

UL 758

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Appliance Wiring Material

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UL Standard for Safety for Appliance Wiring Material, UL 758

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Recognition and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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This Standard consists of pages dated as shown in the following checklist:

Page	Date
1-66	July 14, 2000

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1

UL 758

Standard for Appliance Wiring Material

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July 14, 2000

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1 effective July 14, 2005

1.1 These requirements cover Appliance Wiring Material (AWM) in the form of single insulated conductors, multi-conductor cables, optical fibers, individual insulated conductors, and fiber optic members for use as components in multi-conductor cables.

1.2 The appliance wiring material covered by the requirements of this Standard are solely for use as factory-installed wiring either within the overall enclosure of appliances and other equipment (internal wiring) or as external interconnecting cable for appliances (external wiring), or for further processing as components in multi-conductor cables.

1.3 These requirements do not cover any wire, cable, or cord types that are presently covered in the National Electrical Code (NEC), NFPA 70, and are not intended for installation in buildings or structures in accordance with the NEC except within the scope of the installation instructions of the end-product for which their use is intended.

1.4 These requirements cover appliance wiring material with operating temperatures from a minimum 60°C (140°F) dry temperature rating and voltage ratings from a minimum 30-volt rating. Conductor size ranges from 50 AWG to 2000 kcmil. Appliance wiring material (AWM) composed entirely of optical fiber members or electrical conductors in combination with optical fiber members are also covered by these requirements.

1.5 These requirements do not cover the optical performance of any optical-fiber member or group of such members.

1.6 In addition to these constructions, this Standard establishes guidelines for the evaluation of special constructions that, due to their specific end product use, are not required to meet all of the requirements for general construction AWM.

1.7 The final acceptance of AWM is dependent upon its use in complete equipment that conforms with the standards applicable to such equipment.

1.8 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 General

2 effective July 14, 2005

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this Standard shall comply with the requirements for that component.

2.1.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

2.1.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.1.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

2.1.5 Polymeric materials evaluated for its intended use, are not prohibited from being used in the insulation and jacket applications indicated in Table 2.1.

Table 2.1
Polymeric materials for use in wire and cable and associated AWM ratings

AWM rating	Minimum average thickness of insulation,		Compound's use or rating
	inch	(mm)	
Sunlight resistant	0.030	0.76	Outer PVC or TPE insulation or jacket rated for 720 hours sunlight resistance
W60C (60°C Wet)	0.030	0.76	PVC insulation rated for use in Type TW thermoplastic-insulated wire
W60C or W75C (60°C or 75°C Wet)	0.030	0.76	PVC insulated rated for use in Types THW or THHW thermoplastic-insulated wire
W60C or W75C (60°C or 75°C Wet)	0.015	0.38	PVC insulation rated for use in Type THWN thermoplastic-insulated wire
W60C, W75C or W90C (60°C, 75°C, or 90°C Wet)	0.015	0.38	PVC insulation rated for use in Type THWN-2 thermoplastic-insulated wire

2.2 Units of measurement

2.2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.2.2 Unless otherwise indicated, all voltage values mentioned in this Standard are root-mean-square (rms).

2.2.3 Equipment calibrated in metric units is to be used when a requirement is applied in metric terms.

2.3 Undated references

2.3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

2.3.2 Wherever the designation "UL 1581" is used in this Standard, reference is to be made to the designated part(s) of the Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

CONSTRUCTION

3 General

3 effective July 14, 2005

3.1 A coding system and definitions for each rating and use parameter used to help determine the acceptability of an AWM for a specific end-product use are located in Tables 3.1 and 3.2 respectively.

Table 3.1
Rating and use codes^a

Use rating	Mechanical rating	Dry location temperature rating ^f	Voltage rating ^d	Flame ratings ^e	Special ratings (one or more)	
I – Internal wiring ^b	A – Not evaluated	Rating expressed in °C. Minimum temperature rating is 60°C.	Voltage rating expressed in volts (V), kilovolts (kV) or direct current kilovolts (kV DC). Minimum voltage rating is 30 V.	H – Horizontal flame test	O60C – Oil 60°C	
II – External wiring ^c	B – Normal handling		OF – Cables containing optical fiber members only	V – Vertical flame test	O75C – Oil 75°C	
F – Further processing only in AWM cables	C – Special use, see tag markings		VM – Cables containing insulated conductors of mixed voltage ratings; see tag markings	VW-1 – Vertical wire flame test	O80C – Oil 80°C	
S – Special applications, see tag marking				FT1	W60C – Wet 60°C	
				FT2	W75C – Wet 75°C	
				NR	W90C – Wet 90°C G – Gasoline resistant SUN RES – Sunlight resistant. OFM – Cable contains optical fiber members in addition to electrical conductors. SHIELDED – (Not required). Marking for AWM using one or more shields.	

Table 3.1 Continued on Next Page

Table 3.1 Continued

Use rating	Mechanical rating	Dry location temperature rating ^f	Voltage rating ^d	Flame ratings ^e	Special ratings (one or more)
					TAG – See tag markings.
^a Example of code: "I B 80C 300V VW-1 O60C." ^b AWM Use Rating I may be used in Use Rating F applications. ^c AWM Use Rating II may be used in Use Rating I and Use Rating F applications. ^d Volts AC rms unless specified otherwise. Refer to Table 45.1 for applicable ratings. ^e One or more ratings may apply. ^f Refer to Table 7.3 for acceptable ratings.					

Table 3.2
Ratings and use code definitions

Use ratings	
I	Internal wiring – Totally enclosed by equipment enclosure or equivalent. Not required to use a protective integral or nonintegral jacket. Flame Rating H is required. Also suitable for Use Rating F applications.
II	External wiring – Partially or totally exposed from the equipment. Includes interconnecting wires and cables. Required to use a protective integral or nonintegral jacket. Flame Rating V is required. Also suitable for Use Rating I and Use Rating F applications.
F	For further processing – Only intended to be processed into Use Rating I, II, or S appliance wiring material.
S	Wiring for special applications – Intended to be installed in a special application with the possibility of being evaluated for special ratings or waiving certain construction and performance requirements of general internal (I) or external (II) use AWM. Special applications use are required to be marked on the tag or spool of the finished AWM.
Mechanical ratings	
A	Not evaluated
B	Evaluated for normal handling (See 7.3.1.3).
C	Additional use; see tag marking
Dry temperature ratings	
___ °C	The dry temperature rating is expressed in °C. Minimum dry temperature rating of AWM is 60°C. For AWM composed entirely of optical fiber members, cable coverings and jacket are evaluated for a temperature rating.
Voltage ratings	
OF	Composed entirely of optical fiber members.
___ V, ___ kV, ___ kV DC	Voltage rating expressed in volts (V), kilovolts (kV) or direct current kilovolts (kV DC). Minimum operating AC voltage rating of all electrical AWM wires and cables is 30 volts. Peak AC voltages are limited to the effective DC voltage.
VM	Multiple conductor cables composed of conductors with mixed voltage ratings. See tag marking.
Flame ratings	
H	Horizontal
V	Vertical
VW-1	VW-1
FT1	FT-1
FT2	FT-2
NR	Not flame rated
Special ratings – not required (one or more may be used)	

Table 3.2 Continued on Next Page

Table 3.2 Continued

O60C	Oil rated for 60°C – Insulation is rated for exposure to oil at 60°C. When only the jacket or the insulation and jacket of jacketed cable is oil rated at 60°C, it must be noted on the spool or tag. In this case the code must also include Special Rating S.
O75C	Oil rated for 75°C – Insulation is rated for exposure to oil at 75°C. When only the jacket or the insulation and jacket of jacketed cable is oil rated at 75°C, it must be noted on the tag markings. In this case the code must also include Special Rating S.
O80C	Oil rated for 80°C – Insulation is rated for prolonged exposure to oil at 80°C. When only the jacket or the insulation and jacket of jacketed cable is oil rated at 80°C, it must be noted on the tag markings. In this case the code must also include Special Rating S.
W60C	Wet rated for 60°C – Insulation is rated for continuous immersion in water at 60°C.
W75C	Wet rated for 75°C – Insulation is rated for continuous immersion in water at 75°C.
W90C	Wet rated for 90°C – Insulation is rated for continuous immersion in water at 90°C.
G	Gasoline resistant – Finished AWM is rated for continuous immersion in gasoline at room temperature.
"SUN RES" or "SUNLIGHT RESISTANT"	Outermost insulation, covering, or jacket is rated for continuous exposure to sunlight.
OFM	Indicates that the AWM contains optical fibers members in addition to electrical conductors.
SHIELDED	Not required – Marking to indicate that a finished AWM contains one or more electrical shields.
Special ratings – not required unless otherwise specified (one or more may be used)	
TAG	Special ratings. See tag for use, or intended applications. Indicates AWM evaluated for a specific voltage or use defined in the tag marking. It is possible that the specific use requires additional tests that are different than those outlined in this Standard, or waive tests outlined in the Standard, or both based on the end use application. Examples of special uses, ratings, and intended applications. 1) "AWM similar to Type (insert Listed wire type and category: SVT Flexible Cord, CM Communications Cable, etc.) except (insert exception to requirements) – This Construction Was Evaluated to the Test Requirements in the UL Standard (insert UL Standard number and title: UL 62, Flexible Cord and Fixture Wire, etc.)" 2) "Telephone Handset Cord" – Flame Rating H is required, even though it is an external use cable. 3) "Hermetically-Sealed Wiring" – This construction waives all flame test requirements. 4) "Television High Voltage Wire" – Intended for insulation in television equipment. Flame rating VW-1 is required. 5) "X-Ray Cable" – This construction is permitted to use mixed voltage rated conductors under a common jacket.

3.2 Tables 3.3 – 3.9 serve as indices to requirements for construction details and basic test methods for typical AWM constructions.

Table 3.3
Single or multiple conductor with extruded insulation

Uses:	I, II, F, S
Ratings:	Table 3.1
Conductors:	
Material	See Conductor, Section 5
Size	See Conductor, Section 5
Insulation:	
Material	See Insulation, Section 7
Thickness	See Insulation, Section 7
Covering:	
Material	See Coverings, Section 8
Markings:	See Surface Marking of AWM, Section 46, and Markings on Tag, Reel or Carton, Section 47
Basic tests: Physical Properties of Insulation and Jacket, Unaged and Air Oven Aged, Section 14 Conductor Corrosion Test, Section 18 Deformation Test (Thermoplastics and Class XL Only), Section 19 Flexibility Test After Air Oven Conditioning, Section 20 Heat Shock Test (Thermoplastic Materials Only), Section 21 Cold Bend Test, Section 22 Crush Resistance Test (Mechanical Abuse Rating B), Section 26 Dielectric Test, Method I, Section 28 Dielectric Test, Method II, Section 29 Dielectric Test, Method III, Section 30 Horizontal Flame Test for Use Rating I, Section 39 Elective tests/ratings: See Table 3.9	

Table 3.4
Single conductor with other-than-extruded insulation

Uses:	I, II, F, S
Ratings:	Table 3.1
Conductors:	
Material	See Conductor, Section 5
Size	See Conductor, Section 5
Insulation:	
Material	See Insulation, Section 7
Thickness	See Insulation, Section 7
Covering:	
Material	See Coverings, Section 8
Markings:	See Surface Marking of AWM, Section 46, and Markings on Tag, Reel or Carton, Section 47
Basic tests: Conductor Corrosion Test, Section 18 Flexibility Test After Air Oven Conditioning, Section 20 Cold Bend Test, Section 22 Conductor Resistance Test, Section 27 Dielectric Test, Method I, Section 28 Dielectric Test, Method II, Section 29 Horizontal Flame Test for Use Rating I, Section 39	

Table 3.4 Continued on Next Page

Table 3.4 Continued

Vertical Flame Test for Use Rating II, Section 40	
Elective tests/ratings:	See Table 3.9

Table 3.5
Parallel cable with extruded integral insulation and jacket

Uses:	I, II, S
Ratings:	Table 3.1
Conductors:	
Material	See Conductor, Section 5
Size	See Conductor, Section 5
Integral insulation and jacket:	
Material	See Insulation, Section 7
Thickness	See Insulation, Section 7
Markings:	See Surface Marking of AWM, Section 46, and Markings on Tag, Reel or Carton, Section 47
Basic tests: Physical Properties of Insulation and Jacket, Unaged and Air Oven Aged, Section 14 – Test insulation only. Conductor Corrosion Test, Section 18 Deformation Test (Thermoplastics and Class XL Only), Section 19 Flexibility Test After Air Oven Conditioning, Section 20 Heat Shock Test (Thermoplastic Materials Only), Section 21 Cold Bend Test, Section 22 Conductor Resistance Test, Section 27 Dielectric Test, Method I, Section 28 Dielectric Test, Method II, Section 29 Dielectric Test, Method III, Section 30 Horizontal Flame Test for Use Rating I, Section 39 Vertical Flame Test for Use Rating II, Section 40 Elective tests/ratings: See Table 3.9	

Table 3.6
Multiple-conductor cable using non-integral jacket

Uses:	I, II, S
Ratings:	Table 3.1
Conductors:	
Material	See Conductor, Section 5
Size	See Conductor, Section 5
Insulated conductors:	See Insulation, Section 7 The voltage and temperature rating of the cable shall not exceed the lowest rating of either the insulated conductors or the fiber optic members. Cables designated mechanical Rating B shall use only insulated conductors that are designated mechanical Rating B. Cables with wet ratings W60C, W75C, and W90C shall use insulated conductors that comply with the applicable wet rating. Cables composed entirely of optical fiber members shall be designated with voltage Rating OF.
Covering:	
Material	See Coverings, Section 8
Shield:	See Shield(s), Section 11

Table 3.6 Continued on Next Page

Table 3.6 Continued

Jacket:	
Material	See Overall Jacket, Section 13
Thickness	See Overall Jacket, Section 13
Markings:	See Surface Marking of AWM, Section 46, and Markings on Tag, Reel, or Carton, Section 47
Basic tests: Insulated conductors tested in accordance with Tables 3.3, 3.4, 3.5, or 3.7. Physical Properties of Insulation and Jacket, Unaged and Air Oven Aged, Section 14 Deformation Test (Thermoplastics and Class XL Only), Section 19 Flexibility Test After Air Oven Conditioning, Section 20 Heat Shock Test (Thermoplastic Materials Only), Section 21 Cold Bend Test, Section 22 Horizontal Flame Test for Use Rating I, Section 39 Vertical Flame Test for Use Rating II, Section 40 Elective tests/ratings: See Table 3.9	

Table 3.7
Bonded or laminated flat ribbon cable

Uses:	I, F, S
Ratings:	Table 3.1
Conductors:	
Material	See Conductor, Section 5
Size	See Conductor, Section 5
Insulation:	
Material	See Insulation, Section 7
Thickness	See Insulation, Section 7
Covering:	
Material	See Coverings, Section 8
Markings:	See Surface Marking of AWM, Section 46, and Markings on Tag, Reel, or Carton, Section 47
Basic tests: Physical Properties of Insulation and Jacket, Unaged and Air Oven Aged, Section 14 – Test bonded only Conductor Corrosion Test, Section 18 Deformation Test (Thermoplastics and Class XL Only), Section 19 Flexibility Test After Air Oven Conditioning, Section 20 Heat Shock Test (Thermoplastic Materials Only), Section 21 Cold Bend Test, Section 22 Delamination Test (Laminated Constructions Only), Section 23 Conductor Resistance Test, Section 27 Dielectric Test, Method I, Section 28 Dielectric Test, Method II, Section 29 Dielectric Test, Method III, Section 30 Horizontal Flame Test for Use Rating I, Section 39 Elective tests/ratings: See Table 3.9	

Table 3.8
High voltage DC wire with extruded insulation

Uses:	I, II, F, S
Ratings:	Table 3.1
Conductors:	
Material	See Conductor, Section 5
Size	See Conductor, Section 5
Insulation:	
Material	See Insulation, Section 7 (solid insulation only)
Thickness	See Insulation, Section 7
Covering:	
Material	See Coverings, Section 8
Markings:	See Surface Marking of AWM, Section 46, and Markings on Tag, Reel, or Carton, Section 47
Basic tests: Physical Properties of Insulation and Jacket, Unaged and Air Oven Aged, Section 14 – Test insulation only Conductor Corrosion Test, Section 18 Deformation Test (Thermoplastics and Class XL Only), Section 19 Flexibility Test After Air Oven Conditioning, Section 20 Heat Shock Test, Section 21 Shrinkback Test – Special Rating TV Wires Only, Section 24 Ozone Resistance Test – Special Rating TV Use Wires Only, Section 25 Conductor Resistance Test, Section 27 High-Voltage DC Wire Dielectric Voltage-Withstand Test, Method I, Section 31 High-Voltage DC Wire Dielectric Voltage-Withstand Test, Method II, Section 32 High-Voltage Cut-Through Test, Special Rated TV Wire Only, Section 33 Horizontal Flame Test for Use Rating I, Section 39 Vertical Flame Test for Use Rating II, Section 40 VW-1 Flame Test (required for TV wire), Section 41 Elective tests/ratings: See Table 3.9	

Table 3.9
Elective tests and ratings

Flame tests:	VW-1 Flame Test, Section 41 FT-1 Flame Test, Section 42 FT-2 Flame Test, Section 43
Mechanical test:	Crush Resistance Test (Mechanical Abuse Rating B), Section 26
Sunlight resistance test:	Physical Properties of Insulation and Jacket, Sunlight Resistance, Section 17
Oil and gasoline resistance tests:	Physical Properties of Insulation and Jacket, Oil Immersion Aging, Section 15 Physical Properties of Gasoline Resistant Insulation and Jacket, Section 16
Wet ratings tests:	Temperature Correction Factor (Wet Rated AWM), Section 36

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Table 3.9 Continued

	Capacitance and Relative Permittivity Tests (Wet Rated AWM), Section 37 Short Term Insulation-Resistance Test in Water at Room Temperature (Wet Rated AWM), Section 34, required for all wet rated wires. Long Term Insulation-Resistance Test in Water at Elevated Temperature (Wet Rated AWM), Section 35, at 50°C required for wires rated W60C. Long Term Insulation-Resistance Test in Water at Elevated Temperature (Wet Rated AWM), Section 35, at 75°C required for wires rated W75C. Long Term Insulation-Resistance Test in Water at Elevated Temperature (Wet Rated AWM), Section 35, at 90°C required for wires rated W90C.
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4 Materials

4 effective July 14, 2005

4.1 Each material used in AWM shall be compatible with all of the other materials used in the wire or cable.

4.2 Due to possible incompatibility, TPE materials of the styrenic type may not be suitable for use in cords whereby direct contact with PVC may occur. A separator is one acceptable means of avoiding direct contact. Other combinations of materials which could be incompatible, if any, are as yet undetected.

5 Conductor

5 effective July 14, 2005

5.1 General

5.1.1 A conductor consisting of a single wire is designated as a solid conductor, while one consisting of a number of individual wires is designated as a stranded conductor. The American Wire Gauge (AWG) numbers, the kcmil (thousands of circular mils) sizes, and the square-millimeter sizes each signify a definite nominal total cross-sectional area (see Table 5.1) independent of the conductor material. The individual wires used in making up a stranded conductor are not required to correspond to any particular AWG or other standard gauge size.

Table 5.1
Conductor dimensions

Size of conductor, AWG	Diameter of solid conductor				Cross-sectional area of stranded conductor			
	Nominal,		Minimum,		Nominal,		Minimum,	
	Mils	(mm)	Mils	(mm)	Cmils	(mm ²)	Cmils	(mm ²)
50	0.99	0.0251	0.98	0.025	0.980	0.000497	0.960	0.000486
49	1.11	0.0282	1.10	0.028	1.23	0.000624	1.21	0.000613
48	1.24	0.0315	1.23	0.031	1.54	0.000768	1.51	0.000765
47	1.40	0.0356	1.39	0.035	1.96	0.000993	1.92	0.000973
46	1.57	0.0399	1.55	0.029	2.46	0.00125	2.41	0.00122
45	1.76	0.0447	1.74	0.044	3.10	0.00157	3.04	0.00154
44	2.0	0.051	1.98	0.050	4.00	0.00203	3.92	0.00198
43	2.2	0.056	2.18	0.055	4.84	0.00245	4.74	0.00240
42	2.5	0.064	2.48	0.063	6.25	0.00317	6.13	0.003115
41	2.8	0.071	2.77	0.070	7.84	0.00397	7.68	0.00389
40	3.1	0.079	3.07	0.078	9.61	0.00487	9.42	0.00477
39	3.5	0.089	3.47	0.088	12.2	0.00621	11.9	0.00603
38	4.0	0.102	3.96	0.101	16.0	0.00811	15.7	0.00796
37	4.5	0.114	4.46	0.113	20.2	0.0103	19.8	0.0100
36	5.0	0.127	4.95	0.126	25.0	0.0127	24.5	0.0124
35	5.6	0.142	5.54	0.141	31.4	0.0159	30.8	0.0156
34	6.3	0.160	6.24	0.158	39.7	0.020	38.9	0.0197
33	7.1	0.180	7.03	0.179	50.4	0.0255	49.4	0.0250
32	8.0	0.203	7.92	0.201	64.0	0.0324	62.7	0.0318
31	8.9	0.226	8.81	0.244	79.2	0.0401	77.6	0.0393
30	10.0	0.254	9.9	0.251	100	0.0507	98	0.0497
29	11.3	0.287	11.2	0.284	128	0.0647	125	0.0633
28	12.6	0.320	12.5	0.318	159	0.0804	156	0.0790
27	14.2	0.361	14.1	0.358	202	0.102	198	0.100
26	15.9	0.404	15.7	0.399	253	0.128	248	0.126
25	17.9	0.455	17.7	0.450	320	0.162	314	0.159
24	20.1	0.511	19.9	0.506	404	0.205	396	0.201
23	22.6	0.574	22.4	0.568	511	0.259	501	0.254
22	25.3	0.643	25.0	0.637	640	0.324	627	0.318
21	28.5	0.724	28.2	0.717	812	0.412	796	0.404
20	32.0	0.813	31.7	0.805	1020	0.519	1000	0.509
19	35.9	0.912	35.6	0.904	1290	0.653	1264	0.641
18	40.3	1.02	40.0	1.016	1620	0.823	1588	0.807
17	45.3	1.15	44.9	1.140	2050	1.04	2009	1.02
16	50.8	1.29	50.3	1.278	2580	1.31	2528	1.28
15	57.1	1.45	56.5	1.435	3260	1.65	3195	1.62
14	64.1	1.63	63.5	1.613	4110	2.08	4028	2.04
13	72.0	1.83	71	1.81	5180	2.63	5076	2.58
12	80.8	2.05	80	2.03	6530	3.31	6399	3.24
11	90.7	2.30	90	2.28	8230	4.17	8065	4.09
10	101.9	2.588	101	2.56	10380	5.261	10172	5.16
9	114.4	2.906	113	2.88	13090	6.631	12828	6.50
8	128.5	3.264	127	3.23	16510	8.367	16180	8.20
7	144.3	3.665	143	3.63	20820	10.55	20404	10.34
6	162.0	4.115	160	4.07	26240	13.30	25715	13.03

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