

# **KANTHAL**

## **Precision Technology**

### **Conductive Alloys**



# Kanthal Conductive Alloys

Kanthal Palm Coast offers a broad range of wires in the dimensions between 0.51 - 0.010 mm 0.0201 - 0.0004 in.

For those applications where commodity grade wire is inadequate in its properties, Kanthal Palm Coast has the capabilities to customize and optimize high quality wire with precision tolerances, specialty coatings or other unique qualities to specific customer needs. Our service concept includes the design and development of a complete custom wire or take advantage of a single step of the engineering process, for instance coating, stranding, plating or enameling of customer supplied wire.



*Conductive Alloys are used for coils in the Disk Drive, Audio Speaker and Microphone markets.*

*They are also used for small motors, solenoids, transformers, relays, and applications that require precision layer wound coils.*

*Beryllium copper can be used for the leads of Audio Voice Coils where extra strength and flexibility is needed.*

Conductive alloys can be drawn to any diameter in our manufacturing range. They can also be rolled into ribbon or square wire configurations. These can be delivered bare or coated with one of our wide range of Insulation's and/or Bond Coats. Aluminum wire can also receive an anodized coating. This wire can also be delivered coated with an insulation and/or Bond. Copper, Copper Clad and Beryllium Copper alloys can also be plated prior to any Insulation and/or Bond Coating or delivered bare.

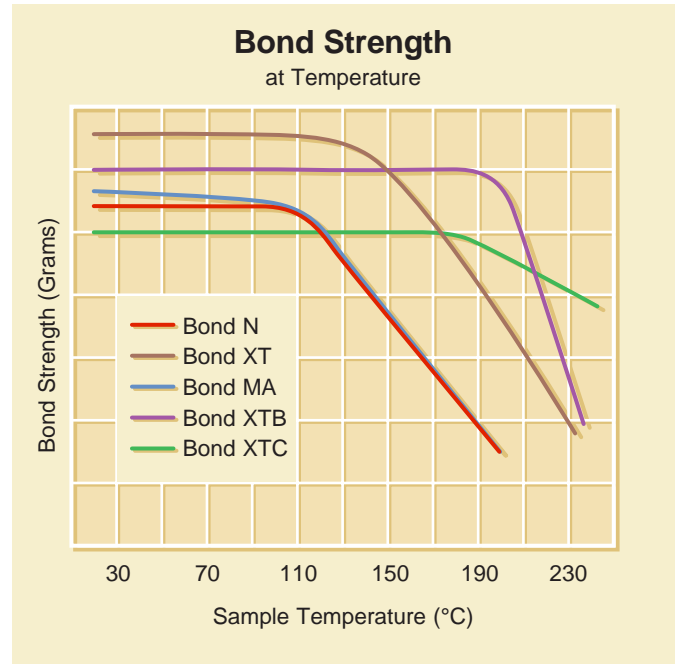


# Insulating Coatings

Kanthal Designation	Description	Thermal Class (°C)	Nema Mw 1000 Specification	General Comments
Formvar	Polyvinyl Acetal Insulation	105	MW15-A,C	Excellent flexibility, abrasion resistance and chemical stability.
4025 Polyurethane	Polyurethane Insulation	130	MW75-C	Long term cure stability. Easily solderable.
Poly	Polyurethane Insulation	155	MW2-C; MW75-C; MW79-C	Excellent dielectric properties and easily solderable.
Poly/Nylon	Polyurethane with Polyamide Topcoat	155	MW28-C; MW80-C	Easily solderable; abrasion resistant & easier winding.
Poly180B	Polyurethane Insulation	180	MW79-C	Highest Temperature Polyurethane - Easily Solderable.
TRI-2-SOD	Solderable Polyester-imide Insulation	180	MW26-C; MW77-C	Highest temperature capability solderable insulation.
TRI-2-SOD/ Nylon	Solderable Polyester-imide with Polyamide Topcoat	155	MW27-C	Solderable Polyester with the toughness/windability of Nylon.
Polyclad	THEIC Modified Polyester Insulation	200 for Copper 220 for Aluminum	MW72; MW74	Temperature stability of Polyester.
Polyclad/ Nylon	THEIC Modified Polyester with Polyamide Topcoat	180	MW76	Temperature stability of Polyester with toughness/windability of Nylon.
Polyclad/ Aminide	THEIC Modified Polyester with Polyamide-imide Topcoat	200 for Copper 220 for Aluminum	MW35; MW73	Increased temperature capability over Polyclad N.
Estmide	Polyester-imide Insulation	180	MW30	Good temperature stability, solvent resistance & windability.
Aminide	Polyamide-imide Insulation (also usable as Topcoat)	220	MW81-C	High Temperature Insulation with Lubricity & Chemical Resistance.
PAC 240	Aromatic Polyimide Insulation	240	MW16; MW20; MW71	Highest temperature capability with good chemical resistance. Mechanically strip before soldering.

# Bondcoats

Kanthal Designation	Description	Max. Usage Temp.* (°C)	Bonding Technique
<b>Bond B</b>	Thermoplastic Polyvinyl Butyral	100	Methanol, Acetone or Heat Activated
<b>Bond E</b>	Thermoplastic Epoxy	130	Acetone, MEK or Heat Activated
<b>Bond P</b>	Thermoplastic Polyester Phenolic	130	Acetone, MEK or Heat Activated
<b>Bond N</b>	Thermoplastic Polyamide	145	Acetone, MEK or Heat Activated
<b>Bond M-A</b>	Thermoplastic Polyamide	155	Methyl Alcohol or Heat Activated
<b>Bond SE</b>	Thermosetting Structural Adhesive Epoxy	170	MEK or Heat Activated
<b>Bond A-I</b>	Thermoplastic Polyamide-imide	180	NMP or Heat Activated
<b>Bond XT</b>	Thermoplastic Polyamide-imide	195	Heat Activated
<b>Bond XTC</b>	Thermoplastic Polyamide-imide	220+	Heat Activated
<b>Bond XTB</b>	Thermoplastic Polyamide-imide	220+	Heat Activated, Isopropyl Alcohol, Methyl Alcohol



\* Maximum usage temperature is based on the temperature at which the adhesive still retains 5-10% of its room temperature strength.

# Custom Insulating and Bond Builds

In addition to standard NEMA or JIS builds, Kanthal Palm Coast is capable of applying "Thin" and "Ultra Thin" builds of Insulations and Bonds. These builds are thinner than Nema Type 1 builds and still meet the Nema Dielectric, and other requirements. We can also apply custom builds to meet any special requirements.

Bare Wire	KANTHAL "Ultra Thin Builds"					
	Min. Increase of Insulating Film		Min. Increase of Bonding Film		Max. Dia. Increase	
Size Range	mm	in	mm	in	mm	in
0.511 thru 0.287	0.0076	0.0003	0.0076	0.0003	0.0229	0.0009
0.226 thru 0.158	0.0051	0.0002	0.0051	0.0002	0.0178	0.00070
0.127 thru 0.071	0.0038	0.00015	0.0038	0.00015	0.0127	0.00050
0.056 thru 0.028	0.0031	0.00012	0.0031	0.00012	0.0114	0.00045
	0.0025	0.0001	0.0025	0.0001	0.0076	0.0003

Bare Wire	KANTHAL "Thin Builds"					
	Min. Increase of Insulating Film		Min. Increase of Bonding Film		Max. Dia. Increase	
Size Range	mm	in	mm	in	mm	in
0.511 thru 0.287	0.0127	0.0005	0.0127	0.0005	0.0356	0.0014
0.226 thru 0.158	0.0089	0.00035	0.0089	0.00035	0.0254	0.00100
0.127 thru 0.071	0.0061	0.00024	0.0061	0.00024	0.0191	0.00075
0.056 thru 0.028	0.0041	0.00016	0.0041	0.00016	0.0140	0.00055
	0.0031	0.00012	0.0031	0.00012	0.0940	0.00037

# Aluminum

Aluminum wire is used primarily as electrical conductors due to its inherent ability to rapidly dissipate heat, resist corrosion and its reduction in weight over other alloys.

- 1350 Aluminum has a purity of 99 to 99.5%. 1350 Al has been widely used for disk drive coils and development of tethers with heat resistant enamels and high strength bond coatings.

- EEE Aluminum, is a proprietary alloy with a purity of 99 to 99.3%. This alloy allows us to produce wire with narrow fields for resistance, elongation, and tensile strength.

## Nominal Physical Properties:

ASTM specification B230, B609, B544, B231, B400.

### 1350 AL (EC)

Resistivity: 0.028  $\Omega\text{mm}^2\text{ m}^{-1}$ , 16.782  $\Omega/\text{cmf}$

Density: 2.703  $\text{g}/\text{cm}^3$ , 0.097  $\text{lb}/\text{in}^3$

DC Conductivity: 61.8% of Copper

Tensile: 186-207  $\text{N mm}^{-2}$ , 27-30  $\text{ksi}$

Yield: 166-179  $\text{N mm}^{-2}$ , 24-26  $\text{ksi}$

Elongation: 1.2-1.4%

Thermal Coefficient of Resistance, 20°C

Change in Unit Resistance at 20°C/°C: .00408

### EEE AI

Resistivity: 0.028  $\Omega\text{mm}^2\text{ m}^{-1}$ , 16.84  $\Omega/\text{cmf}$

Density: 2.70  $\text{g}/\text{cm}^3$ , 0.097  $\text{lb}/\text{in}^3$

DC Conductivity: 65.2% of Copper

Tensile: 200-235  $\text{N mm}^{-2}$ , 29-34  $\text{ksi}$

Yield: 193-200  $\text{N mm}^{-2}$ , 28-29  $\text{ksi}$

Elongation: 2-4%

Thermal Coefficient of Resistance, 20°C

Change in Unit Resistance at 20°C/°C: .00408

# Copper Clad Aluminum Wire

Copper Clad Aluminum is available with 10% or 15% Copper Cladding over an Aluminum core. CCA is used for electrical contact material and conductors. CCA offers the inherent characteristics of aluminum while the copper cladding provides greater conduction of current and the ease of soldering of copper.

## Nominal Physical Properties

IAW ASTM B 566, B 193, B 258, NBS Handbook 100-Copper Wire Tables.

### 10% CCA (CDA 101)

Class 10A (annealed) & 10H (hard)

Resistivity: 0.026  $\Omega\text{mm}^2\text{ m}^{-1}$ , 15.90  $\Omega/\text{cmf}$

Density: 3.32  $\text{g}/\text{cm}^3$ , 0.1203  $\text{lb}/\text{in}^3$

DC Conductivity: 65% of Copper

% Copper by Volume: 10%

% Copper by Weight: 26.8%

Tensile Strength - Hard: 193  $\text{N mm}^{-2}$ , 28  $\text{ksi}$

Tensile Strength - Annealed: 110  $\text{N mm}^{-2}$ , 16  $\text{ksi}$

### 15%CCA (CDA 102)

Class 15A (annealed) & 15H (hard)

Resistivity: 0.26  $\Omega\text{mm}^2\text{ m}^{-1}$ , 15.50  $\Omega/\text{cmf}$

Density: 3.36  $\text{g}/\text{cm}^3$ , 0.1312  $\text{lb}/\text{in}^3$

DC Conductivity: 67% of Copper

% Copper by Volume: 15%

% Copper by Weight: 36.6%

Tensile Strength - Hard: 207  $\text{N mm}^{-2}$ , 30  $\text{ksi}$

Tensile Strength - Annealed: 138  $\text{N mm}^{-2}$ , 20  $\text{ksi}$

# Copper Wire

We offer OFHC copper in grades 1 & 2.

Copper has excellent physical, electrical conductivity, and thermal resistance properties. Copper is easily soldered, welded, and plated for excellent corrosion resistance. Gold plated pure copper is used when electrical conductivity is crucial and its application is critical in maintaining a stable resistance with minimal variation from foot to foot.

## Nominal Physical Properties

ASTM B 170, 1, 2, 3, F 68, 250, 272-grade1& 2

### Grade 1 Copper C10100 99.99% Cu min.

Oxygen free electronic

### Grade 2 Copper C10200 99.95% Cu + Ag min.

Oxygen free

Resistivity: 0.17  $\Omega\text{mm}^2\text{ m}^{-1}$ , 10.371  $\Omega/\text{cmf}$

Density: 8.94  $\text{g}/\text{cm}^3$ , 0.323  $\text{lb}/\text{in}^3$

DC Conductivity: 100%

Tensile strength - Hard: 455  $\text{N mm}^{-2}$ , 66  $\text{ksi}$

Tensile strength - Annealed: 220  $\text{N mm}^{-2}$ , 32  $\text{ksi}$

# Beryllium Copper Wire

Within this group of alloys, Beryllium copper offers the highest tensile strength at approximately 1586  $\text{N mm}^{-2}$ . It is used when high conductance and forming a rigid part is needed.

## Nominal Physical Properties:

Beryllium-copper C17200 Contains 1.8 to 2.0 Be

C17300 (alloy M25) ASTM B 197(C17200)

Resistivity: 0.095-0.191  $\Omega\text{mm}^2\text{ m}^{-1}$ , 57-115  $\Omega/\text{cmf}$

Density: 8.25  $\text{g}/\text{cm}^3$ , 0.298  $\text{lb}/\text{in}^3$

DC Conductivity: 15-30% IACS at 20C

Tensile strength: 415-1586  $\text{N mm}^{-2}$ , 60-230  $\text{ksi}$

**Note:** Various temper treatments determine tensile strength, elongation, yield, conductivity, and resistivity.

# Conductive Alloy Comparison

AWG	Diameter		Resistance ( $\Omega/m, \Omega/ft$ )								Weight (g/m, lbs/1000 ft)							
			OFHC Cu		15% CCAI		10% CCAI		1350 AI		OFHC Cu		15% CCAI		10% CCAI		1350 AI	
	Inches	mm	$\Omega/m$	$\Omega/ft$	$\Omega/m$	$\Omega/ft$	$\Omega/m$	$\Omega/ft$	$\Omega/m$	$\Omega/ft$	g/m	lbs/1000 ft	g/m	lbs/1000 ft	g/m	lbs/1000 ft	g/m	lbs/1000 ft
25.00	0.01790	0.4547	0.1062	0.0324	0.1587	0.0484	0.1628	0.0496	0.1718	0.0524	1.4529	0.9754	0.5915	0.3971	0.5411	0.3633	0.4408	0.2959
25.25	0.01739	0.4417	0.1125	0.0343	0.1681	0.0513	0.1725	0.0526	0.1820	0.0555	1.3711	0.9205	0.5582	0.3747	0.5106	0.3428	0.4160	0.2793
25.50	0.01689	0.4291	0.1192	0.0363	0.1782	0.0543	0.1828	0.0557	0.1929	0.0588	1.2938	0.8686	0.5267	0.3536	0.4819	0.3235	0.3926	0.2635
25.75	0.01641	0.4168	0.1263	0.0385	0.1888	0.0576	0.1937	0.0590	0.2044	0.0623	1.2210	0.8197	0.4971	0.3337	0.4547	0.3053	0.3704	0.2487
26.00	0.01594	0.4049	0.1339	0.0408	0.2001	0.0610	0.2052	0.0626	0.2166	0.0660	1.1522	0.7735	0.4691	0.3149	0.4291	0.2881	0.3496	0.2347
26.25	0.01549	0.3933	0.1419	0.0433	0.2120	0.0646	0.2175	0.0663	0.2296	0.0700	1.0873	0.7300	0.4427	0.2972	0.4050	0.2719	0.3299	0.2215
26.50	0.01504	0.3821	0.1503	0.0458	0.2247	0.0685	0.2305	0.0703	0.2433	0.0742	1.0261	0.6889	0.4177	0.2804	0.3822	0.2566	0.3113	0.2090
26.75	0.01461	0.3712	0.1593	0.0486	0.2381	0.0726	0.2442	0.0745	0.2578	0.0786	0.9683	0.6501	0.3942	0.2647	0.3606	0.2421	0.2938	0.1972
27.00	0.01420	0.3606	0.1688	0.0515	0.2523	0.0769	0.2588	0.0789	0.2732	0.0833	0.9137	0.6134	0.3720	0.2497	0.3403	0.2285	0.2772	0.1861
27.25	0.01379	0.3503	0.1789	0.0545	0.2673	0.0815	0.2742	0.0836	0.2895	0.0883	0.8623	0.5789	0.3510	0.2357	0.3211	0.2156	0.2616	0.1756
27.50	0.01340	0.3403	0.1896	0.0578	0.2833	0.0864	0.2906	0.0886	0.3067	0.0935	0.8137	0.5463	0.3313	0.2224	0.3031	0.2035	0.2469	0.1657
27.75	0.01301	0.3305	0.2009	0.0612	0.3002	0.0915	0.3080	0.0939	0.3250	0.0991	0.7679	0.5155	0.3126	0.2099	0.2860	0.1920	0.2330	0.1564
28.00	0.01264	0.3211	0.2129	0.0649	0.3181	0.0970	0.3263	0.0995	0.3444	0.1050	0.7246	0.4865	0.2950	0.1981	0.2699	0.1812	0.2199	0.1476
28.25	0.01228	0.3119	0.2256	0.0688	0.3371	0.1028	0.3458	0.1054	0.3650	0.1113	0.6838	0.4591	0.2784	0.1869	0.2547	0.1710	0.2075	0.1393
28.50	0.01193	0.3030	0.2390	0.0729	0.3572	0.1089	0.3665	0.1117	0.3868	0.1179	0.6453	0.4332	0.2627	0.1764	0.2403	0.1614	0.1958	0.1314
28.75	0.01159	0.2944	0.2533	0.0772	0.3786	0.1154	0.3883	0.1184	0.4099	0.1250	0.6089	0.4088	0.2479	0.1664	0.2268	0.1523	0.1848	0.1240
29.00	0.01126	0.2859	0.2684	0.0818	0.4012	0.1223	0.4115	0.1255	0.4343	0.1324	0.5746	0.3858	0.2340	0.1571	0.2140	0.1437	0.1744	0.1171
29.25	0.01094	0.2778	0.2844	0.0867	0.4251	0.1296	0.4361	0.1329	0.4603	0.1403	0.5423	0.3641	0.2208	0.1482	0.2020	0.1356	0.1645	0.1105
29.50	0.01062	0.2698	0.3014	0.0919	0.4505	0.1373	0.4621	0.1409	0.4877	0.1487	0.5117	0.3436	0.2083	0.1399	0.1906	0.1280	0.1553	0.1042
29.75	0.01032	0.2621	0.3194	0.0974	0.4774	0.1455	0.4897	0.1493	0.5168	0.1576	0.4829	0.3242	0.1966	0.1320	0.1799	0.1208	0.1465	0.0984
30.00	0.01003	0.2546	0.3385	0.1032	0.5059	0.1542	0.5189	0.1582	0.5477	0.1670	0.4557	0.3060	0.1855	0.1246	0.1697	0.1140	0.1383	0.0928
30.25	0.00974	0.2474	0.3587	0.1093	0.5360	0.1634	0.5499	0.1676	0.5804	0.1769	0.4301	0.2887	0.1751	0.1175	0.1602	0.1075	0.1305	0.0876
30.50	0.00946	0.2403	0.3801	0.1159	0.5680	0.1732	0.5827	0.1777	0.6150	0.1875	0.4058	0.2725	0.1652	0.1109	0.1511	0.1015	0.1231	0.0827
30.75	0.00919	0.2334	0.4028	0.1228	0.6019	0.1835	0.6175	0.1883	0.6517	0.1987	0.3830	0.2571	0.1559	0.1047	0.1426	0.0958	0.1162	0.0780
31.00	0.00893	0.2268	0.4268	0.1301	0.6379	0.1945	0.6543	0.1995	0.6906	0.2106	0.3614	0.2426	0.1471	0.0988	0.1346	0.0904	0.1097	0.0736
31.25	0.00867	0.2203	0.4523	0.1379	0.6759	0.2061	0.6934	0.2114	0.7318	0.2231	0.3410	0.2290	0.1388	0.0932	0.1270	0.0853	0.1035	0.0695
31.50	0.00842	0.2140	0.4793	0.1461	0.7163	0.2184	0.7348	0.2240	0.7755	0.2364	0.3218	0.2161	0.1310	0.0880	0.1199	0.0805	0.0976	0.0656
31.75	0.00818	0.2079	0.5079	0.1548	0.7590	0.2314	0.7786	0.2374	0.8218	0.2506	0.3037	0.2039	0.1236	0.0830	0.1131	0.0759	0.0921	0.0619
32.00	0.00795	0.2019	0.5382	0.1641	0.8043	0.2452	0.8251	0.2516	0.8709	0.2655	0.2866	0.1924	0.1167	0.0783	0.1067	0.0717	0.0870	0.0584
32.25	0.00772	0.1962	0.5703	0.1739	0.8523	0.2599	0.8743	0.2666	0.9228	0.2814	0.2705	0.1816	0.1101	0.0739	0.1007	0.0676	0.0821	0.0551
32.50	0.00750	0.1906	0.6043	0.1842	0.9032	0.2754	0.9265	0.2825	0.9779	0.2981	0.2552	0.1714	0.1039	0.0698	0.0951	0.0638	0.0774	0.0520
32.75	0.00729	0.1851	0.6404	0.1952	0.9571	0.2918	0.9818	0.2993	1.0363	0.3159	0.2409	0.1617	0.0981	0.0658	0.0897	0.0602	0.0731	0.0491
33.00	0.00708	0.1798	0.6786	0.2069	1.0142	0.3092	1.0404	0.3172	1.0981	0.3348	0.2273	0.1526	0.0925	0.0621	0.0847	0.0568	0.0690	0.0463
33.25	0.00688	0.1747	0.7191	0.2192	1.0748	0.3277	1.1025	0.3361	1.1637	0.3548	0.2145	0.1440	0.0873	0.0586	0.0799	0.0536	0.0651	0.0437
33.50	0.00668	0.1697	0.7621	0.2323	1.1389	0.3472	1.1683	0.3562	1.2331	0.3760	0.2024	0.1359	0.0824	0.0553	0.0754	0.0506	0.0614	0.0412
33.75	0.00649	0.1649	0.8075	0.2462	1.2069	0.3680	1.2381	0.3775	1.3067	0.3984	0.1910	0.1282	0.0778	0.0522	0.0711	0.0478	0.0580	0.0389
34.00	0.00630	0.1601	0.8557	0.2609	1.2789	0.3899	1.3119	0.4000	1.3847	0.4222	0.1802	0.1210	0.0734	0.0493	0.0671	0.0451	0.0547	0.0367
34.25	0.00612	0.1556	0.9068	0.2765	1.3553	0.4132	1.3903	0.4239	1.4674	0.4474	0.1701	0.1142	0.0692	0.0465	0.0634	0.0425	0.0516	0.0346
34.50	0.00595	0.1511	0.9609	0.2930	1.4362	0.4379	1.4732	0.4492	1.5550	0.4741	0.1605	0.1078	0.0653	0.0439	0.0598	0.0401	0.0487	0.0327
34.75	0.00578	0.1468	1.0183	0.3105	1.5219	0.4640	1.5612	0.4760	1.6478	0.5024	0.1515	0.1017	0.0617	0.0414	0.0564	0.0379	0.0460	0.0309
35.00	0.00561	0.1426	1.0791	0.3290	1.6127	0.4917	1.6543	0.5044	1.7461	0.5323	0.1429	0.0960	0.0582	0.0391	0.0532	0.0357	0.0434	0.0291
35.25	0.00545	0.1385	1.1435	0.3486	1.7090	0.5210	1.7531	0.5345	1.8503	0.5641	0.1349	0.0906	0.0549	0.0369	0.0502	0.0337	0.0409	0.0275
35.50	0.00530	0.1346	1.2117	0.3694	1.8110	0.5521	1.8577	0.5664	1.9608	0.5978	0.1273	0.0855	0.0518	0.0348	0.0474	0.0318	0.0386	0.0259
35.75	0.00515	0.1307	1.2840	0.3915	1.9191	0.5851	1.9686	0.6002	2.0778	0.6335	0.1201	0.0806	0.0489	0.0328	0.0447	0.0300	0.0364	0.0245
36.00	0.00500	0.1270	1.3607	0.4148	2.0336	0.6200	2.0861	0.6360	2.2018	0.6713	0.1134	0.0761	0.0462	0.0310	0.0422	0.0283	0.0344	0.0231
36.50	0.00472	0.1198	1.5279	0.4658	2.2836	0.6962	2.3425	0.7142	2.4725	0.7538	0.1009	0.0678	0.0411	0.0276	0.0376	0.0252	0.0306	0.0206
37.00	0.00445	0.1131	1.7158	0.5231	2.5643	0.7818	2.6305	0.8020	2.7764	0.8465	0.0899	0.0604	0.0366	0.0246	0.0335	0.0225	0.0273	0.0183
37.50	0.00420	0.1067	1.9267	0.5874	2.8796	0.8779	2.9539	0.9006	3.1177	0.9505	0.0801	0.0537	0.0326	0.0219	0.0298	0.0200	0.0243	0.0163
38.00	0.00397	0.1007	2.1636	0.6596	3.2336	0.9858	3.3170	1.0113	3.5010	1.0674	0.0713	0.0479	0.0290	0.0195	0.0266	0.0178	0.0216	0.0145
38.50	0.00374	0.0950	2.4295	0.7407	3.6311	1.1070	3.7248	1.1356	3.9314	1.1986	0.0635	0.0426	0.0258	0.0174	0.0236	0.0159	0.0193	0.0129
39.00	0.00353	0.0897	2.7282	0.8318	4.0774	1.2431	4.1827	1.2752	4.4147	1.3459	0.0565	0.0380	0.0230	0.0155	0.0211	0.0141	0.0172	0.0115
39.50	0.00333	0.0846	3.0636	0.9340	4.5787	1.3959	4.6968	1.4320	4.9574	1.5114	0.0503	0.0338	0.0205	0.0138	0.0188	0.0126	0.0153	0.0103
40.00	0.00314	0.0799	3.4402	1.0488	5.1415	1.5675	5.2742	1.6080	5.5668	1.6972	0.0448	0.0301	0.0183	0.0123	0.0167	0.0112	0.0136	0.0091

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