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UL Standard for Safety
for

Class T Fuses, UL 198H

Fourth Edition, Dated July 13, 1988

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Standard for

Class T Fuses

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Fourth Edition

July 13, 1988

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated July 13, 1988. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

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

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The Department of Defense (DoD) has approved the Fourth edition of UL 198H on June 21, 1991, including revision pages through and including June 22, 1990. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the DoD approved text.

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 published set of revision pages.

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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 differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, 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

1.1 These requirements cover Class T fuses for use in accordance with the National Electrical Code, NFPA 70.

1.2 A Class T fuse has either a maximum current rating of 1200 amperes with a voltage rating of 300 volts a-c, or a maximum current rating of 800 amperes with a voltage rating of 600 volts a-c.

Paragraph 1.2 revised October 20, 1993

1.3 Class T fuses are of the nonrenewable cartridge current limiting type and have an interrupting rating of 200,000 amperes rms symmetrical, with peak let-through currents and total clearing amperes-squared-seconds specified for the individual case sizes.

1.4 These fuses are intended for use with fuseholders that will properly receive Class T fuses, but will not receive fuses of any other type. The 300 volts knife blade-type fuses rated not more than 600 amperes are for either clip mounting or bolted-in installation. The 300 volt fuses rated more than 600 amperes and the 600 volt knife blade fuses are for bolted-in installation only.

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those in use when the standard was developed, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this standard.

Paragraph 1.5 added June 22, 1990

2. Glossary

2.1 **CASE SIZE** — Fuses of all ratings for which the size of the cartridge is the same, for example, fuses rated in the range of 31 — 60 amperes, are 60 ampere case size and fuses rated in the range of 61 — 100 amperes, are 100 ampere case size.

Paragraph 2.1 revised October 20, 1993

2.2 **CLEARING TIME** — The total time measured from the beginning of the specified overcurrent condition until the interruption of the circuit. The clearing time is equal to the sum of the melting time and the arcing time.

2.3 **CURRENT-LIMITING FUSE** — A fuse that (1) interrupts all available currents within its interrupting rating and within its current-limiting range, (2) limits the clearing time at rated voltage to an interval equal to or less than the first major or symmetrical current loop duration, and (3) limits peak let-through current to a value less than the peak current that would be possible with the fuse replaced by a solid conductor of the same impedance.

2.4 **CURRENT-LIMITING RANGE** — That range of rms symmetrical available currents equal to and less than the interrupting rating in which the total clearing time at rated voltage and frequency is less than 1/2 cycle.

2.5 **INTERRUPTING RATING** — The rating specifying the highest rms symmetrical, alternating current that the fuse is required to interrupt under the conditions of these requirements.

2.6 **I^2t (AMPERES-SQUARED-SECONDS)** — An expression of the energy available as a result of current flow. The term is usually applied during the melting, arcing, or total clearing time of the fuse under which, in the latter instance, it is often designated as Clearing I^2t .

2.7 **MAXIMUM ENERGY** — The test condition under which in a specified maximum time (1/2 cycle), the maximum amount of heat possible is generated in the fuse before clearing.

2.8 **MELTING TIME** — The time required for the current to melt the current-responsive element.

2.9 **NORMAL FREQUENCY RECOVERY VOLTAGE** — The normal frequency rms voltage impressed upon the fuse after the circuit has been interrupted and after high frequency transients have subsided.

2.10 PEAK LET-THROUGH CURRENT (I_p) —

The maximum instantaneous current through the fuse during the total clearing time.

2.11 RATING TESTS — Current-Carrying-Capacity Test, Section 9, Temperature Test, Section 10, and Clearing Time-Current Tests, Section 11.

2.12 RECOVERY VOLTAGE — The voltage impressed upon the fuse after a circuit has been interrupted.

2.13 THRESHOLD CURRENT — The rms symmetrical available current at the threshold of the current-limiting range, where melting of the current-responsive element has occurred at approximately 90 degrees on the symmetrical current wave and total clearing time is less than 1/2 cycle at rated voltage, rated frequency, and with a circuit power factor of 20 percent or less.

2.14 THRESHOLD RATIO — The ratio obtained by dividing the threshold current by the continuous current rating of the fuse.

3. Units of Measurement

3.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

4. References

4.1 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.

CONSTRUCTION

5. General

5.1 Iron or steel, plated or unplated, shall not be used for parts that are depended upon to carry current.

5.2 A connection between the fusible element and a terminal of a fuse shall provide positive and permanent electrical contact. The connection shall be soldered, brazed, or welded, or shall otherwise be made equivalently secure.

5.3 A tube of a fuse shall be ceramic, melamine-impregnated glass fiber, or the equivalent.

5.4 An adhesive employed in a fuse shall be acceptable for the application and shall function as intended. See paragraphs 8.9—8.11.

6. Ferrule-Type Fuses

6.1 A ferrule shall be of brass or copper and shall be circular in cross section, as shown in Figure 6.1.

6.2 The dimensions of a ferrule-type fuse shall be in accordance with Table 6.1.

6.3 Solder or any other projection on the end of a ferrule-type fuse shall not cause the total length of fuse over such a projection to exceed the maximum length given in column A of Table 6.1.

TABLE 6.1
DIMENSIONS OF FERRULE-TYPE FUSES IN INCHES (mm)

Fuse Rating		Overall Length of Fuse ^a	Length of Ferrule ^b	Outside Diameter of Ferrule ^c	Thickness of Rejection Feature ^d	Width of Rejection Feature ^{d,e}	Diameter of Rejection Feature ^{e,f}
Volts	Amperes						
		A	B	C	D	E	F
300	0 — 30	0.880 (22.35)	0.280 (7.11)	0.406 (10.31)	—	—	—
	31 — 60	0.880 (22.35)	0.280 (7.11)	0.563 (14.30)	—	—	—
600	0 — 30	1.500 (38.10)	0.280 (7.11)	0.563 (14.30)	—	—	—
	31 — 60	1.560 (39.62)	0.410 (10.41)	0.812 (20.62)	0.062 (1.57)	0.812 (20.62)	0.994 (25.25)

^aTolerances: 0 — 60 amperes, 300 volts, ± 0.020 inch (± 0.51 mm); 0 — 60 amperes, 600 volts, ± 0.040 inch (± 1.02 mm).

^bTolerance: ± 0.020 inch (± 0.51 mm).

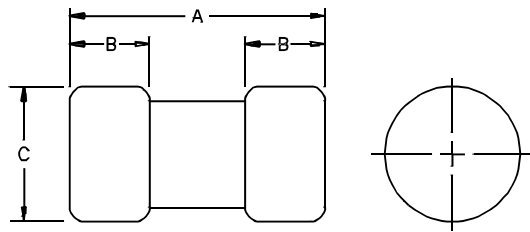
^cTolerance: ± 0.006 inch (± 0.15 mm). Diameter of tube is less than ferrules.

^dTolerance: ± 0.006 inch (± 0.15 mm).

^eRejection feature may be either square or round.

^fTolerance: minus 0.006 plus 0.016 inch (minus 0.15 plus 0.41 mm).

FIGURE 6.1
FERRULE-TYPE FUSES



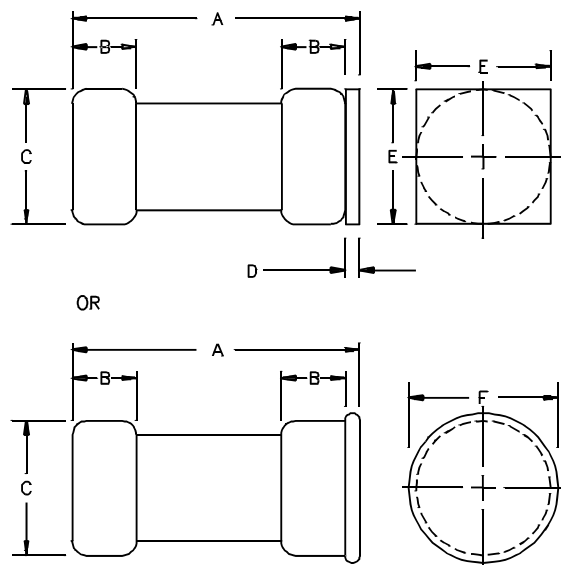
0-60 AMPERES 300 VOLTS
0-30 AMPERES 600 VOLTS

Exception: A press-fitted assembly of materials not subject to shrinkage or warping due to heat or moisture is considered acceptable for maintaining blade alignment provided the construction complies with the Knife-Blade-Alignment Test, Section 14.

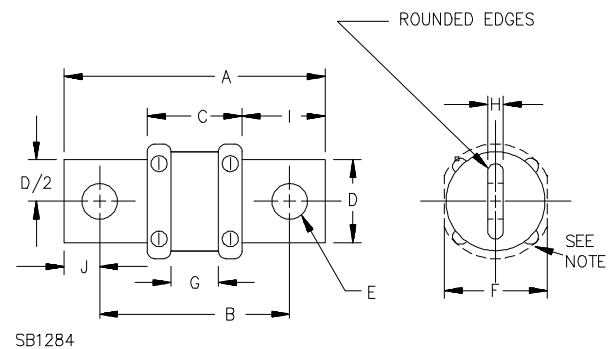
7.3 A cap shall be of metal of a thickness to provide the required physical strength and, if depended upon to carry current, shall be of brass or copper. Caps, assembly rings, washers, or the like, of iron or steel shall be protected against corrosion.

7.4 The dimensions of a knife blade-type fuse shall be in accordance with Figure 7.1 and Table 7.1.

FIGURE 7.1
KNIFE BLADE-TYPE FUSES



SC1285-1



Note — The dashed line represents limit of the maximum 0.063 inch (1.58 mm) projection of screw, rivet head, or the like.

7.5 No part of a knife blade-type fuse shall extend farther from the axis of the fuse than the distance given in column F of Table 7.1.

7. Knife-Blade-Type Fuses

7.1 The blades of a fuse shall be of copper or brass and in substantial alignment.

7.2 Alignment of blades shall be provided by means other than friction between surfaces.

TABLE 7.1
DIMENSIONS OF KNIFE-BLADE-TYPE FUSES IN INCHES (mm)

Fuse Rating		Overall Length of Fuse ^a	Distance Between Mounting Centers ^b	Maximum Length of Body	Width of Blade ^c	Diameter of Mounting Holes ^d	Maximum Diameter of Fuse	Minimum Length of Insulated Body	Thickness of Blade ^e	Minimum Length of Blade	Distance of Mounting Holes From End ^c
Volts	Amperes										
		A	B	C	D	E	F	G	H	I	J
300	61—100	2.156 (54.76)	1.556 (39.52)	0.850 (21.59)	0.750 (19.05)	0.281 (7.14)	0.828 (21.03)	0.250 (6.35)	0.125 (3.18)	0.646 (16.41)	0.300 (7.62)
	101 — 200	2.438 (61.93)	1.695 (43.05)	0.850 (21.59)	0.875 (22.22)	0.344 (8.74)	1.078 (27.38)	0.250 (6.35)	0.188 (4.78)	0.787 (19.99)	0.372 (9.45)
	201 — 400	2.750 (69.85)	1.844 (46.84)	0.860 (21.84)	1.000 (25.40)	0.406 (10.31)	1.344 (34.14)	0.250 (6.35)	0.250 (6.35)	0.926 (23.52)	0.453 (11.51)
	401 — 600	3.063 (77.80)	2.031 (51.59)	0.880 (22.35)	1.250 (31.75)	0.484 (12.29)	1.625 (41.28)	0.250 (6.35)	0.312 (7.92)	1.074 (27.28)	0.516 (13.11)
	601 — 800	3.375 (85.73)	2.219 (56.36)	0.891 (22.63)	1.750 (44.45)	0.547 (13.89)	2.078 (52.78)	0.250 (6.35)	0.375 (9.53)	1.222 (31.04)	0.578 (14.68)
	801 — 1200	4.000 (101.6)	2.531 (64.29)	1.078 (27.38)	2.000 (50.80)	0.609 (15.48)	2.516 (63.90)	0.250 (6.35)	0.438 (11.11)	1.441 (36.60)	0.735 (18.67)
600	61 — 100	2.953 (75.01)	2.352 (59.74)	1.640 (41.66)	0.750 (19.05)	0.281 (7.14)	0.828 (21.03)	0.500 (12.70)	0.125 (3.18)	0.646 (16.41)	0.300 (7.62)
	101 — 200	3.250 (82.55)	2.507 (63.67)	1.660 (42.16)	0.875 (22.22)	0.344 (8.74)	1.078 (27.38)	0.500 (12.70)	0.188 (4.78)	0.787 (19.99)	0.372 (9.45)
	201 — 400	3.625 (92.08)	2.719 (69.06)	1.730 (43.94)	1.000 (25.40)	0.406 (10.31)	1.625 (41.28)	0.500 (12.70)	0.250 (6.35)	0.926 (23.52)	0.453 (11.51)
	401 — 600	3.984 (101.19)	2.953 (75.01)	1.780 (45.21)	1.250 (31.75)	0.484 (12.29)	2.094 (53.19)	0.500 (12.70)	0.312 (7.92)	1.074 (27.28)	0.516 (13.11)
	601 — 800	4.328 (109.93)	3.172 (80.57)	1.875 (47.63)	1.750 (44.45)	0.547 (13.89)	2.516 (63.91)	0.500 (12.70)	0.375 (9.53)	1.207 (30.66)	0.578 (14.68)

^a Tolerances: 61 — 200 amperes, 300 volts, ± 0.020 (± 0.51 mm); 201 — 1200 amperes, 300 volts and 61 — 800 amperes, 600 volts, ± 0.040 inch (± 1.2 mm).

^b Tolerance: ± 0.015 inch (± 0.38 mm).

^c Tolerance: ± 0.020 inch (± 0.51 mm), except J tolerance ± 0.028 inch (± 0.71 mm) for 801 — 1200 amperes, 300 volts.

^d Tolerance: minus 0.000 inch (minus 0.00 mm); 61 — 100 amperes, plus 0.005 inch (plus 0.13 mm); 101 — 200 amperes, plus 0.006 inch (plus 0.15 mm); 201 — 400 amperes, plus 0.007 inch (plus 0.18 mm); 401 — 1200 amperes, plus 0.008 inch (plus 0.20 mm).

^e Tolerance: ± 0.006 inch (± 0.15 mm).

PERFORMANCE

8. General

8.1 Samples of fuses are to be subjected to the tests indicated in Table 8.1.

TABLE 8.1
TESTS OF FUSES

Test	Fuse Current Rating (Amperes)	
	0—600	601—1200
Carrying Capacity — 110%	X	X
Temperature	X	X
135% Clearing-Time-Current	X	—
150% Clearing-Time-Current	—	X
200% Clearing-Time-Current	X	—
200% Clearing at Rated Voltage	X	—
300% Clearing at Rated Voltage	—	X
Interrupting and Current Limiting Ability		
Interrupting Ability	X	X
Maximum Energy	X	X
Maximum Threshold Ratio	X	X
Let-Through Current and Clearing I^2t	X	X
Intermediate interrupting Ability	X	X

8.2 Tests of fuses are performed on groups of samples, referred to herein as sets. The number of samples constituting a set are given in Table 8.2.

8.3 Table 8.2 is based on the assumption that the same internal features, such as link material and shape, are constant for any fuse case size. If the internal features, such as link material, change at some intermediate rating in a particular fuse case size, this fact is to be taken into account during selection of test samples, and sufficient samples are to be selected to determine that constructions involving each different type of material or construction are subjected to the complete test program outlined in Table 8.2.

8.4 All power factors are to be lagging, with circuit resistance and reactance in series connection.

8.5 No current limiting reactor is to have a ferromagnetic core or structure.

8.6 One set of fuses is to be provided for the rating tests and sufficient fuses are to be provided for the other tests, see Table 8.2.

8.7 If the manufacturer so elects, the fuses used in the temperature and 110-percent-current tests may be used for 135-percent, 150-percent and 200-percent current tests. The temperature of such fuses is not to be higher than that of the ambient air when the 135-percent, 150-percent, or 200-percent current test is started.

8.8 If the overall results of the rating tests, and interrupting tests on the samples of one of the ratings are acceptable, all fuses of the case size or group, see paragraph 8.3, represented by those samples are considered to be acceptable.

8.9 To determine whether an adhesive complies with the requirements in paragraph 5.4, samples of the fuse are to be subjected to appropriate interrupting ability, low interrupting ability, and 200 percent or 300 percent clearing at rated voltage tests. Before being tested, samples are to be conditioned in an oven at the temperature and time described in paragraph 8.10 and other samples are to be conditioned for a minimum of 5 days in a humidity cabinet having a relative humidity of 93 ± 2 percent at $32.0 \pm 2.0^\circ\text{C}$ ($89.6 \pm 3.6^\circ\text{F}$).

Exception: Conditioning tests on an adhesive may be omitted if the fuse performs acceptably during the interrupting ability, low interrupting ability, and 200 percent or 300 percent clearing at rated voltage tests, with the adhesive omitted.

TABLE 8.2
FUSES — REQUIRED TEST SAMPLES

Fuse Rating, Amperes	Minimum Number of Samples											
	Rating Tests				200% and 300% Clearing Test at Rated Voltage ^d	Interrupting and Current-Limiting Ability Tests ^{a,c}				Intermediate Interruption		
	110% Current and Temper- ature	Clearing Time-Current				Inter- rupting Ability	Maximum Energy ^e	Thresh- old Ratio	Let- Through ^b			
		135%	150%	200%						100,000	50,000	25,000
	30	3	3	-	2	1	1	1	1	6	1	1
60	3	3	-	2	1	1	1	1	6	1	1	1
100	3	3	-	2	1	1	1	1	6	1	1	1
200	3	2	-	2	1	1	1	1	6	1	1	1
400	3	2	-	2	1	1	1	1	6	1	1	1
600	3	2	-	2	1	1	1	1	6	1	1	1
800	2	-	2	-	1	1	1	1	5	1	1	-
1200	1	-	1	-	1	1	1	1	5	1	1	-

^a Fewer samples are required when measurements are combined with other tests.

^b One additional sample of each rating within each case size is required for let-through current test at 100,000 amperes.

^c More samples may be required, see paragraph 13.5.

^d More samples may be required, see paragraph 12.1A.

^e See exception to paragraph 13.17.

Table 8.2 revised October 20, 1993

8.10 The oven conditioning described in paragraph 8.9 is to be conducted for 1000 hours. The oven temperature is to be taken from the intersection of a selected temperature-index line in Figure 8.1 with the 1000-hour line, where the temperature index T is, at the manufacturer's option, either (1) the maximum observed operating temperature of the adhesive, or (2) the maximum acceptable operating temperature of any part in contact with the adhesive. Intermediate temperature indices may be interpolated. The maximum observed operating temperature is that attained when the fuse is carrying 110 percent of rated current, and while in a 25°C (77°F) ambient. Measurement may be made in ambients of 18—32°C (65—90°F) and the reading corrected to 25°C. The maximum acceptable operating temperature is the sum of two values: (1) the rise permitted in the temperature test and (2) 25°C.

Exception: On the same selected temperature-index line in Figure 8.1, a shorter or longer time at the corresponding higher or lower temperature respectively may be employed if agreeable to all concerned, providing that the time is not less than 300 hours.

8.11 After conditioning, fuses are to be brought to and tested at room temperature to determine the performance.