	42.07	42.13	42.19	42.26	42.32	740
750	42.32	42.38	42.45	42.51	42.58	42.64	42.70	42.77	42.83	42.90	42.96	750
760	42.96	43.02	43.09	43.15	43.22	43.28	43.35	43.41	43.48	43.54	43.60	760
770	43.60	43.67	43.73	43.80	43.86	43.92	43.99	44.05	44.12	44.18	44.25	770
780	44.25	44.31	44.38	44.44	44.50	44.57	44.63	44.70	44.76	44.82	44.89	780
790	44.89	44.95	45.02	45.08	45.15	45.21	45.28	45.34	45.40	45.47	45.53	790
800	45.53	45.60	45.66	45.72	45.79	45.85	45.92	45.98	46.05	46.11	46.18	800
810	46.18	46.24	46.30	46.37	46.43	46.50	46.56	46.62	46.69	46.75	46.82	810
820	46.82	46.88	46.94	47.01	47.07	47.14	47.20	47.27	47.33	47.39	47.46	820
830	47.46	47.52	47.58	47.65	47.71	47.78	47.84	47.90	47.97	48.03	48.09	830
840	48.09	48.16	48.22	48.28	48.35	48.41	48.48	48.54	48.60	48.66	48.73	840
850	48.73	48.79	48.85	48.92	48.98	49.04	49.10	49.17	49.23	49.29	49.36	850
860	49.36	49.42	49.48	49.54	49.61	49.67	49.73	49.79	49.86	49.92	49.98	860
870	49.98	50.04										870

IRON-CONSTANTAN THERMOCOUPLES

Table 3 - Fahrenheit Table - Even Increments of emf

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.
Reference Junctions at 32 F.)

Millivolts	Degrees F											Millivolts
	.00	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00	
-7.00	-267	-273	-279	-285	-292	-298	-305	-313	-320			-7.00
-6.00	-212	-217	-222	-228	-233	-238	-244	-249	-255	-261	-267	-6.00
-5.00	-165	-169	-174	-178	-183	-188	-192	-197	-202	-207	-212	-5.00
-4.00	-121	-125	-130	-134	-138	-142	-147	-151	-156	-160	-165	-4.00
-3.00	-80	-84	-88	-92	-96	-100	-105	-109	-113	-117	-121	-3.00
-2.00	-42	-45	-49	-53	-57	-61	-65	-69	-72	-76	-80	-2.00
-1.00	-4	-8	-12	-15	-19	-23	-26	-30	-34	-38	-42	-1.00
(-)0.00	32	29	25	21	18	14	10	7	3	0	-4	(-)0.00
(+)0.00	32	36	39	43	46	50	53	57	60	64	67	(+)0.00
1.00	67	71	74	78	81	85	88	92	95	99	102	1.00
2.00	102	105	109	112	116	119	123	126	129	133	136	2.00
3.00	136	140	143	146	150	153	156	160	163	166	170	3.00
4.00	170	173	177	180	183	187	190	193	196	200	203	4.00
5.00	203	206	210	213	216	220	223	226	230	233	236	5.00
6.00	236	240	243	246	249	253	256	259	263	266	269	6.00
7.00	269	272	276	279	282	286	289	292	295	299	302	7.00
8.00	302	305	308	312	315	318	321	325	328	331	334	8.00
9.00	334	338	341	344	347	351	354	357	360	364	367	9.00
10.00	367	370	373	376	380	383	386	389	393	396	399	10.00
11.00	399	402	406	409	412	415	419	422	425	428	431	11.00
12.00	431	435	438	441	444	448	451	454	457	461	464	12.00
13.00	464	467	470	474	477	480	483	487	490	493	496	13.00
14.00	496	499	503	506	509	513	516	519	522	526	529	14.00
15.00	529	532	535	539	542	545	548	552	555	558	561	15.00
16.00	561	565	568	571	574	578	581	584	587	591	594	16.00
17.00	594	597	601	604	607	610	614	617	620	623	627	17.00
18.00	627	630	633	636	640	643	646	649	653	656	659	18.00
19.00	659	662	666	669	672	675	679	682	685	688	692	19.00
20.00	692	695	698	701	705	708	711	714	718	721	724	20.00

IRON-CONSTANTAN THERMOCOUPLES--Continued

Table 3 - Fahrenheit Table - Even Increments of emf

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.
Reference Junctions at 32 F.)

Millivolts	Degrees F											Millivolts
	.00	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00	
20.00	692	695	698	701	705	708	711	714	718	721	724	20.00
21.00	724	727	731	734	737	741	744	747	750	754	757	21.00
22.00	757	760	763	767	770	773	777	780	783	786	790	22.00
23.00	790	793	796	799	803	806	809	812	816	819	822	23.00
24.00	822	825	829	832	835	839	842	845	848	852	855	24.00
25.00	855	858	861	865	868	871	874	878	881	884	887	25.00
26.00	887	890	894	897	900	903	907	910	913	916	919	26.00
27.00	919	923	926	929	932	936	939	942	945	948	952	27.00
28.00	952	955	958	961	964	967	971	974	977	980	983	28.00
29.00	983	987	990	993	996	999	1002	1006	1009	1012	1015	29.00
30.00	1015	1018	1021	1024	1028	1031	1034	1037	1040	1043	1046	30.00
31.00	1046	1050	1053	1056	1059	1062	1065	1068	1071	1074	1078	31.00
32.00	1078	1081	1084	1087	1090	1093	1096	1099	1102	1105	1108	32.00
33.00	1108	1112	1115	1118	1121	1124	1127	1130	1133	1136	1139	33.00
34.00	1139	1142	1145	1148	1151	1154	1157	1160	1164	1167	1170	34.00
35.00	1170	1173	1176	1179	1182	1185	1188	1191	1194	1197	1200	35.00
36.00	1200	1203	1206	1209	1212	1215	1217	1220	1223	1226	1229	36.00
37.00	1229	1232	1235	1238	1241	1244	1247	1250	1253	1256	1259	37.00
38.00	1259	1261	1264	1267	1270	1273	1276	1279	1282	1285	1288	38.00
39.00	1288	1290	1293	1296	1299	1302	1305	1308	1311	1313	1316	39.00
40.00	1316	1319	1322	1325	1328	1331	1333	1336	1339	1342	1345	40.00
41.00	1345	1348	1350	1353	1356	1359	1362	1365	1367	1370	1373	41.00
42.00	1373	1376	1379	1381	1384	1387	1390	1393	1395	1398	1401	42.00
43.00	1401	1404	1407	1410	1412	1415	1418	1421	1424	1426	1429	43.00
44.00	1429	1432	1435	1438	1440	1443	1446	1449	1451	1454	1457	44.00
45.00	1457	1460	1463	1465	1468	1471	1474	1477	1480	1482	1485	45.00
46.00	1485	1488	1491	1494	1496	1499	1502	1505	1508	1510	1513	46.00
47.00	1513	1516	1519	1522	1524	1527	1530	1533	1536	1539	1541	47.00
48.00	1541	1544	1547	1550	1553	1556	1558	1561	1564	1567	1570	48.00
49.00	1570	1573	1576	1578	1581	1584	1587	1590	1593	1596	1599	49.00
50.00	1599	1602										50.00

IRON-CONSTANTAN THERMOCOUPLES

Table 4 - Fahrenheit Table - Even Increments of temperature

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.
Reference Junctions at 32 F.)

°F	Millivolts										°F	
	0	1	2	3	4	5	6	7	8	9		10
-310	-7.66	-7.68	-7.69	-7.70	-7.71	-7.73	-7.74	-7.75	-7.76	-7.78	-7.79	-310
-300	-7.52	-7.54	-7.55	-7.57	-7.58	-7.59	-7.61	-7.62	-7.64	-7.65	-7.66	-300
-290	-7.38	-7.39	-7.40	-7.42	-7.44	-7.45	-7.46	-7.48	-7.49	-7.51	-7.52	-290
-280	-7.22	-7.24	-7.25	-7.27	-7.28	-7.30	-7.31	-7.33	-7.34	-7.36	-7.38	-280
-270	-7.06	-7.07	-7.09	-7.11	-7.12	-7.14	-7.15	-7.17	-7.19	-7.20	-7.22	-270
-260	-6.89	-6.90	-6.92	-6.94	-6.96	-6.97	-6.99	-7.01	-7.02	-7.04	-7.06	-260
-250	-6.71	-6.73	-6.75	-6.77	-6.78	-6.80	-6.82	-6.84	-6.85	-6.87	-6.89	-250
-240	-6.53	-6.55	-6.57	-6.59	-6.61	-6.62	-6.64	-6.66	-6.68	-6.70	-6.71	-240
-230	-6.35	-6.37	-6.38	-6.40	-6.42	-6.44	-6.46	-6.48	-6.50	-6.52	-6.53	-230
-220	-6.16	-6.18	-6.19	-6.21	-6.23	-6.25	-6.27	-6.29	-6.31	-6.33	-6.35	-220
-210	-5.96	-5.98	-6.00	-6.02	-6.04	-6.06	-6.08	-6.10	-6.12	-6.14	-6.16	-210
-200	-5.76	-5.78	-5.80	-5.82	-5.84	-5.86	-5.88	-5.90	-5.92	-5.94	-5.96	-200
-190	-5.55	-5.57	-5.59	-5.61	-5.63	-5.65	-5.67	-5.70	-5.72	-5.74	-5.76	-190
-180	-5.34	-5.36	-5.38	-5.40	-5.42	-5.44	-5.46	-5.49	-5.51	-5.53	-5.55	-180
-170	-5.12	-5.14	-5.16	-5.19	-5.21	-5.23	-5.25	-5.27	-5.30	-5.32	-5.34	-170
-160	-4.90	-4.92	-4.94	-4.97	-4.99	-5.01	-5.03	-5.06	-5.08	-5.10	-5.12	-160
-150	-4.68	-4.70	-4.72	-4.74	-4.76	-4.79	-4.81	-4.83	-4.86	-4.88	-4.90	-150
-140	-4.44	-4.47	-4.49	-4.51	-4.54	-4.56	-4.58	-4.61	-4.63	-4.65	-4.68	-140
-130	-4.21	-4.23	-4.26	-4.28	-4.30	-4.33	-4.35	-4.38	-4.40	-4.42	-4.44	-130
-120	-3.97	-4.00	-4.02	-4.04	-4.07	-4.09	-4.12	-4.14	-4.16	-4.19	-4.21	-120
-110	-3.73	-3.76	-3.78	-3.81	-3.83	-3.85	-3.88	-3.90	-3.93	-3.95	-3.97	-110
-100	-3.49	-3.51	-3.54	-3.56	-3.59	-3.61	-3.64	-3.66	-3.68	-3.71	-3.73	-100
-90	-3.24	-3.27	-3.29	-3.32	-3.34	-3.36	-3.39	-3.41	-3.44	-3.46	-3.49	-90
-80	-2.99	-3.02	-3.04	-3.07	-3.09	-3.12	-3.14	-3.17	-3.19	-3.22	-3.24	-80
-70	-2.74	-2.76	-2.79	-2.81	-2.84	-2.86	-2.89	-2.92	-2.94	-2.97	-2.99	-70
-60	-2.48	-2.51	-2.53	-2.56	-2.58	-2.61	-2.64	-2.66	-2.69	-2.71	-2.74	-60
-50	-2.22	-2.25	-2.27	-2.30	-2.33	-2.35	-2.38	-2.40	-2.43	-2.46	-2.48	-50
-40	-1.96	-1.99	-2.01	-2.04	-2.06	-2.09	-2.12	-2.14	-2.17	-2.20	-2.22	-40
-30	-1.70	-1.72	-1.75	-1.78	-1.80	-1.83	-1.86	-1.88	-1.91	-1.94	-1.96	-30
-20	-1.43	-1.46	-1.48	-1.51	-1.54	-1.56	-1.59	-1.62	-1.64	-1.67	-1.70	-20
-10	-1.16	-1.19	-1.21	-1.24	-1.27	-1.29	-1.32	-1.35	-1.38	-1.40	-1.43	-10
(-)0	-.89	-.91	-.94	-.97	-1.00	-1.02	-1.05	-1.08	-1.10	-1.13	-1.16	(-)0
(+)0	-.89	-.86	-.83	-.80	-.78	-.75	-.72	-.70	-.67	-.64	-.61	(+)0

IRON-CONSTANTAN THERMOCOUPLES--Continued

Table 4 - Fahrenheit Table - Even Increments of temperature

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.
Reference Junctions at 32 F.)

°F	0	1	2	3	4	5	6	7	8	9	10	°F
	Millivolts											
(+)0	-.89	-.86	-.83	-.80	-.78	-.75	-.72	-.70	-.67	-.64	-.61	(+)0
10	-.61	-.58	-.56	-.53	-.50	-.48	-.45	-.42	-.39	-.36	-.34	10
20	-.34	-.31	-.28	-.25	-.22	-.20	-.17	-.14	-.11	-.09	-.06	20
30	-.06	-.03	-.00	.03	.05	.08	.11	.14	.17	.19	.22	30
40	.22	.25	.28	.31	.34	.36	.39	.42	.45	.48	.50	40
50	.50	.53	.56	.59	.62	.65	.67	.70	.73	.76	.79	50
60	.79	.82	.84	.87	.90	.93	.96	.99	1.02	1.04	1.07	60
70	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.30	1.33	1.36	70
80	1.36	1.39	1.42	1.45	1.48	1.51	1.54	1.56	1.59	1.62	1.65	80
90	1.65	1.68	1.71	1.74	1.77	1.80	1.83	1.85	1.88	1.91	1.94	90
100	1.94	1.97	2.00	2.03	2.06	2.09	2.12	2.14	2.17	2.20	2.23	100
110	2.23	2.26	2.29	2.32	2.35	2.38	2.41	2.44	2.47	2.50	2.52	110
120	2.52	2.55	2.58	2.61	2.64	2.67	2.70	2.73	2.76	2.79	2.82	120
130	2.82	2.85	2.88	2.91	2.94	2.97	3.00	3.03	3.06	3.08	3.11	130
140	3.11	3.14	3.17	3.20	3.23	3.26	3.29	3.32	3.35	3.38	3.41	140
150	3.41	3.44	3.47	3.50	3.53	3.56	3.59	3.62	3.65	3.68	3.71	150
160	3.71	3.74	3.77	3.80	3.83	3.86	3.89	3.92	3.95	3.98	4.01	160
170	4.01	4.04	4.07	4.10	4.13	4.16	4.19	4.22	4.25	4.28	4.31	170
180	4.31	4.34	4.37	4.40	4.43	4.46	4.49	4.52	4.55	4.58	4.61	180
190	4.61	4.64	4.67	4.70	4.73	4.76	4.79	4.82	4.85	4.88	4.91	190
200	4.91	4.94	4.97	5.00	5.03	5.06	5.09	5.12	5.15	5.18	5.21	200
210	5.21	5.24	5.27	5.30	5.33	5.36	5.39	5.42	5.45	5.48	5.51	210
220	5.51	5.54	5.57	5.60	5.63	5.66	5.69	5.72	5.75	5.78	5.81	220
230	5.81	5.84	5.87	5.90	5.93	5.96	5.99	6.02	6.05	6.08	6.11	230
240	6.11	6.14	6.17	6.20	6.24	6.27	6.30	6.33	6.36	6.39	6.42	240
250	6.42	6.45	6.48	6.51	6.54	6.57	6.60	6.63	6.66	6.69	6.72	250
260	6.72	6.75	6.78	6.81	6.84	6.87	6.90	6.93	6.96	7.00	7.03	260
270	7.03	7.06	7.09	7.12	7.15	7.18	7.21	7.24	7.27	7.30	7.33	270
280	7.33	7.36	7.39	7.42	7.45	7.48	7.51	7.54	7.58	7.61	7.64	280
290	7.64	7.67	7.70	7.73	7.76	7.79	7.82	7.85	7.88	7.91	7.94	290
300	7.94	7.97	8.00	8.04	8.07	8.10	8.13	8.16	8.19	8.22	8.25	300

IRON-CONSTANTAN THERMOCOUPLES--Continued

Table 4 - Fahrenheit Table - Even Increments of temperature

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.
Reference Junctions at 32 F.)

°F	Millivolts											°F
	0	1	2	3	4	5	6	7	8	9	10	
300	7.94	7.97	8.00	8.04	8.07	8.10	8.13	8.16	8.19	8.22	8.25	300
310	8.25	8.28	8.31	8.34	8.37	8.40	8.44	8.47	8.50	8.53	8.56	310
320	8.56	8.59	8.62	8.65	8.68	8.71	8.74	8.77	8.80	8.84	8.87	320
330	8.87	8.90	8.93	8.96	8.99	9.02	9.05	9.08	9.11	9.14	9.17	330
340	9.17	9.20	9.24	9.27	9.30	9.33	9.36	9.39	9.42	9.45	9.48	340
350	9.48	9.51	9.54	9.58	9.61	9.64	9.67	9.70	9.73	9.76	9.79	350
360	9.79	9.82	9.85	9.88	9.92	9.95	9.98	10.01	10.04	10.07	10.10	360
370	10.10	10.13	10.16	10.19	10.22	10.25	10.28	10.32	10.35	10.38	10.41	370
380	10.41	10.44	10.47	10.50	10.53	10.56	10.60	10.63	10.66	10.69	10.72	380
390	10.72	10.75	10.78	10.81	10.84	10.87	10.90	10.94	10.97	11.00	11.03	390
400	11.03	11.06	11.09	11.12	11.15	11.18	11.21	11.24	11.28	11.31	11.34	400
410	11.34	11.37	11.40	11.43	11.46	11.49	11.52	11.55	11.58	11.62	11.65	410
420	11.65	11.68	11.71	11.74	11.77	11.80	11.83	11.86	11.89	11.92	11.96	420
430	11.96	11.99	12.02	12.05	12.08	12.11	12.14	12.17	12.20	12.23	12.26	430
440	12.26	12.30	12.33	12.36	12.39	12.42	12.45	12.48	12.51	12.54	12.57	440
450	12.57	12.60	12.64	12.67	12.70	12.73	12.76	12.79	12.82	12.85	12.88	450
460	12.88	12.91	12.94	12.98	13.01	13.04	13.07	13.10	13.13	13.16	13.19	460
470	13.19	13.22	13.25	13.28	13.31	13.34	13.38	13.41	13.44	13.47	13.50	470
480	13.50	13.53	13.56	13.59	13.62	13.65	13.68	13.72	13.75	13.78	13.81	480
490	13.81	13.84	13.87	13.90	13.93	13.96	13.99	14.02	14.05	14.08	14.12	490
500	14.12	14.15	14.18	14.21	14.24	14.27	14.30	14.33	14.36	14.39	14.42	500
510	14.42	14.45	14.48	14.52	14.55	14.58	14.61	14.64	14.67	14.70	14.73	510
520	14.73	14.76	14.79	14.82	14.85	14.88	14.91	14.94	14.98	15.01	15.04	520
530	15.04	15.07	15.10	15.13	15.16	15.19	15.22	15.25	15.28	15.31	15.34	530
540	15.34	15.37	15.40	15.44	15.47	15.50	15.53	15.56	15.59	15.62	15.65	540
550	15.65	15.68	15.71	15.74	15.77	15.80	15.84	15.87	15.90	15.93	15.96	550
560	15.96	15.99	16.02	16.05	16.08	16.11	16.14	16.17	16.20	16.23	16.26	560
570	16.26	16.30	16.33	16.36	16.39	16.42	16.45	16.48	16.51	16.54	16.57	570
580	16.57	16.60	16.63	16.66	16.69	16.72	16.75	16.78	16.82	16.85	16.88	580
590	16.88	16.91	16.94	16.97	17.00	17.03	17.06	17.09	17.12	17.15	17.18	590
600	17.18	17.21	17.24	17.28	17.31	17.34	17.37	17.40	17.43	17.46	17.49	600

IRON-CONSTANTAN THERMOCOUPLES--Continued

Table 4 - Fahrenheit Table - Even Increments of temperature

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.
Reference Junctions at 32 F.)

°F	Millivolts										°F	
	0	1	2	3	4	5	6	7	8	9		10
600	17.18	17.21	17.24	17.28	17.31	17.34	17.37	17.40	17.43	17.46	17.49	600
610	17.49	17.52	17.55	17.58	17.61	17.64	17.68	17.71	17.74	17.77	17.80	610
620	17.80	17.83	17.86	17.89	17.92	17.95	17.98	18.01	18.04	18.08	18.11	620
630	18.11	18.14	18.17	18.20	18.23	18.26	18.29	18.32	18.35	18.38	18.41	630
640	18.41	18.44	18.47	18.50	18.54	18.57	18.60	18.63	18.66	18.69	18.72	640
650	18.72	18.75	18.78	18.81	18.84	18.87	18.90	18.94	18.97	19.00	19.03	650
660	19.03	19.06	19.09	19.12	19.15	19.18	19.21	19.24	19.27	19.30	19.34	660
670	19.34	19.37	19.40	19.43	19.46	19.49	19.52	19.55	19.58	19.61	19.64	670
680	19.64	19.67	19.70	19.74	19.77	19.80	19.83	19.86	19.89	19.92	19.95	680
690	19.95	19.98	20.01	20.04	20.07	20.10	20.13	20.16	20.20	20.23	20.26	690
700	20.26	20.29	20.32	20.35	20.38	20.41	20.44	20.47	20.50	20.53	20.56	700
710	20.56	20.59	20.62	20.66	20.69	20.72	20.75	20.78	20.81	20.84	20.87	710
720	20.87	20.90	20.93	20.96	20.99	21.02	21.05	21.08	21.11	21.14	21.18	720
730	21.18	21.21	21.24	21.27	21.30	21.33	21.36	21.39	21.42	21.45	21.48	730
740	21.48	21.51	21.54	21.57	21.60	21.64	21.67	21.70	21.73	21.76	21.79	740
750	21.79	21.82	21.85	21.88	21.91	21.94	21.97	22.00	22.03	22.06	22.10	750
760	22.10	22.13	22.16	22.19	22.22	22.25	22.28	22.31	22.34	22.37	22.40	760
770	22.40	22.43	22.46	22.49	22.52	22.55	22.58	22.62	22.65	22.68	22.71	770
780	22.71	22.74	22.77	22.80	22.83	22.86	22.89	22.92	22.95	22.98	23.01	780
790	23.01	23.04	23.08	23.11	23.14	23.17	23.20	23.23	23.26	23.29	23.32	790
800	23.32	23.35	23.38	23.41	23.44	23.47	23.50	23.53	23.56	23.60	23.63	800
810	23.63	23.66	23.69	23.72	23.75	23.78	23.81	23.84	23.87	23.90	23.93	810
820	23.93	23.96	23.99	24.02	24.06	24.09	24.12	24.15	24.18	24.21	24.24	820
830	24.24	24.27	24.30	24.33	24.36	24.39	24.42	24.45	24.48	24.52	24.55	830
840	24.55	24.58	24.61	24.64	24.67	24.70	24.73	24.76	24.79	24.82	24.85	840
850	24.85	24.88	24.91	24.94	24.98	25.01	25.04	25.07	25.10	25.13	25.16	850
860	25.16	25.19	25.22	25.25	25.28	25.32	25.35	25.38	25.41	25.44	25.47	860
870	25.47	25.50	25.53	25.56	25.59	25.62	25.65	25.68	25.72	25.75	25.78	870
880	25.78	25.81	25.84	25.87	25.90	25.93	25.96	25.99	26.02	26.06	26.09	880
890	26.09	26.12	26.15	26.18	26.21	26.24	26.27	26.30	26.33	26.36	26.40	890
900	26.40	26.43	26.46	26.49	26.52	26.55	26.58	26.61	26.64	26.67	26.70	900

IRON-CONSTANTAN THERMOCOUPLES--Continued

Table 4 - Fahrenheit Table - Even Increments of temperature

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.
Reference Junctions at 32 F.)

°F	Millivolts										°F	
	0	1	2	3	4	5	6	7	8	9		10
900	26.40	26.43	26.46	26.49	26.52	26.55	26.58	26.61	26.64	26.67	26.70	900
910	26.70	26.74	26.77	26.80	26.83	26.86	26.89	26.92	26.95	26.98	27.02	910
920	27.02	27.05	27.08	27.11	27.14	27.17	27.20	27.23	27.26	27.30	27.33	920
930	27.33	27.36	27.39	27.42	27.45	27.48	27.51	27.54	27.58	27.61	27.64	930
940	27.64	27.67	27.70	27.73	27.76	27.80	27.83	27.86	27.89	27.92	27.95	940
950	27.95	27.98	28.02	28.05	28.08	28.11	28.14	28.17	28.20	28.23	28.26	950
960	28.26	28.30	28.33	28.36	28.39	28.42	28.45	28.48	28.52	28.55	28.58	960
970	28.58	28.61	28.64	28.67	28.70	28.74	28.77	28.80	28.83	28.86	28.89	970
980	28.89	28.92	28.96	28.99	29.02	29.05	29.08	29.11	29.14	29.18	29.21	980
990	29.21	29.24	29.27	29.30	29.33	29.37	29.40	29.43	29.46	29.49	29.52	990
1000	29.52	29.56	29.59	29.62	29.65	29.68	29.71	29.75	29.78	29.81	29.84	1000
1010	29.84	29.87	29.90	29.94	29.97	30.00	30.03	30.06	30.10	30.13	30.16	1010
1020	30.16	30.19	30.22	30.25	30.28	30.32	30.35	30.38	30.41	30.44	30.48	1020
1030	30.48	30.51	30.54	30.57	30.60	30.64	30.67	30.70	30.73	30.76	30.80	1030
1040	30.80	30.83	30.86	30.89	30.92	30.96	30.99	31.02	31.05	31.08	31.12	1040
1050	31.12	31.15	31.18	31.21	31.24	31.28	31.31	31.34	31.37	31.40	31.44	1050
1060	31.44	31.47	31.50	31.53	31.56	31.60	31.63	31.66	31.69	31.72	31.76	1060
1070	31.76	31.79	31.82	31.85	31.88	31.92	31.95	31.98	32.01	32.05	32.08	1070
1080	32.08	32.11	32.14	32.18	32.21	32.24	32.27	32.30	32.34	32.37	32.40	1080
1090	32.40	32.43	32.47	32.50	32.53	32.56	32.60	32.63	32.66	32.69	32.72	1090
1100	32.72	32.76	32.79	32.82	32.86	32.89	32.92	32.95	32.98	33.02	33.05	1100
1110	33.05	33.08	33.11	33.15	33.18	33.21	33.24	33.28	33.31	33.34	33.37	1110
1120	33.37	33.41	33.44	33.47	33.50	33.54	33.57	33.60	33.64	33.67	33.70	1120
1130	33.70	33.73	33.76	33.80	33.83	33.86	33.90	33.93	33.96	33.99	34.03	1130
1140	34.03	34.06	34.09	34.12	34.16	34.19	34.22	34.26	34.29	34.32	34.36	1140
1150	34.36	34.39	34.42	34.45	34.49	34.52	34.55	34.58	34.62	34.65	34.68	1150
1160	34.68	34.72	34.75	34.78	34.82	34.85	34.88	34.92	34.95	34.98	35.01	1160
1170	35.01	35.05	35.08	35.11	35.15	35.18	35.21	35.25	35.28	35.31	35.35	1170
1180	35.35	35.38	35.41	35.45	35.48	35.51	35.54	35.58	35.61	35.64	35.68	1180
1190	35.68	35.71	35.74	35.78	35.81	35.84	35.88	35.91	35.94	35.98	36.01	1190
1200	36.01	36.05	36.08	36.11	36.15	36.18	36.21	36.25	36.28	36.31	36.35	1200

IRON-CONSTANTAN THERMOCOUPLES--Continued

Table 4 - Fahrenheit Table - Even Increments of temperature

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.
Reference Junctions at 32 F.)

°F	Millivolts										°F	
	0	1	2	3	4	5	6	7	8	9		10
1200	36.01	36.05	36.08	36.11	36.15	36.18	36.21	36.25	36.28	36.31	36.35	1200
1210	36.35	36.38	36.42	36.45	36.48	36.52	36.55	36.58	36.62	36.65	36.69	1210
1220	36.69	36.72	36.75	36.79	36.82	36.86	36.89	36.92	36.96	36.99	37.02	1220
1230	37.02	37.06	37.09	37.13	37.16	37.20	37.23	37.26	37.30	37.33	37.36	1230
1240	37.36	37.40	37.43	37.47	37.50	37.54	37.57	37.60	37.64	37.67	37.71	1240
1250	37.71	37.74	37.78	37.81	37.84	37.88	37.91	37.95	37.98	38.02	38.05	1250
1260	38.05	38.08	38.12	38.15	38.19	38.22	38.26	38.29	38.32	38.36	38.39	1260
1270	38.39	38.43	38.46	38.50	38.53	38.57	38.60	38.64	38.67	38.70	38.74	1270
1280	38.74	38.77	38.81	38.84	38.88	38.91	38.95	38.98	39.02	39.05	39.08	1280
1290	39.08	39.12	39.15	39.19	39.22	39.26	39.29	39.33	39.36	39.40	39.43	1290
1300	39.43	39.47	39.50	39.54	39.57	39.61	39.64	39.68	39.71	39.75	39.78	1300
1310	39.78	39.82	39.85	39.89	39.92	39.96	39.99	40.03	40.06	40.10	40.13	1310
1320	40.13	40.17	40.20	40.24	40.27	40.31	40.34	40.38	40.41	40.45	40.48	1320
1330	40.48	40.52	40.55	40.59	40.62	40.66	40.69	40.73	40.76	40.80	40.83	1330
1340	40.83	40.87	40.90	40.94	40.98	41.01	41.05	41.08	41.12	41.15	41.19	1340
1350	41.19	41.22	41.26	41.29	41.33	41.36	41.40	41.43	41.47	41.50	41.54	1350
1360	41.54	41.58	41.61	41.65	41.68	41.72	41.75	41.79	41.82	41.86	41.90	1360
1370	41.90	41.93	41.97	42.00	42.04	42.07	42.11	42.14	42.18	42.22	42.25	1370
1380	42.25	42.29	42.32	42.36	42.39	42.43	42.46	42.50	42.53	42.57	42.61	1380
1390	42.61	42.64	42.68	42.71	42.75	42.78	42.82	42.85	42.89	42.92	42.96	1390
1400	42.96	43.00	43.03	43.07	43.10	43.14	43.18	43.21	43.25	43.28	43.32	1400
1410	43.32	43.35	43.39	43.43	43.46	43.50	43.53	43.57	43.60	43.64	43.68	1410
1420	43.68	43.71	43.75	43.78	43.82	43.85	43.89	43.92	43.96	44.00	44.03	1420
1430	44.03	44.07	44.10	44.14	44.18	44.21	44.25	44.28	44.32	44.35	44.39	1430
1440	44.39	44.42	44.46	44.50	44.53	44.57	44.60	44.64	44.68	44.71	44.75	1440
1450	44.75	44.78	44.82	44.85	44.89	44.93	44.96	45.00	45.03	45.07	45.10	1450
1460	45.10	45.14	45.18	45.21	45.25	45.28	45.32	45.35	45.39	45.42	45.46	1460
1470	45.46	45.50	45.53	45.57	45.60	45.64	45.68	45.71	45.75	45.78	45.82	1470
1480	45.82	45.85	45.89	45.92	45.96	46.00	46.03	46.07	46.10	46.14	46.18	1480
1490	46.18	46.21	46.25	46.28	46.32	46.35	46.39	46.42	46.46	46.50	46.53	1490
1500	46.53	46.57	46.60	46.64	46.67	46.71	46.74	46.78	46.82	46.85	46.89	1500
1510	46.89	46.92	46.96	47.00	47.03	47.07	47.10	47.14	47.17	47.21	47.24	1510
1520	47.24	47.28	47.32	47.35	47.39	47.42	47.46	47.49	47.53	47.56	47.60	1520
1530	47.60	47.63	47.67	47.70	47.74	47.78	47.81	47.85	47.88	47.92	47.95	1530
1540	47.95	47.99	48.02	48.06	48.09	48.13	48.16	48.20	48.24	48.27	48.31	1540
1550	48.31	48.34	48.38	48.41	48.45	48.48	48.52	48.55	48.59	48.62	48.66	1550
1560	48.66	48.69	48.73	48.76	48.80	48.83	48.87	48.90	48.94	48.97	49.01	1560
1570	49.01	49.04	49.08	49.11	49.15	49.18	49.22	49.25	49.29	49.32	49.36	1570
1580	49.36	49.39	49.43	49.46	49.50	49.53	49.56	49.60	49.63	49.67	49.70	1580
1590	49.70	49.74	49.77	49.81	49.84	49.88	49.91	49.94	49.98	50.01	50.05	1590
1600	50.05											1600