

ROLA

Tough Enamel "D"

Magnet Winding WIRE

TECHNICAL DATA



Technical Bulletin No. 18
July, 1954

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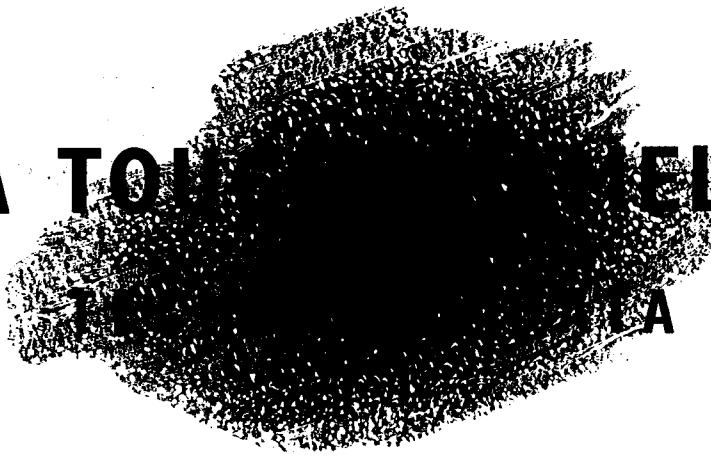
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ROLA TOUGH ENAMEL "D"



Rola Tough Enamel "D" is an entirely new type of Tough Enamel which in many respects is vastly superior to any of the previously available types of Tough Enamel. It combines some of the best features of Oleo-resinous and Tough Enamel coatings and, in addition, has some which are not possessed by either.

For this reason Rola Tough Enamel "D" requires a set of specifications which differ in important respects from the 10-years-old standards of vinyl-acetal enamels.

ELECTRICAL PROPERTIES

Its electrical characteristics are excellent and its dielectric strength such as to permit the use of single instead of double coated wire in many applications. This can result in a space factor improvement ranging from 3% in the heavy gauges to 12% in the fine ones.

The electrical properties of Rola Tough Enamel "D" are better than those of any Tough Enamel we have tested and are less affected by humidity than even those of Oleo-resinous covered wires. This is of great importance when it is desired to use non-impregnated coils.

MOISTURE RESISTANCE

We are now preparing specifications to cover this property of retention of electrical characteristics after immersion in water but due to the novelty of the test, these involve considerable research.

In the interim the following typical figures are provided for the guidance of Rola Tough Enamel "D" users.

.010" diameter bare wire coated with .0005" radial addition of Tough Enamel "D".

Samples 12 inches in length immersed in a mercury bath. Voltages applied between mercury and conductor.

INSULATION RESISTANCE

Test	As Made	After 1 Hour in water at 20° C.	After 30 Days in water at 20° C.
Insulation Resistance	>100,000 M Ω	>100,000 M Ω	>100,000 M Ω
Breakdown A.C. Voltage	2,000 v.	1,500 v.	1,400 v.

COLOR CODING

Another important feature of Rola Tough Enamel "D" is its inherent color-coding. It can be supplied in a range of distinctive colors, each baked into the enamel, to facilitate identification in complex coil assemblies.

SOLDERING

Another very useful feature of Rola Tough Enamel "D" is the facility with which it can be soldered without stripping. The technique used will vary with individual requirements, but it can be stated that success has been achieved with cored solder and a very hot iron.

ROLA TOUGH ENAMEL "D" WIRES

Following widespread production use of Rola Tough Enamel "D" under a divergent series of commercial applications we feel the time has come to lay down Tentative

Specifications for this remarkable Tough Enamel so that prospective users may be able fully to evaluate its outstanding characteristics.

WIRE. Rola bare copper wire conforms to the specifications set out in the following pages.

DIMENSIONS & TOLERANCES. The size of each gauge of wire is expressed as its diameter in decimals of an inch. Not more than four places of decimals are used. Rola wire does not vary from the nominal diameter by more than the amounts listed in Table I.

**TABLE I
DIAMETER VARIATIONS**

Wire Diameter in Inches	Variation from Nominal Size
Under .0100	± .0001 inch
.0100 and above	± 1%

DENSITY. For the purpose of calculating weights, cross-sections, etc., the density of the copper is taken as 8.89 gr. per cubic centimetre (.32117 lb. per cu. in.) at 20° C. (68° F.).

RESISTIVITY. The resistivity of the copper is not more than .75% above nor 1.8% below the International Standard for the resistivity of annealed copper (.67879 microms per inch cube or 875.2 ohms per mile, pound) at 20° C. (68° F.).

SPOOLING. Rola Tough Enamel "D" is wound on spools under such tension as will give it an even and compact winding. A soft body of wire is considered unsatisfactory. The wire is one continuous length on each spool.

ENAMEL COATING. Rola Tough Enamel "D" is coated with a continuous insulating film of enamel of such quality as to meet the requirements of these specifications when the wire is taken directly from the spool delivered to the purchaser.

COLOUR Red is standard colour. Green, Orange, Violet and Clear are available as non-standard colours.

ENAMEL THICKNESS. The minimum and maximum permissible additions of enamel are set out in Table II.

MEASUREMENT OF ENAMEL ADDITION. The enamel addition for Rola Tough Enamel "D" conforms to the specifications set out in Table II. The addition to the diameter of the bare wire is determined by discarding a length of approximately 12 feet of wire from the spool, measuring the diameter over the enamel

TABLE II
PERMISSIBLE ENAMEL ADDITIONS

Size B & S	Nominal Bare Wire Diameter (Inch)	Single		Double		Triple		Quadruple		Size B & S
		Min. Addition (Inch)	Max. Addition (Inch)	Min. Addition (Inch)	Max. Addition (Inch)	Min. Addition (Inch)	Max. Addition (Inch)	Min. Addition (Inch)	Max. Addition (Inch)	
8	.1285	.0016	.0026	.0033	.0044	.0045	.0057	.0058	.0079	8
9	.1144	16	26	32	43	44	56	57	78	9
10	.1019	15	25	31	42	43	55	56	77	10
11	.0907	15	25	30	41	42	53	54	75	11
12	.0808	14	24	29	39	40	51	52	72	12
13	.0720	14	23	28	38	39	49	50	69	13
14	.0641	14	23	27	37	38	48	49	68	14
15	.0571	13	22	26	36	37	47	48	67	15
16	.0508	12	21	26	35	36	45	46	64	16
17	.0453	12	20	25	34	35	44	45	62	17
18	.0403	11	19	24	33	34	43	44	61	18
19	.0359	11	19	23	32	33	41	42	59	19
20	.0320	10	18	22	30	31	39	40	56	20
21	.0285	10	18	21	29	30	38	39	54	21
22	.0253	10	17	20	28	29	36	37	52	22
23	.0226	.0009	16	19	27	28	35	36	51	23
24	.0201	9	15	19	26	27	34	35	49	24
25	.0179	9	14	18	25	26	33	34	47	25
26	.0159	8	13	17	24	25	31	32	45	26
27	.0142	8	13	16	22	23	29	30	42	27
28	.0126	7	12	15	21	22	28	29	39	28
29	.0113	7	12	14	20	21	27	28	38	29
30	.0100	6	11	13	19	20	26	27	36	30
31	.0089	6	11	13	18	19	25			31
32	.0080	6	10	12	17	18	24			32
33	.0071	5	.0009	11	16	17	23			33
34	.0063	5	8	10	14	15	20			34
35	.0056	4	7	.0009	13	14	19			35
36	.0050	4	7	8	12	13	18			36
37	.0045	3	6	8	11	12	16			37
38	.0040	3	6	7	10	11	15			38
39	.0035	2	5	6	.0009	10	14			39
40	.0031	2	5	6	8	.0009	12			40
41	.0027	2	4	5	7					41
42	.0024	2	4	4	6					42
43	.0021	2	4							43
44	.0019	2	4							44

of the wire on the spool, then, by burning, removing the enamel at the point of measurement. The diameter of the bare wire is then measured and the difference between the two measurements is taken

as the addition to the diameter of the wire at this point. Three sets of measurements are made at four feet intervals and the average of these results accepted as the amount of enamel addition.



CONTINUITY OF COVERING. Wires .0020" to .0201" in diameter (bare) inclusive are tested by passing a sample of wire not less than 50 yards in length through a bath containing clean mercury. The length of wire immersed in the mercury should be 2.4 inches and the rate of travel of the wire through the bath should be 12 inches per second + 10%.

A test voltage of 50 volts is passed between the enamel and the mercury bath. A magnetic relay and counter operate for each enamel fault which passes through the mercury bath. The maximum number of faults in each piece of Rola Tough Enamel "D" wire is not greater than that shown in Table III.

**TABLE III
MAXIMUM NUMBER OF FAULTS**

Nominal Bare Wire Diameter (Inch)	B & S Size	Maximum Number Of Faults Per 50 Yards			
		Enamel	Double Enamel	Triple Enamel	Quadruple Enamel
.0201-.0071	24-33	10	6	4	1
.0063-.0031	34-40	15	9	5	
.0028-.0020	41-44	20	12		

For this test, the magnetic relay and counter are calibrated in the following manner:—The counter operates with certainty when 50 volts is maintained for 0.085 seconds across a test resistor of 10,000 ohms connected in place of the wire and mercury bath. Under the same conditions, the counter does not operate with a test resistor of 15,000 ohms. Further, the counter does not operate if 50 volts is maintained for 0.05 seconds across a test resistor of 10,000 ohms. Further, when a test resistor of 500 ohms is connected in series with the relay, the counter does operate within 0.06 seconds.

NOTE: For details of the pin-hole testing machine and method of calibration, see British Standard 156:1951.

ADHERENCE AND FLEXIBILITY. (a) When stretched to breaking point at a temperature of 15.6° — 26.7° C. (60° — 80° F.), a piece of Rola Tough Enamel "D" having an effective length of 10 inches will not show cracks in the enamel film.

(b) *Wire sizes 29 B&S and heavier.*
A piece of Rola Tough Enamel "D" bent around itself will not show cracks or ruptures in the enamel film.

(c) *Wire sizes 30 B&S and finer.*
A piece of Rola Tough Enamel "D" stretched 25% (or to breaking point of the copper, should this be less than 25%) then wound on a mandrel three times the diameter of the bare wire, will not show cracks or ruptures in the enamel film.

These tests are to be made at temperatures between 15.6° and 26.7° C (60° — 80° F.) and with ten tightly and evenly wound turns.

ABRASION SCRAPE. In this test the surface of the wire is repeatedly scraped with an 0.016 inch diameter steel needle placed at right angles to the wire and working to and fro in a direction parallel to the wire. When wire is tested with the needle loaded with the weights specified in Table IV. the average abrasion scrape must be not less than 30 strokes and no single test less than 15. Tests are made at 0, 120 and 240 degrees around the periphery of the wire. These tests are made on two samples and averaged to determine the abrasion scrape value. Stroke frequency is 60 per minute. Wire to be tested is first wiped to remove lubricant and then stretched slightly, 1%, to remove kinks. The tests are made at a temperature of 15.6° — 26.7° C. (60° — 80° F.). Standard abrasion testers are fitted with an electrical circuit providing 12 volts at approximately 5 milliamperes between the needle and the wire sample. This circuit is designed so that it shuts off the scraper when the wire is worn through to the

TABLE IV
ABRASION SCRAPE — LOAD IN GRAMMES TO GIVE 30 STROKES

Size B & S	Nominal Bare Wire Diameter (Inches)	Single	Double	Triple	Quadruple	Size B & S
10	.1019	520	730	850	960	10
11	.0907	520	730	850	960	11
12	.0808	520	730	850	960	12
13	.0720	520	730	850	960	13
14	.0641	500	700	800	900	14
15	.0571	470	660	780	850	15
16	.0508	440	620	740	800	16
17	.0453	410	590	700	760	17
18	.0403	390	560	670	720	18
19	.0359	360	520	620	680	19
20	.0320	340	490	580	640	20
21	.0285	320	460	540	600	21
22	.0253	290	430	510	560	22
23	.0226	280	400	480	520	23
24	.0201	260	370	440	490	24
25	.0179	240	350	410	460	25
26	.0159	230	320	380	430	26
27	.0142	210	300	360	400	27
28	.0126	200	280	330	370	28
29	.0113	180	260	300	350	29
30	.0100	160	240	280	320	30

copper for approximately one-third of the stroke length of $\frac{3}{8}$ in.

Rola Tough Enamel "D" will meet the requirements of Table IV.

SOLVENT RESISTANCE. *Test A (i). Wires less than .0100" diameter (bare)*
A sample of wire 10 inches in length is slowly and steadily elongated to 11 inches at the rate of approximately 12 inches per minute, then heated in air at 110° C. ± 2° C. (230° F. ± 3.6° F.) for 16 hours and allowed to cool to room temperature. It is then immersed for two hours in the appropriate solvent and at the temperature set out in Table V. After removal of the wire from the solvent bath the solvent on it is allowed to evaporate at a temperature not exceeding that of Table V. When the dried wire is examined under

a magnification of approximately 15 diameters no visible signs of enamel wrinkling or disintegration will be detected.

(ii) *Wires .0100 diameter (bare) and larger.*

A sample of the wire is wound on a mandrel of the appropriate size listed

TABLE V
SOLVENTS AND IMMERSION TEMPERATURES

Solvent	Temperature Range
Methylated Spirit	35- 40° C. (95-104° F.)
Xylol—Butanol (approx. 2:1)	35- 40° C. (95-104° F.)
Xylol	65- 70° C. (149-158° F.)
White Spirit	95-100° C. (203-212° F.)

TABLE VI
MANDREL DIAMETER

Nominal Bare Wire Diameter (Inch)	B & S Size	Ratio Of Mandrel Diameter To Bare Wire Diameter			
		Enamel	Double Enamel	Triple Enamel	Quadruple Enamel
.1285-.0907	8-11	4	5	6	7
.0808-.0571	12-15	3	4	5	6
.0508-.0320	16-20	2	3	4	5
.0285-.0201	21-24	1.5	2		

in Table VI. and after slipping the helix off the mandrel the sample is then heated in air at 110° C. ± 2° C. (230° F ± 3.6° F.) for 16 hours and allowed to cool to room temperature. It is then immersed for two hours in the appropriate solvent and at the temperature set out in Table V. After removal of the wire from the solvent bath the solvent on it is allowed to evaporate at a temperature not exceeding that of Table V. When the dried wire is examined under a magnification of approximately 15 diameters no visible signs of enamel wrinkling or disintegration will be detected.

Test B.—After immersion without bending in any of the following liquids for 24 hours at temperatures of 15.6° — 26.7° C. (60° — 80° F.), it will be found that the insulating film on Rola Tough

Enamel “D” will not have softened sufficiently to allow it to be removed by rubbing with cheese-cloth gripped between the thumb and forefinger.

SOLVENTS:

- 55° Petroleum Naphtha (VMP).
- Commercial Grade 3° Toluol.
- 1% Caustic Potash Solution.
- Kerosene.
- Benzene (C₆ H₆).

AGEING. After being heated (unstretched and unbent) in an oven at 125° C. (257° F.) for 168 hours, Rola Tough Enamel “D” does not show cracks when wound on a mandrel three times its bare wire diameter. Ten turns, tensioned to provide a tight, even winding, are considered adequate for this test.

TABLE VII
DIELECTRIC STRENGTH TEST VOLTAGES

Nominal Bare Wire Diameter (Inch)	B & S Size	Total Tension On Wires	Total Number Of Twists	Test Voltage			
				Single	Double	Triple	Quadruple
.1285-.0907	8-11	15 lb.	3	2300	4500	6000	7500
.0808-.0571	12-15	9 lb.	6	2000	4000	5000	7000
.0508-.0320	16-20	3 lb.	9	1700	3500	4500	5500
.0285-.0201	21-24	1 lb.	12	1400	3000	4000	5000
.0179-.0126	25-28	12 oz.	16	1000	2500	3000	4000
.0113-.0080	29-32	4 oz.	20	750	1700	2500	
.0071-.0050	33-36	1.5 oz.	24	600	1200	1700	
.0045-.0031	37-40	.5 oz.	30	450	800	1200	
.0028-.0020	41-44	.3 oz.	35	350	650		



HEAT SHOCK. Prepare samples as follows:

- (a) Wire 29 B&S and heavier—bent around a mandrel three times the diameter of the bare wire.
- (b) Wire 30 B&S and finer—stretched 20% or to the breaking point of the copper, whichever is less, and then wound on a mandrel three times the diameter of the wire.

After being placed in an oven at 125° C. (257° F.) for one hour, Rola Tough Enamel "D" samples will show no ruptures or cracks in the film.

COMPLETENESS OF CURE (Toluol-Alcohol Test). A piece of Rola Tough Enamel "D" immersed with out bending in a boiling mixture initially containing 30% commercial grade 3° Toluol and 70% Denatured Ethyl Alcohol by volume for a period of five minutes will, on removal, show no visible signs of swelling or blistering of the enamel except within $\frac{1}{2}$ in. of the immersed end. Four inches immersed in the liquid is sufficient for the test.

DIELECTRIC STRENGTH TESTS. *Twist Test:* When subjected to the following test Rola Tough Enamel "D" withstands the

TABLE VIII
ELONGATION CHARACTERISTICS
TOUGH ENAMEL COPPER WIRE

Nominal Bare Wire Diameter (Inch)	B. & S Size	Minimum Elongation (Per Cent)
.1285-.1144	8-9	30%
.1019-.0226	10-23	25%
.0201-.0063	24-34	20%
.0056-.0031	35-40	15%
.0028-.0020	41-44	10%

voltages listed in Table VII. Twist together for a distance of 4.75 inches two pieces of the wire to be tested. The tension on the wire while being twisted and the number of twists must conform to Table VII. An initial voltage of not more than 120 volts A.C. is then applied between the two twisted wires and the voltage gradually increased until the coating is punctured. The voltage should be measured with an R.M.S. voltmeter.

ELONGATION TESTS. Rola Tough Enamel "D" meets the requirements of Table VIII.





SINGLE TOUGH ENAMEL "D"

GAUGE B. & S.	Dia. over Insulation		WEIGHT			RESISTANCE			TURNS		APPROX CURRENT RATING
	MIN.	MAX.	LB. PER 1000 FEET	LB. PER CU. INCH	FEET PER POUND	OHMS per 1000 FT.	OHMS per LB.	OHMS per CU. INCH	PER SQ. IN.	PER LIN. IN.	
8	.1288	.1324	50.48	.2469	19.81	.6282	.0124	.00307	58.7	7.66	11.0
9	.1149	.1181	40.03	.2455	24.81	.7921	.0196	.00482	73.6	8.58	8.7
10	.1024	.1054	31.76	.2448	31.49	.9989	.0134	.00770	92.5	9.62	6.9
*10½	.0968	.0998	28.36	.2458	35.26	1.118	.0394	.00969	104	10.2	6.1
11	.0913	.0942	25.18	.2445	39.71	1.260	.0500	.01228	117	10.8	5.4
*11½	.0864	.0892	22.52	.2440	44.40	1.409	.0625	.01526	130	11.4	4.9
12	.0814	.0840	19.98	.2431	50.05	1.588	.0749	.01823	146	12.1	4.3
*12½	.0770	.0796	17.86	.2441	55.99	1.713	.0959	.02341	164	12.8	3.8
13	.0726	.0750	15.85	.2404	63.09	2.003	.1264	.03039	182	13.5	3.4
*13½	.0687	.0710	14.16	.2407	70.62	2.163	.1527	.03675	204	14.3	3.0
14	.0648	.0670	12.57	.2420	79.55	2.525	.2009	.04862	231	15.2	2.7
*14½	.0613	.0634	11.24	.2398	88.97	2.824	.2512	.06024	256	16.0	2.4
15	.0578	.0598	9.971	.2401	100.3	3.184	.3193	.07666	289	17.0	2.2
*15½	.0547	.0566	8.895	.2402	112.4	3.570	.4013	.09639	324	18.0	1.9
16	.0515	.0534	7.910	.2406	126.4	4.016	.5076	.1221	365	19.1	1.7
*16½	.0487	.0506	7.058	.2376	141.1	4.501	.6351	.1509	404	20.1	1.5
17	.0460	.0477	6.276	.2374	159.3	5.064	.8067	.1915	454	21.3	1.3
*17½	.0435	.0452	5.614	.2367	178.1	5.661	1.008	.2386	506	22.5	1.2
18	.0410	.0426	4.979	.2369	200.8	6.385	1.282	.3037	571	23.9	1.1
*18½	.0387	.0404	4.451	.2355	224.7	7.142	1.605	.3780	635	25.2	.96
19	.0365	.0382	3.950	.2347	253.2	8.051	2.039	.4785	713	26.7	.86
*19½	.0347	.0361	3.524	.2335	283.8	8.703	2.470	.5767	795	28.2	.76
20	.0326	.0341	3.134	.2335	319.1	10.15	3.239	.7563	894	29.9	.68
*20½	.0309	.0323	2.799	.2330	357.3	11.37	4.191	.9765	999	31.6	.61
21	.0292	.0305	2.487	.2313	402.1	12.80	5.147	1.190	1116	33.4	.54
*21½	.0276	.0290	2.221	.2306	450.2	14.33	6.451	1.488	1246	35.3	.48
22	.0261	.0273	1.974	.2301	506.6	16.14	8.176	1.881	1399	37.4	.43
*22½	.0247	.0258	1.769	.2288	565.3	18.00	10.17	2.327	1552	39.4	.38
23	.0232	.0244	1.565	.2290	639.0	20.36	13.01	2.979	1756	41.9	.34
*23½	.0220	.0231	1.394	.2279	717.4	22.86	16.40	3.738	1962	44.3	.32
24	.0208	.0218	1.243	.2279	804.5	25.67	20.65	4.706	2200	46.9	.27
*24½	.0197	.0207	1.111	.2268	900.1	28.73	25.86	5.865	2450	49.5	.24
25	.0186	.0195	.9867	.2266	1013	32.37	32.79	7.430	2756	52.5	.21
*25½	.0176	.0185	.8801	.2251	1136	36.31	41.25	9.285	3069	55.4	.19
26	.0166	.0174	.7837	.2273	1276	40.81	52.07	11.83	3481	59.0	.17
*26½	.0157	.0166	.7036	.2247	1421	45.49	64.64	14.52	3832	61.9	.15
27	.0149	.0156	.6224	.2232	1607	51.47	82.71	18.46	4303	65.6	.13
*27½	.0141	.0148	.5564	.2220	1797	57.74	103.8	23.04	4789	69.2	.12
28	.0132	.0140	.4943	.2243	2023	64.90	131.3	29.45	5446	73.8	.106
*28½	.0124	.0131	.4458	.2249	2243	72.02	161.5	36.32	6053	77.8	.096
29	.0119	.0126	.3926	.2179	2547	81.83	208.4	45.41	6659	81.6	.084
*29½	.0112	.0119	.3485	.2188	2869	92.27	264.7	57.92	7534	86.8	.074
30	.0105	.0112	.3118	.2209	3207	103.2	331.0	73.12	8501	92.2	.067
*30½	.0100	.0107	.2802	.2179	3569	114.9	410.1	89.36	9332	96.6	.060
31	.0094	.0100	.2476	.2189	4039	130.1	525.5	115.0	10609	103	.053
*31½	.0089	.0095	.2245	.2223	4454	143.5	639.1	142.1	11881	109	.048

Variations from this table within manufacturing limits maybe expected in practice. Resistance values are based on nominal bare wire diameters and are in accordance with the International Standard for annealed copper, i.e. 875.2 Ohms per mile/pound at 20°C. (68°F.).

† Calculated at 1500 circular mils per ampere, (equivalent to 850 amperes per square inch).

*Non Standard.



SINGLE TOUGH ENAMEL "D"

GAUGE B. & S.	Dia. over Insulation		WEIGHT			RESISTANCE			TURNS		APPROX. CURRENT RATING
	MIN.	MAX.	LB. PER 1000 FEET	LB. PER CU. INCH	FEET PER POUND	OHMS per 1000 FT.	OHMS per LB.	OHMS per CU. INCH	PER SQ. IN.	PER LIN. IN.	
32	.0085	.0091	.1964	.2127	5092	164.1	835.6	177.7	12996	114	.042
*32½	.0080	.0086	.1750	.2100	5714	184.4	1054	221.3	14400	120	.037
33	.0075	.0081	.1559	.2128	6414	206.9	1327	282.4	16384	128	.033
*33½	.0071	.0077	.1315	.1997	7605	245.5	1867	372.8	18225	135	.028
34	.0067	.0072	.1238	.2139	8078	260.9	2107	450.7	20736	144	.026
*34½	.0063	.0068	.1122	.2104	8913	288.1	2568	540.3	22500	150	.024
35	.0059	.0064	.09827	.2176	10176	329.0	3348	728.5	26569	163	.021
*35½	.0056	.0061	.08761	.2135	11414	369.2	4214	899.7	29241	171	.018
36	.0053	.0058	.07802	.2106	12817	414.8	5316	1119	32400	180	.017
*36½	.0050	.0055	.06897	.2439	14499	469.5	6807	1660	36100	190	.064
37	.0047	.0052	.06193	.2106	16147	523.1	8446	1779	40804	202	.013
38	.0042	.0047	.04916	.2074	20342	659.6	13418	2783	50625	225	.010
39	.0036	.0041	.03904	.2199	25615	831.8	21307	4685	67600	260	.008
40	.0032	.0037	.03100	.2173	32258	1049	33839	7353	84100	290	.006
41	.0029	.0033	.02459	.2138	40667	1323	53802	11503	104329	323	.005
42	.0026	.0030	.01946	.2067	51387	1673	85970	17770	127449	357	.004
43	.0023	.0026	.01531	.2218	65317	2104	137427	30481	173889	417	.003
44	.0021	.0025	.01207	.2279	82850	2672	221375	50451	226576	476	.002

Variations from this table within manufacturing limits may be expected in practice. Resistance values are based on nominal bare wire diameters and are in accordance with the international Standard for annealed copper, i.e. 875.2 Ohms per mile/pound at 20°C. (68°F.).

‡ Calculated at 1500 circular mils per ampere, (equivalent to 850 amperes per square inch).

*Non Standard.





DOUBLE TOUGH ENAMEL "D"

GAUGE B. & S.	Dia. over Insulation		WEIGHT			RESISTANCE			TURNS		APPROX. CURRENT RATING
	MIN.	MAX.	LB. PER 1000 FEET	LB. PER CU. INCH	FEET PER POUND	OHMS per 1000 FT.	OHMS per LB.	OHMS per CU. INCH	PER SQ. IN.	PER LIN. IN.	
8	.1305	.1342	50.74	.2414	19.71	.6832	.01238	.002988	57.1	7.56	11.0
9	.1165	.1198	39.97	.2385	25.02	.7921	.01982	.004727	71.6	8.46	8.7
10	.1040	.1071	31.92	.2386	31.33	.9989	.03129	.007466	89.7	9.47	6.9
*10½	.0984	.1015	28.52	.2377	35.06	1.118	.03920	.007318	100	10.0	6.1
11	.0928	.0958	25.32	.2363	39.49	1.260	.04976	.00176	112	10.6	5.4
*11½	.0879	.0908	22.64	.2350	44.17	1.409	.06223	.01467	125	11.2	4.9
12	.0829	.0855	20.09	.2377	49.78	1.588	.07905	.01879	142	11.9	4.3
*12½	.0785	.0811	17.96	.2335	55.68	1.713	.09538	.02227	156	12.5	3.8
13	.0740	.0765	15.94	.2351	62.73	2.003	.1256	.02953	177	13.3	3.4
*13½	.0701	.0725	14.24	.2326	70.22	2.163	.1519	.03533	196	14.0	3.0
14	.0661	.0684	12.64	.2338	79.11	2.525	.1997	.04669	222	14.9	2.7
*14½	.0626	.0648	11.31	.2318	88.42	2.824	.2497	.05788	246	15.7	2.4
15	.0591	.0612	10.03	.2307	99.70	3.184	.3174	.07322	276	16.6	2.2
*15½	.0560	.0580	8.948	.2198	111.8	3.570	.3991	.08722	306	17.5	1.9
16	.0529	.0548	7.958	.2295	125.7	4.016	.5048	.1158	346	18.6	1.7
*16½	.0501	.0520	7.110	.2272	140.8	4.501	.6337	.1440	384	19.6	1.5
17	.0473	.0491	6.315	.2252	158.3	5.064	.8016	.1805	428	20.7	1.3
*17½	.0448	.0466	5.650	.2260	177.0	5.661	1.002	.2264	480	21.9	1.2
18	.0423	.0440	5.011	.2247	199.6	6.385	1.274	.2863	538	23.2	1.1
*18½	.0400	.0418	4.479	.2221	223.3	7.142	1.595	.3542	595	24.4	.96
19	.0377	.0395	3.976	.2223	251.5	8.051	2.024	.4499	671	25.9	.86
*19½	.0359	.0374	3.550	.2196	281.7	8.703	2.452	.5385	745	27.3	.76
20	.0338	.0353	3.156	.2196	316.9	10.15	3.216	.7062	835	28.9	.68
*20½	.0321	.0335	2.819	.2185	354.7	11.37	4.033	.8812	930	30.5	.61
21	.0303	.0316	2.505	.2177	399.2	12.80	5.110	1.112	1043	32.3	.54
*21½	.0287	.0301	2.238	.2156	446.8	14.33	6.403	1.380	1156	34.0	.48
22	.0271	.0284	1.988	.2147	503.0	16.14	8.118	1.743	1296	36.0	.43
*22½	.0257	.0269	1.783	.2134	560.8	18.00	10.09	2.153	1436	37.9	.38
23	.0242	.0255	1.577	.2124	634.1	20.36	12.91	2.742	1616	40.2	.34
*23½	.0230	.0242	1.406	.2107	711.2	22.86	16.26	3.426	1798	42.4	.32
24	.0218	.0229	1.253	.2086	798.1	25.67	20.49	4.274	1998	44.7	.27
*24½	.0207	.0218	1.121	.2072	892.1	28.73	25.63	5.210	2218	47.1	.24
25	.0195	.0206	.9953	.2065	1005	32.37	32.53	6.717	2490	49.9	.21
*25½	.0185	.0196	.8883	.2040	1126	36.31	40.88	8.339	2756	52.5	.19
26	.0175	.0185	.7912	.2045	1264	40.81	51.58	10.55	3102	55.7	.17
*26½	.0166	.0177	.7107	.2013	1407	45.49	64.00	12.88	3399	58.3	.15
27	.0157	.0165	.6289	.2021	1590	51.47	81.84	16.54	3856	62.1	.13
*27½	.0149	.0157	.5609	.1999	1783	57.74	102.9	20.58	4277	65.4	.12
28	.0140	.0149	.4998	.2006	2001	64.90	129.9	26.06	4816	69.4	.106
*28½	.0132	.0140	.4431	.1968	2257	72.02	162.5	31.98	5329	73.0	.096
29	.0126	.0134	.3973	.1958	2517	81.83	206.0	40.33	5914	76.9	.084
*29½	.0119	.0127	.3523	.1941	2838	92.27	261.9	50.83	6610	81.3	.074
30	.0112	.0120	.3158	.1955	3167	103.2	326.8	63.89	7430	86.2	.067
*30½	.0107	.0115	.2835	.1918	3527	114.9	405.2	77.72	8118	90.1	.060
31	.0101	.0108	.2509	.1915	3986	130.1	518.6	99.31	9158	95.7	.053
*31½	.0096	.0103	.2221	.1851	4502	143.5	646.0	119.6	10000	100	.048

Variations from this table within manufacturing limits may be expected in practice. Resistance values are based on nominal bare wire diameters and are in accordance with the international Standard for annealed copper, i.e. 875.2 Ohms per mile/pound at 20°C. (68°F.).

† Calculated at 1500 circular mils per ampere, (equivalent to 850 amperes per square inch).
* Non Standard.



DOUBLE TOUGH ENAMEL "D"

GAUGE B. & S.	Dia. over Insulation		WEIGHT			RESISTANCE			TURNS		†APPROX CURRENT RATING
	MIN.	MAX.	LB. PER 1000 FEET	LB. PER CU. INCH	FEET PER POUND	OHMS per 1000 FT.	OHMS per LB.	OHMS per CU. INCH	PER SQ. IN.	PER LIN. IN.	
*32	.0091	.0098	.1991	.1864	5023	164.1	824.3	153.6	11236	106	.042
32½	.0086	.0093	.1773	.1853	5640	184.4	1040	192.7	12544	112	.037
33	.0081	.0088	.1581	.2159	6325	206.9	1309	282.6	13924	118	.033
*33½	.0077	.0084	.1418	.1817	7052	245.5	1731	314.5	15376	124	.028
*34	.0072	.0078	.1256	.1851	7962	260.9	2077	384.4	17689	133	.026
34½	.0068	.0074	.1138	.1832	8787	288.1	2531	463.7	19321	139	.024
35	.0064	.0070	.09976	.1846	10024	329.0	3298	608.8	22201	149	.021
*35½	.0061	.0067	.08896	.1804	11241	369.2	4150	748.7	24336	156	.018
36	.0057	.0063	.07925	.1842	12618	414.8	5234	964.1	27889	167	.017
*36½	.0054	.0060	.07007	.1788	14271	469.5	6700	1198	30625	175	.014
37	.0052	.0057	.06294	.1756	15888	523.1	8311	1459	33489	183	.013
38	.0046	.0051	.04999	.1768	20004	659.6	13195	2333	42436	206	.010
39	.0040	.0045	.03972	.1829	25176	831.8	20941	3830	55225	235	.008
40	.0036	.0040	.03157	.1820	31676	1049	33228	6047	69169	263	.006
41	.0032	.0036	.02504	.1804	39936	1320	52835	9531	86436	294	.005

Variations from this table within manufacturing limits maybe expected in practice. Resistance values are based on nominal bare wire diameters and are in accordance with the International Standard for annealed copper, i.e. 875.2 Ohms per mile/pound at 20°C. (68°F.).

† Calculated at 1500 circular mils per ampere, (equivalent to 850 amperes per square inch).
* Non Standard.



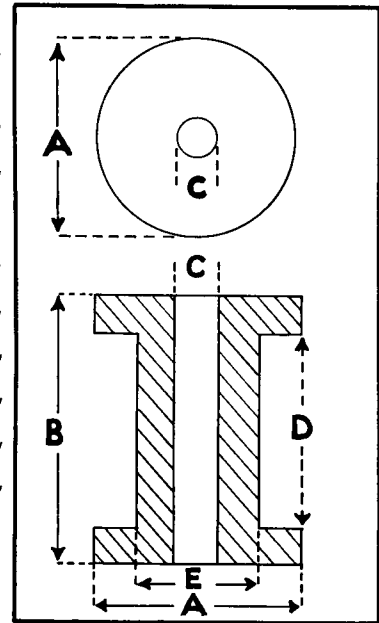
GAUGE CONVERSION TABLES

This table gives the comparative wire diameters of annealed bare copper wire drawn to American Standards (B. & S.) and of wire of corresponding gauges drawn to British Standards (S.W.G.). For added convenience it also lists the B. & S. sizes in millimeters.

B. & S.		S.W.G.		Mm. SIZE	B. & S.		S.W.G.		Mm. SIZE
GAUGE	NOM. DIA.	NEAREST GAUGE	NOM. DIA.		GAUGE	NOM. DIA.	NEAREST GAUGE	NOM. DIA.	
8	.1285	10	.1280	3.264	24	.0201	25	.0200	.5105
9	.1144	11	.1160	2.906	24½	.0190			.4826
10	.1019	12	.1040	2.588	25	.0179	26	.0180	.4547
10½	.0963			2.446	25½	.0169	27	.0164	.4293
11	.0907	13	.0920	2.305	26	.0159			.4039
11½	.0858			2.179	26½	.0150	28	.0148	.3810
12	.0808	14	.0800	2.053	27	.0142			.3607
12½	.0764			1.941	27½	.0134	29	.0136	.3404
13	.0720	15	.0720	1.828	28	.0126	30	.0124	.3200
13½	.0680			1.727	28½	.0119	31	.0116	.3023
14	.0641	16	.0640	1.628	29	.0113			.2870
14½	.0605			1.537	29½	.0106	32	.0108	.2692
15	.0571	17	.0560	1.450	30	.0100	33	.0100	.2540
15½	.0539			1.369	30½	.0095	34	.0092	.2413
16	.0508			1.290	31	.0089			.2261
16½	.0480	18	.0480	1.219	31½	.0084	35	.0084	.2134
17	.0453			1.151	32	.0080			.2032
17½	.0427			1.085	32½	.0075	36	.0076	.1905
18	.0403	19	.0400	1.024	33	.0071			.1803
18½	.0380			.9652	33½	.0067	37	.0068	.1702
19	.0359	20	.0360	.9119	34	.0063			.1600
19½	.0339			.8611	34½	.0059	38	.0060	.1499
20	.0320	21	.0320	.8128	35	.0056	39	.0052	.1422
20½	.0302			.7671	36	.0050	40	.0048	.1270
21	.0285	22	.0280	.7239	37	.0045	41	.0044	.1143
21½	.0269			.6833	38	.0040	42	.0040	.1016
22	.0253			.6426	39	.0035	43	.0036	.0889
22½	.0239	23	.0240	.6071	40	.0031	44	.0032	.0787
23	.0226	24	.0220	.5740	41	.0028	45	.0028	.0711
23½	.0213			.5410	42	.0025	46	.0024	.0635
					43	.0022			.0559
					44	.0020	47	.0020	.0508

Spool Dimensions (Inches)

SPOOL TYPE	FLANGE DIAMETER (A)	OVERALL WIDTH (B)	BORE (C)	TRAVERSE (D)	BARREL DIAMETER (E)
1	4-1/2"	3-17/32"	.630"	3-9/32"	2-1/4"
2	6-1/4"	3-21/32"	.630"	3-9/32"	2-1/4"
3	12"	8"	1-9/32"	6"	6"
4	8"	7-3/4"	1-5/16"	6"	3-3/4"
5	6-1/2"	4-5/32"	.630"	3-9/32"	3-1/8"
6	4-1/2"	4-5/32"	.630"	3-9/32"	2-1/4"
7	4-1/2"	3-35/64"	.630"	3-9/32"	2-1/4"
8	2-1/2"	3-1/2"	.630"	2-3/4"	1-1/2"
C	3-5/8"	3-1/2"	.630"	3-9/32"	2-1/8"
D	6-15/16"	4-11/16"	.630"	4-5/16"	4"
H	2-1/8"	3-17/32"	.630"	3-9/32"	1"



STANDARD SPOOLING AND PACKING INFORMATION

RANGE OF GAUGES PER SPOOL	DESCRIPTION OF SPOOL	TYPE NO. OF SPOOL	AVERAGE TARE (lbs.)	AVERAGE WEIGHT WIRE PER SPOOL (lb.)		NUMBER OF SPOOLS PER CASE	CASE NUMBER	EXTERNAL MEASUREMENTS OF CASE (inches)	SHIPPING MEASUREMENTS	GROSS WEIGHT OF CASES (lb.)	
				ENAMEL	COVERED					MAX.	MIN.
14-20	12" M.C.	3	9.5	80	60	2	3/2	16 3/4 x 12 3/4 x 14 1/2	1' 10"	235	105
										1	3/1
19-24	20 lb. T.P.	D	.98	15	13	6	D/6	17 1/2 x 15 x 7 7/8	1' 2"	155	80
20-25	8" M.C.	4	4	30	25	4	4/4	18 7/8 x 16 5/8 x 9	1' 8"	190	80
25-29	6 1/2" W.	5	1.4	12	8	8	5/8	13 1/16 x 8 1/16 x 13 1/16	11"	145	75
										12	5/12
25-29	6 1/2" D.C.	2	3.4	12	8	8	2/8	18 1/4 x 14 1/4 x 7 1/4	1' 1"	160	90
30-36	4 1/2" W.	6	.72	5	4	18	6/18	14 x 8 1/2 x 14	1' 0"	208	68
										27	6/27
30-36	4 1/2" D.C.A.	7	.68	5	4	16	7/16	16 3/4 x 10 x 10 1/8	1' 0"	140	60
30-36	4 1/2" D.C.	1	1.5	5	4	16	1/16	16 3/4 x 10 x 10 1/8	1' 0"	150	70
37-39	3 lb. T.P.	C	.31	2.5	2	24	C/24	17 1/2 x 11 3/4 x 8 3/8	1' 0"	90	37
										36	C/36
40 & finer	1 lb. T.P.	H	.1	.6	.5	48	H/48	16 7/8 x 10 3/8 x 7 7/8	10"	68	36
										8	.16

Key:—M.C., Metal Clad; T.P., Tinplate; W., Wooden; D.C., Diecast; D.C.A., Diecast Aluminium.

ROLA

Magnet WIRE

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