NEMA Standards Publication FU 1-2002

Low Voltage Cartridge Fuses

Published by

National Electrical Manufacturers Association
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Rosslyn, Virginia 22209

www.nema.org

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CONTENTS

Page

Foreword ii

Section 1 GENERAL

1.1 Scope 1

Section 2 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions 1

Section 3 SERVICE CONDITIONS

3.1 Usual Service Conditions 3

3.2 Unusual Service Conditions 3

Section 4 RATINGS

4.1 Current Ratings of Non Time-Delay Fuses 4

4.2 Current Ratings of Time-Delay Fuses 5

4.3 AC Voltage Ratings 5

4.4 DC Voltage Ratings 6

4.5 AC Interrupting Ratings 6

4.6 DC Interrupting Ratings 6

4.7 Frequency Rating 6

Section 5 FUSE CLASSES

5.1 Summary of Fuse Classes 7

5.2 Class G Fuses (Current Limiting) 0-60 Amperes, 480 V and 600 V Alternating Current 7

5.3 Class H Fuses 0-600 Amperes, 250 V and 600 V Alternating Current 7

5.4 Class J Fuses (Current Limiting) 0-600 Amperes, 600 V, Alternating Current 7

5.5 Class K Fuses 0-600 Amperes, 250 V and 600 V, Alternating Current 7

5.6 Class L Fuses (Current Limiting) 601-6000 Amperes, 600 V, Alternating Current 7

5.7 Class R Fuses (Current Limiting) 0-600 Amperes, 250 V and 600 V, Alternating Current 7

5.8 Class T Fuses (Current Limiting) 0-1200 Amperes, 300 V and 600 V, Alternating Current 8

5.9 Class CC Fuses (Current Limiting) 0-30 Amperes, 600 Volts, Alternating Current 8

Section 6 PERFORMANCE

6.1 General 18

6.2 Current Carrying Capacity and Temperature Rise Tests 18

6.3 Overload Opening Time 21

6.4 Interrupting Tests at Rated Voltage 22

6.4.1 Overload Tests 22

6.4.2 10,000 Amperes Short Circuit Tests 22

6.4.3 Interrupting Rating and Intermediate Interruption Level Tests 23

6.5 Maximum Energy 29

6.6 Maximium Threshold Ratio 29

6.7 Direct Current Tests 29

6.7.1 Overload Test 29

6.7.2 Short Circuit Test 30

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Foreword

These standards have been developed by the Low Voltage Fuse Section of NEMA. The purpose of this Standards Publication is to assist in the proper selection and application of the different classes of low voltage cartridge fuses. User needs have been considered throughout the development of these standards.

NEMA standards publications are subject to periodic review. They are revised frequently to meet changing conditions and technical progress. The user should secure the latest editions.

Proposed or recommended revisions should be submitted to:

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This standards publication was developed by the Fuse Section. Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the group/section was composed of the following members:

Cooper Bussmann—St. Louis, MO
Ferraz Shawmut—Newburyport, MA
Littelfuse—DesPlaines, IL
Eagle—Long Island, NY

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Section 1
GENERAL

1.1 SCOPE

This Standards Publication covers the following classes of fuses:

G, H, J, K, L, R, T, and CC low voltage cartridge fuses rated 600 volts or less, alternating current and direct current.

Section 2
DEFINITIONS AND ABBREVIATIONS

2.1 DEFINITIONS

ambient temperature: The temperature of the air surrounding the fuse.

arcing time: The time from the instant the fuse element or link has melted and arcing is initiated until final circuit interruption by the fuse.

body: The part of the fuse that encloses the fuse elements and supports the contacts. Also referred to as cartridge, tube, or case.

cartridge fuse: A fuse consisting of a current responsive element inside a fuse body with contacts on both ends.

cartridge or body size: The set of dimensions of fuses within a fuse class or system. Each individual size covers a given range of rated currents for which the specified dimensions of the fuse remain unchanged.

clearing I^2t (ampere squared seconds): The measure of heat energy developed during current interruption from the initiation of an overcurrent until the fuse clears the circuit. "I^2" stands for the square of the effective (rms) let-through current and "t" stands for the time of current flow in seconds. The term I^2t also applies during the melting or arcing portions of the clearing time and is referred to as melting or arcing I^2t respectively. Clearing I^2t is the sum of melting I^2t and arcing I^2t.

contacts: The external metallic parts of the fuse used to complete the circuit. Also referred to as ferrules, caps, blades, or terminals.

current-limiting fuse: A fuse that, within a specified overcurrent range, limits the clearing time at rated voltage to an interval equal to or less than the first major or symmetrical current loop duration; and limits peak let-through current to a value less than the available peak fault current.

current-limiting range: The range of currents from the threshold current to the interrupting current rating of a fuse.

current rating (I_n): The nominal rms AC or DC ampere rating, based on specified conditions, which is assigned to a fuse.

element: The fusible portion of the fuse that melts during an overcurrent condition to clear the circuit. Also referred to as a link.

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filler: A material used to fill a section or sections of a fuse.

fuse: A protective device that opens a circuit during specified overcurrent conditions by means of a current responsive element.

interrupting rating: The highest prospective rms symmetrical alternating current or direct current that the fuse is required to interrupt under specified conditions verified by operation at rated voltage.

maximum energy: A test condition that causes a fuse to experience maximum energy during interruption within the first ½ cycle.

melting time: The time from the initiation of an overcurrent to the instant arcing of the element begins.

overcurrent: Any current in excess of the fuse current rating.

peak arc voltage: The maximum peak voltage across the fuse during the arcing time.

peak let-through current I_p: The maximum instantaneous current through a fuse during interruption in its current-limiting range.

rating: A designated limit of an operating characteristic under defined conditions.

recovery voltage: The normal frequency rms voltage impressed upon the fuse after the circuit has been interrupted.

rejection feature: A physical characteristic of a fuse and fuse holder (slot, groove, pin, or overall dimension) that normally prevents substitution by other rating or classes of fuses.

renewal element (renewal link): That part of a renewable fuse that is replaced after each interruption.

renewable fuse: A fuse that may be readily restored for service after interruption by the replacement of the renewal elements.

threshold current: The lowest prospective rms symmetrical current for which the fuse is current limiting, under specific test conditions.

threshold ratio: The threshold current divided by the fuse current rating.

time-delay fuse: A fuse capable of carrying a specified overcurrent for a specified minimum time.

voltage rating: The maximum rms AC voltage or DC voltage for which the fuse is designed to operate.

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Section 3
SERVICE CONDITIONS

3.1 USUAL SERVICE CONDITIONS

Fuses conforming to these standards shall operate in a clean, dry environment within their ratings provided:

a. The temperature of the air surrounding the fuse is within the range of -40°C to +55°C whether or not the fuse is in an enclosure.

b. The altitude does not exceed 3030 m (10,000 feet).

3.2 UNUSUAL SERVICE CONDITIONS

For unusual service conditions the manufacturer should be consulted.

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Section 4
RATINGS

4.1 CURRENT RATINGS OF NON TIME-DELAY FUSES

The typical current ratings of Non Time-Delay fuses shall be as shown in Table 4-1.

Table 4-1
CURRENT RATINGS OF NON TIME-DELAY FUSES

Cartridge Size (Amperes)	Current Ratings (Amperes)
0-30	1, 3, 6, 10, 15, 20, 25, 30
31-60	35, 40, 45, 50, 60
61-100	70, 80, 90, 100
101-200	110, 125, 150, 175, 200
201-400	225, 250, 300, 350, 400
401-600	450, 500, 600
601-800	601, 700, 800
801-1200	1000, 1200
1201-1600	1600
1601-2000	2000
2001-2500	2500
2501-3000	3000
3001-4000	4000
4001-5000	5000
5001-6000	6000

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4.2 CURRENT RATINGS OF TIME-DELAY FUSES

The typical current ratings of Time-Delay fuses shall be as shown in Table 4-2.

Table 4-2
CURRENT RATINGS OF TIME-DELAY FUSES

Cartridge Size (Amperes)	Current Ratings (Amperes)
0-30	1/10, 15/100, 2/10, 3/10, 4/10, 1/2, 6/10, 8/10, 1, 1 1/8, 1 1/4, 1-4/10, 1-6/10, 1-8/10, 2, 2-1/4, 2-1/2, 2-8/10, 3, 3-2/10, 3-1/2, 4, 4-1/2, 5, 5-6/10, 6, 6-1/4, 7, 8, 9, 10, 12, 15, 17-1/2,20, 25, 30
31-60	35, 40, 45, 50, 60
61-100	70, 80, 90, 100
101-200	110, 125, 150, 175, 200
201-400	225, 250, 300, 350, 400
401-600	450, 500, 600
601-800	601, 700, 800
801-1200	1000, 1200
1201-1600	1600
1601-2000	2000
2001-2500	2500
2501-3000	3000
3001-4000	4000
4001-5000	5000
5001-6000	6000

4.3 AC VOLTAGE RATINGS

The alternating current voltage ratings for time-delay and non-time-delay fuses shall be as shown in Table 4-3.

Table 4-3
AC VOLTAGE RATINGS – TIME-DELAY AND NON-TIME-DELAY FUSES

125 V
250 V
300 V
480 V
600 V

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4.4 DC VOLTAGE RATINGS

The direct current voltage ratings for time delay and non-time-delay fuses shall be as shown in Table 4-4.

Table 4-4
DC VOLTAGE RATINGS – TIME-DELAY AND NON-TIME-DELAY FUSES

60 V
125 V
160 V
250 V
300 V
400 V
500 V
600 V

4.5 AC INTERRUPTING RATINGS

The alternating current interrupting ratings for both time-delay and non-time-delay fuses in AC amperes shall be as shown in Table 4-5.

Table 4-5
AC INTERRUPTING RATINGS – TIME-DELAY AND NON-TIME-DELAY FUSES

10,000 A
50,000 A
100,000 A
200,000 A
300,000 A

4.6 DC INTERRUPTING RATINGS

The direct current interrupting ratings for time-delay and non-time-delay fuses in DC amperes shall be as shown in Table 4-6.

Table 4-6
DC INTERRUPTING RATINGS – TIME-DELAY AND NON-TIME-DELAY FUSES

10,000 A
20,000 A
50,000 A
100,000 A
150,000 A
200,000 A

4.7 FREQUENCY RATING

The alternating current frequency rating shall be 48-62 Hertz.

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Section 5
FUSE CLASSES

5.1 SUMMARY OF FUSE CLASSES

Fuse classes and alternating current shall be as shown in Table 5-1. Fuses that have both AC and DC ratings may have DC voltage and interrupting ratings different from their AC ratings.

5.2 CLASS G FUSES (CURRENT LIMITING) 0-60 AMPERES, 480 V AND 600 V ALTERNATING CURRENT

Class G fuses shall have specific physical dimensions which make them non-interchangeable with other fuse classes. Class G fuses 0-20 amps shall be used on circuits 600 V or less and Class G fuses 25-60 amps shall be used on circuits 480 V or less. Class G fuses shall have an interrupting rating of 100,000 amperes symmetrical. Class G fuses shall be either time-delay or non-time-delay. Dimensions shall be as shown in Table 5-2.

5.3 CLASS H FUSES 0-600 AMPERES, 250 V AND 600 V ALTERNATING CURRENT

Class H fuses shall have an interrupting rating of 10,000 amperes rms symmetrical. Class H fuses shall be either nonrenewable or renewable. Class H fuses shall be either time-delay or non-time-delay. Dimensions shall be as shown in Table 5-3.

5.4 CLASS J FUSES (CURRENT LIMITING) 0-600 AMPERES, 600 V, ALTERNATING CURRENT

Class J fuses shall have specific physical dimensions that make them non-interchangeable with other fuse classes. Class J fuses shall have an interrupting rating of 200,000 amperes symmetrical. Class J fuses shall provide a high degree of current limitation and shall be either time-delay or non-time-delay. Dimensions shall be as shown in Table 5-4.

5.5 CLASS K FUSES 0-600 AMPERES, 250 V and 600 V, ALTERNATING CURRENT

Class K fuses shall be dimensionally interchangeable with Class H fuses; however, Class K fuses shall have interrupting ratings of 50,000, 100,000, or 200,000 amperes rms symmetrical. Class K fuses shall have three current limiting categories: K1, K5, and K9 and shall be either time-delay or non-time-delay. Dimensions shall be as shown in Table 5-3.

5.6 CLASS L FUSES (CURRENT LIMITING) 601-6000 AMPERES, 600 V, ALTERNATING CURRENT

Class L fuses shall have specific physical dimensions that make them non-interchangeable with other fuse classes. Class L fuses shall have bolt-on terminals and an interrupting rating of 300,000 amperes symmetrical. Dimensions shall be as shown in Table 5-5.

5.7 CLASS R FUSES (CURRENT LIMITING) 0-600 AMPERES, 250 V AND 600 V, ALTERNATING CURRENT

Class R fuses shall have an interrupting rating of 200,000 amperes rms symmetrical. These fuses are identical in size to Class H and Class K fuses except they shall have a rejection feature. Class R fuses can be installed in equipment with Classes H, K, or R fuseholders. Classes H and K fuses are rejected by equipment designed for Class R fuses. Class R fuses shall have two current limiting categories; RK1 and RK5 and shall be either time-delay or non-time-delay. Dimensions shall be as shown in Tables 5-6 and 5-7.

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5.8 CLASS T FUSES (CURRENT LIMITING) 0-1200 AMPERES, 300 V AND 600 V ALTERNATING CURRENT

Class T fuses shall have specific physical dimensions that make them non-interchangeable with other fuse classes. Class T fuses shall have an interrupting rating of 200,000 amperes symmetrical. Class T 300 volt fuses are used on circuits 300 volts or less. Class T 600 volt fuses are used on circuits 600 volts or less. Class T fuses shall be either time-delay or non-time-delay. Dimensions shall be as shown in Tables 5-8 and 5-9.

5.9 CLASS CC FUSES (CURRENT LIMITING) 0-30 AMPERES, 600 V, ALTERNATING CURRENT

Class CC fuses shall have specific physical dimensions that make them non-interchangeable with other fuse classes. Class CC fuses shall have an interrupting rating of 200,000 amperes symmetrical, and have a rejection feature. Class CC fuses shall be either time-delay or non-time-delay. Dimensions shall be as shown in Table 5-10.

Table 5-1
SUMMARY OF FUSE CLASSES AND ALTERNATING CURRENT RATINGS*

Table	Class	Ampere Range	Voltage Rating	AC Interrupting Rating, RMS Symmetrical (KA = 1000 Amps)	Rejection Feature
5-2	G	0-20	600V AC	100 KA	YES
5-2	G	21-60	480V AC	100 kA	YES
5-3	H	0-600	250 & 600V AC	10 KA	NO
5-4	J	0-600	600V AC	200 KA	YES
5-3	K	0-600	250 & 600V AC	50, 100 or 200 KA	NO
5-5	L	601-6000	600V AC	200 KA	YES
5-6	R	0-60	250 & 600V AC	200 KA	YES
5-7	R	61-600	250 & 600V AC	200 KA	YES
5-8	T	0-60	300 & 600V AC	200 KA	YES
5-9	T	61-1200	300V AC	200 KA	YES
5-9	T	61-800	600V AC	200 KA	YES
5-10	CC	0-30	600V AC	200 KA	YES

* For preferred DC ratings, see Tables 4-4 and 4-6.

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Table 5-2
DIMENSIONS OF CLASS G FUSES IN mm (INCHES)

Rating		Overall Length [a]	Maximum Outside Diameter of Body	Minimum Length of Ferrule	Outside Diameter of Ferrule [b]
Volts	Amps	A	B	C	D
600	0-15	3.33	9.5	7.1	10.31
		(1.31)	(0.38)	(0.28)	(0.406))
600	16-20	35.7	9.5	7.1	10.31
		(1.41)	(0.38)	(0.28)	(0.406)
480	21-30	41.3	9.5	7.1	10.31
		(1.62)	(0.38)	(0.28)	(0.406)
480	31- 60	57.1	9.5	7.1	10.31
		(2.25)	(0.38)	(0.28)	(0.406)

[a] ± 0.9 mm (0.03 inch)
[b] ± 0.15 mm (0.006 inch)

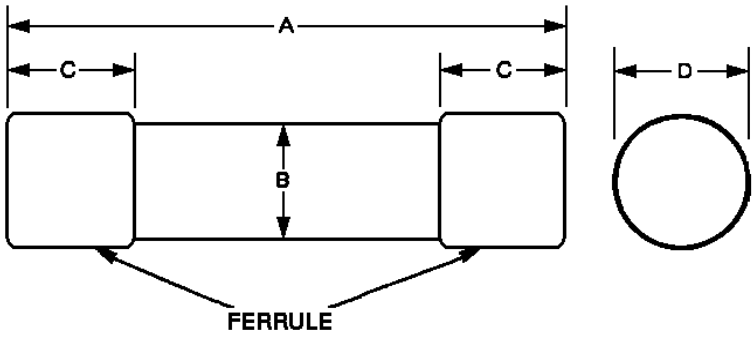

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Table 5-3
DIMENSIONS[a] OF CLASS H AND K FUSES IN mm (INCHES)

Rating							Maximum Dimensions Over Projections[b]	
Volts	Amperes	Overall Length of Fuse[a]	Minimum Length of Ferrule or Blade	Outside Diameter of Ferrule[b]	Thickness of Blade[c]	Width of Blade[d]	Measured Parallel to Blade[e]	Minimum Overall Length of Cylindrical Body[f]
		A	B	C	D	E	F	G
250	0-30	50.80	12.70	14.30				
		(2.00)	(0.50)	(0.56)				
250	31-60	76.20	15.90	20.60				
		(3.00)	(0.63)	(0.81)				
250	61-100	149.00	25.40		3.18	19.10	19.10	85.70
		(5.88)	(1.00)		(0.13)	(0.75)	(0.75)	(3.38)
250	101-200	181.00	34.90		4.80	28.60	25.40	105.00
		(7.13)	(1.38)		(0.19)	(1.13)	(1.00)	(4.13)
250	201-400	219.00	47.60		6.35	41.30	31.80	117.00
		(8.62)	(1.88)		(0.25)	(1.63)	(1.25)	(4.63)
250	401-600	264.00	57.20		6.35	50.80	38.10	132.00
		(10.37)	(2.25)		(0.25)	(2.00)	(1.50)	(5.19)
600	0-30	127.00	12.70	20.62				
		(5.00)	(0.50)	(0.81)				
600	31-60	140.00	15.90	27.00				
		(5.50)	(0.62)	(1.06)				
600	61-100	200.0	25.40		3.18	19.10	22.20	136.50
		(7.88)	(1.00)		(0.13)	(0.75)	(0.87)	(5.38)
600	101-200	245.00	34.90		4.80	28.60	28.60	156.00
		(9.63)	(1.38)		(0.19)	(1.13)	(1.13)	(6.13)
600	201-400	295.00	47.60		6.35	41.30	38.10	181.00
		(11.60)	(1.87)		(0.25)	(1.63)	(1.50)	(7.13)
600	401-600	340.00	57.20		6.35	50.80	44.50	208.00
		(13.40)	(2.25)		(0.25)	(2.00)	(1.75)	(8.19)

Tolerances:

[a] 0-60Amps, ±0.8 mm (±0.03 inch); 61-200Amps, ±1.6 mm (±0.06 inch); 201-600Amps, 2.4 mm (±0.09 inch)

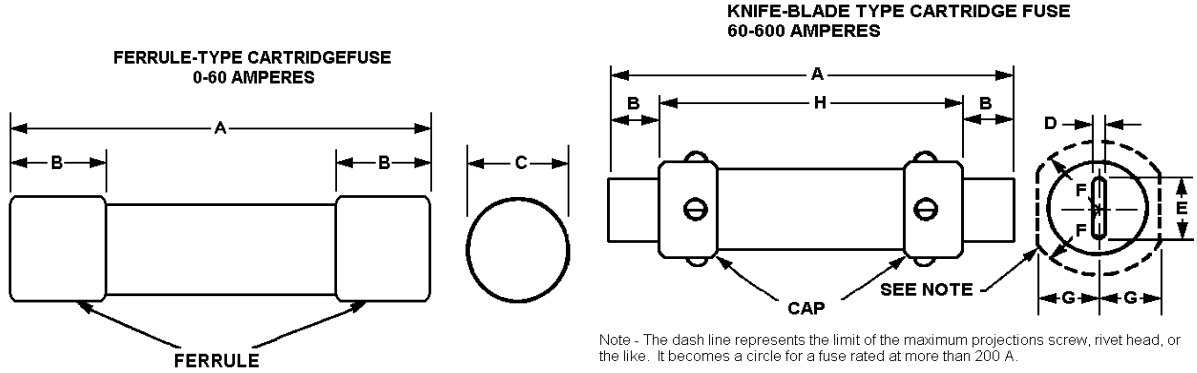
[b] ±0.20 mm (±0.008 inch)

[c] ±0.08 mm (±0.003 inch)

[d] ±0.89 mm (±0.035 inch)

[e] The maximum overall dimension of a screw ring for a renewable fuse

[f] The length of the cylindrical body may be less than the length indicated if there are other means to prevent using a holder which will accommodate a fuse in the next lower bracket of current ratings



Note - The dash line represents the limit of the maximum projections screw, rivet head, or the like. It becomes a circle for a fuse rated at more than 200 A.

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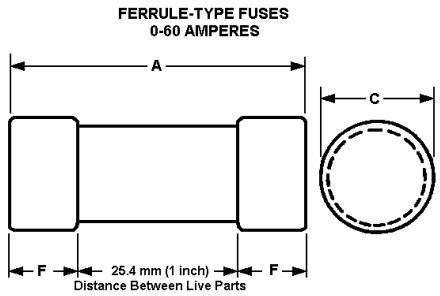
Table 5-4
DIMENSIONS[a] OF CLASS J FUSES IN mm (INCHES)

	Overall Length	Distance Between Centers of Slot	Outside Diameter & Maximum Dimension Over Projection	Width of Blades	Thickness of Blades	Minimum Length of Ferrule or Blades[b]	Distance From End of Blade to Center of Slot	Width of Slot	Length of Slot	Length of Tubular Portion[c]
Amperes	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**
0-30	57.1		20.6			12.7				
	(2.25)		(0.812)			(0.500)				
31-60	60.3		27.0			15.9				
	(2.37)		(1.06)			(0.625)				
61-100	118	92.1	28.6	19.1	3.18	24,6	12.7	7.14	9.52	66.7
	(4.62)	(3.62)	(1.13)	(0.750)	(0.125)	(0.97)	(0.50)	(0.281)	(0.375)	(2.62)
101-200	146.0	111	41.3	28.6	4.78	34.1	17.5	7.14	9.52	76.2
	(5.75)	(4.38)	(1.63)	(1.13)	(0.188)	(1.34)	(0.69)	(0.281)	(0.375)	(3.01)
201-400	181.0	133	54.0	41.3	6.35	46.8	23.8	10.31	13.5	85.7
	(7.12)	(5.25)	(2.13)	(1.63)	(0.250)	(1.84)	(0.94)	(0.406)	(0.531)	(3.37)
401-600	203	152	66.7	50.8	9.52	53.2	25.4	13.5	17.5	95.2
	(8.00)	(6.00)	(2.63)	(2.00)	(0.375)	(2.09)	(1.00)	(0.531)	(0.688)	(3.75)

[a]Tolerances: 0-60 Amperes
Column A: ±0.8 mm (±0.03 inch)
Tolerances: 61-600 Amperes
Column A: ±2.4 mm (±0.09 inch)
Column B: ±1.6 mm (±0.06 inch)
Column C: 0 – 60 A, ± 0.20 mm (±0.008 inch); 61 – 600 A, Dimension is Maximum
Column D: ±0.89 mm (±0.035 inch)
Column E: ±0.08 mm (±0.003 inch)
Column G: ±0.8 mm (±0.03 inch)
Column H: ±0.13 mm (±0.005 inch)
Column J : + 1.5 mm – 0.00 mm (+0.062 inch, -0.000inch)
Column K: ±0.8 mm (±0.03 inch)

[b]The effective length, F, of the blade is measured from the blade end to the fuse body or other acceptable interference means, such as pins through the blades, a collar, or the like.
[c]The length of the cylindrical body may be less than the indicated value if other acceptable interference means such as pins through the blades or collars are provided to prevent mounting the fuse in a fuseholder that will accommodate a fuse rated in the next lower bracket of current ratings.



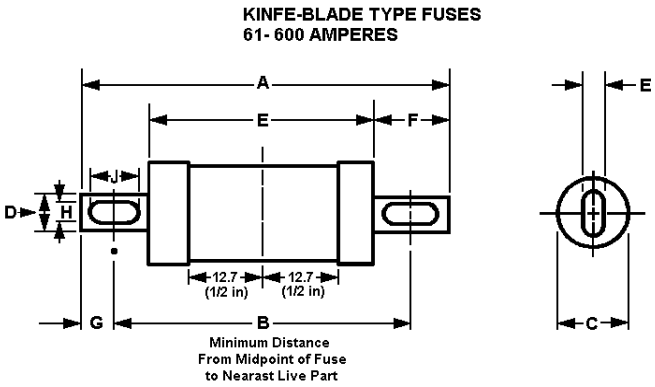


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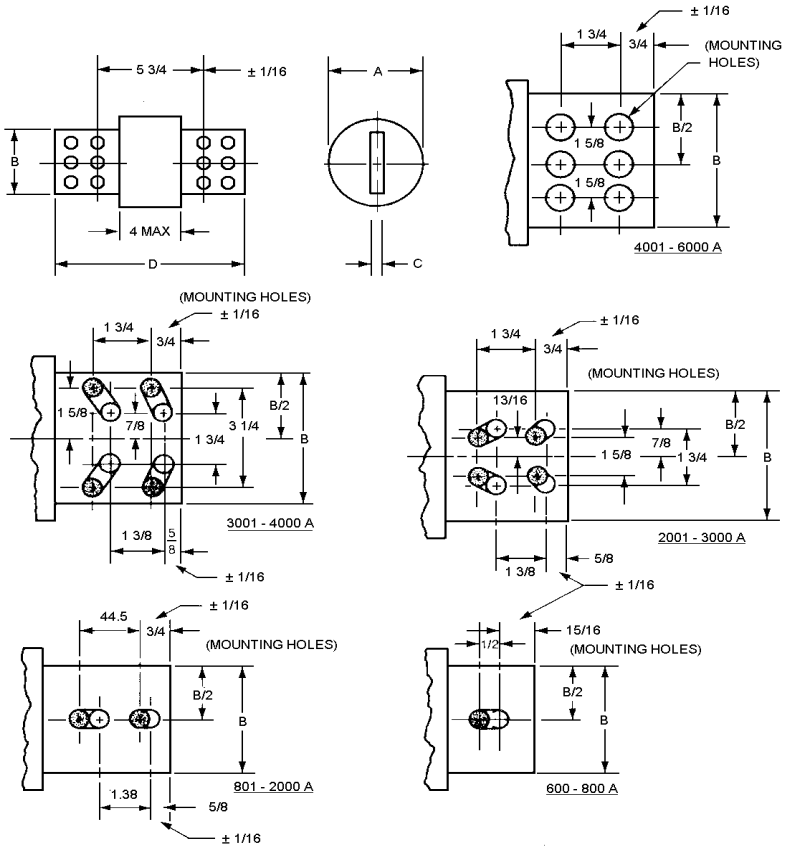
Table 5-5
DIMENSIONS[a] OF CLASS L FUSES
IN mm (INCHES)

Cartridge Size in Amperes	Maximum Diameter A	Width of Blades B	Thickness of Blades C	Overall Length D
601-800	64.3	50.8	9.53	219
	(2.53)	(2.0)	(0.38)	(8.63)
801-1200	70.6	50.8	9.53	273
	(2.78)	(2.0)	(0.38)	(10.75)
1201-1600	77.0	60.3	11.1	273
	(3.03)	(2.38)	(0.44)	(10.75)
1601-2000	89.7	69.9	12.7	273
	(3.53)	(2.75)	(0.50)	(10.75)
2001-2500	128	88.9	19.1	273
	(5.03)	(3.50)	(0.75)	(10.75)
2501-3000	128	102	19.1	273
	(5.03)	(4.0)	(0.75)	(10.75)
3001-4000	147	121	19.1	273
	(5.79)	(4.75)	(0.75)	(10.75)
4001-5000	182	133	25.4	273
	(7.17)	(5.25)	(1.0)	(10.75)
5001-6000	182	146	25.4	273
	(7.17)	(5.75)	(1.0)	(10.75)

[a]Tolerances: Column B: ±1.6 mm (±0.06 inch)
Column C: ±0.8 mm (±0.03 inch)
Column D: ±2.4 mm (±0.09 inch)



ALL TOLERANCES ARE ± 1/64 INCH UNLESS OTHERWISE NOTED.

5/8 ± 1/32 INCH SLOTS OR HOLES MAY BE USED. SHADED HOLES INDICATE DRILLING REQUIRED FOR CLASS "L" FUSE MOUNTING.

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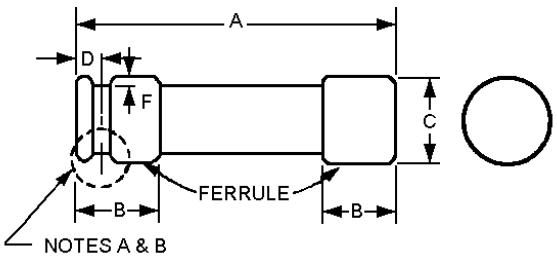
Table 5-6
DIMENSIONS[a] OF FERRULE TYPE CLASS R FUSES IN mm (INCHES)

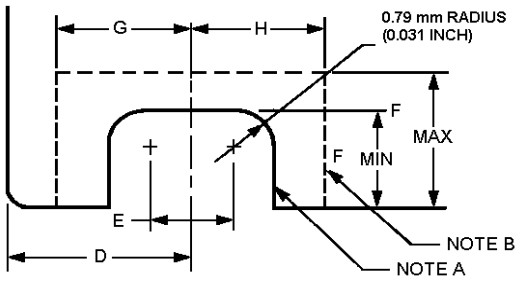
Rating		Overall Length of Fuse	Minimum Length of Ferrule	Outside Diameter of Ferrule	Distance of Rejection Feature From End	Minimum Width of Rejection Feature[b]	Minimum-Maximum Depth of Rejection Feature	Maximum Width Toward End	Maximum Width Toward Body
Volts	Amperes	A	B	C	D	E	F	G	H
250	0-30	50.80	12.70	14.27	3.96	1.78	2.16-3.30	2.92	3.81
		(2.00)	(0.500)	(0.562)	(0.156)	(0.070)	(0.085-0.130)	(0.115)	(0.150)
	31-60	76.20	15.88	20.62	4.78	2.18	2.16-3.30	3.12	4.32
		(3.00)	(0.625)	(.812)	(0.188)	(0.086)	(0.085-0.130)	(0.123)	(0.170)
600	0-30	127.00	12.70	20.62	4.78	2.18	2.16-3.30	3.12	4.32
		(5.00)	(0.500)	(0.812)	(0.188)	(0.066)	(0.085-0.130)	(0.123)	(0.170)
	31-60	139.70	15.88	26.97	6.35	2.18	2.16-3.30	3.91	4.57
		(5.500)	(0.625)	(1.062)	(0.250)	(0.086)	(0.085-0.130)	(0.154)	(0.180)

[a]Tolerances
Column A: ±0.79 mm (±0.031 inch)
Column C: ±0.20 min (±0.008 inch) To provide proper contact, the diameter of rejection ferrule end shall be equal to or not more than 1.27 mm (0.050 inch) smaller than actual diameter of main contact area for any fuse and no part of rejection ferrule end shall protrude beyond the diameter of the main part of the ferrule.
Column D : plus 0.20, minus 0.41 mm (plus 0.008, minus 0.016 inch)
[b]Column E: Distance between centers of 0.79 mm (0.031 inch) radius fillets. Shape of rejection groove is not specified but shall be completely within solid and dashed lines regardless of shape.

FERRULE TYPE 0 - 60 A



FERRULE TYPE REJECTION GROOVE DETAILS



NOTE A–Solid line indicates location, shape and dimensions for minimum rejection groove.

NOTE B–Dashed line indicates location, shape and dimensions for maximum rejection groove.

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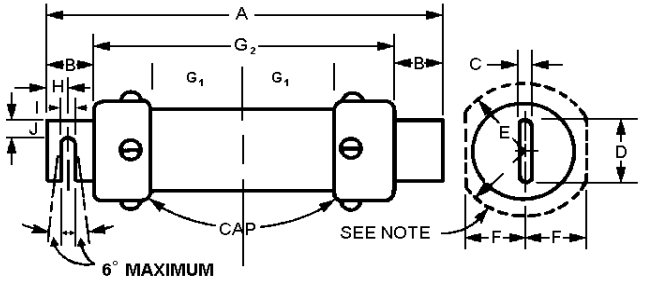
Table 5-7
DIMENSIONS[a] OF KNIFE BLADE TYPE CLASS R FUSES IN mm (INCHES)

Rating		Overall Length of Fuse	Minimum Length of Blade	Thickness of Blade	Width of Blade	Maximum Dimensions Over Projections: Measured Parallel to Blade	Maximum Dimensions Over Projections: Measured at Right Angles to Blade	Minimum Distance from Midpoint of fuse to nearest live part	Minimum Overall Length of Cylindrical Body	Distance of Rejection Feature From End	Width of Rejection Feature	Web Width of Blade at Rejection Feature
Volts	Amperes	A	B	C	D	E	F	G_1	G_2	H	I	J
	61-100	149.2	25.4	3.2	19.1	16.7	15.1	26.2	85.7	12.7	7.1	6.4
		(5.88)	(1.00)	(0.13)	(0.75)	(0.66)	(0.59)	(1.03)	(3.38)	(0.50)	(0.28)	(0.25)
	101-200	181.0	34.9	4.8	28.6	23.8	21.4	30.2	104.8	17.5	7.1	11.1
		(7.13)	(1.38)	(0.19)	(1.13)	(0.94)	(0.84)	(1.19)	(4.13)	(0.69)	(0.28)	(0.44)
	201-400	219.1	47.6	6.4	41.3	30.6	30.6	30.2	117.5	23.8	10.3	15.9
		(8.63)	(1.88)	(0.25)	(1.63)	(1.20)	(1.20)	(1.19)	(4.63)	(0.94)	(0.41)	(0.63)
	401-600	263.5	57.2	6.4	50.8	36.9	36.9	38.9	131.8	28.6	13.5	19.1
		(10.38)	(2.25)	(0.25)	(2.00)	(1.45)	(1.45)	(1.53)	(5.19)	(1.13)	(0.53)	(0.75)
	61-100	200.0	25.4	3.2	19.1	19.8	18.3	44.5	136.5	12.7	7.1	6.4
		(7.88)	(1.00)	(0.13)	(0.75)	(0.78)	(0.72)	(1.75)	(5.38)	(0.50)	(0.28)	(0.25)
	101-200	244.5	34.9	4.8	28.6	27.0	25.0	57.2	155.6	17.5	7.1	11.1
		(9.63)	(1.38)	(0.19)	(1.13)	(1.06)	(0.98)	(2.25)	(6.13)	(0.69)	(0.28)	(0.44)
	201-400	295.3	47.6	6.4	41.3	36.9	36.9	63.5	181.0	23.8	10.3	15.9
		(11.63)	(1.88)	(0.25)	(1.63)	(1.45)	(1.45)	(2.50)	(7.13)	(0.94)	(0.41)	(0.63)
	401-600	339.7	57.2	6.4	50.8	43.7	43.7	208.0	208.0	28.6	13.5	19.1
		(13.38)	(2.25)	(0.25)	(2.00)	(1.72)	(1.72)	(2.69)	(8.19)	(1.13)	(0.53)	(0.75)

[a]Tolerances: Column A: 61-200 A, ±1.57 mm (±0.062 inch); 201-600 A, ±2.39 mm (±0.094 inch)
Column C: ±0.08 mm (±0.003 inch)
Column D: ±0.89 mm (±0.035 inch)
Column H: ±0.20 mm (±0.008 inch)
Column I: minus 0.13, plus 0.64 mm (minus 0.005, plus 0.025 inch)
Dimension is diameter of slot at semicircle. Maximum rounding of corner at end of slot 3.18 mm (0.125 inch) radius.
Column J: ±0.79 mm (±0.031 inch).

[b]The length of the cylindrical body may be less than the indicated value if other acceptable interference means (pins through the blades, collars, or the like) are provided to prevent mounting the fuse in the fuseholder that will accommodate a fuse rated in the next lower bracket of current ratings.

KNIFE-BLADE TYPE 61-600 A



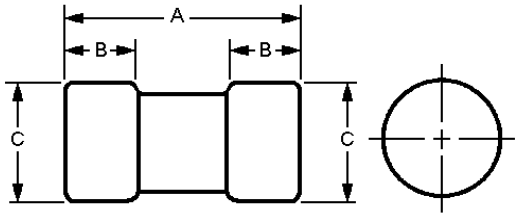
Note - The dash line represents the limit of the maximum projection of a screw, rivet head, or the like. It becomes a circle for a fuse rated at more than 200 A.

Table 5-8
DIMENSIONS[a] OF FERRULE TYPE CLASS T FUSES IN mm (INCHES)

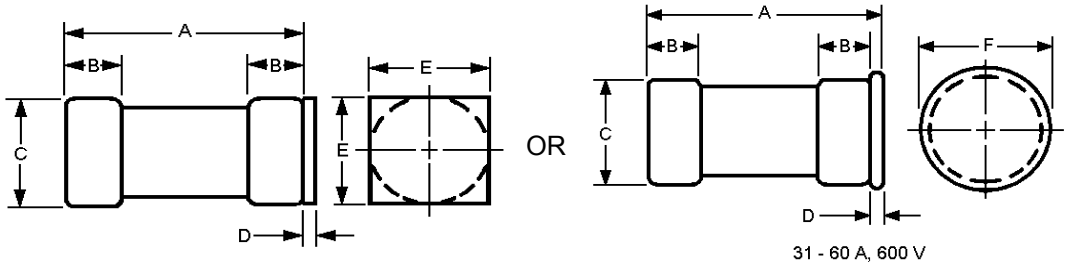
Rating		Overall Length of Fuse	Length of Ferrule	Outside Diameter of Ferrule	Thickness of Rejection Feature	Width of Rejection Feature[b]	Diameter of Rejection Feature[b]
Volts	Amperes	A	B	C	D	E	F
300	0-30	22.4 (0.88)	7.1 (O.28)	10.3 (0.41)	-	-	-
	31-60	22.4 (0.88)	7.1 (0.28)	14.3 (0.56)	-	-	-
600	0-30	38.1 (1.50)	7.1 (0.28)	14.3 (0.56)	-	-	-
	31-60	39.6 (1.56)	10.4 (0.41)	20.6 (0.81)	1.6 (0.06)	20.6 (0.81)	25.3 (0.99)

[a]Tolerances:
Column A: 0-60 A, 300 V, ±0.51 mm (±0.020 inch); 0-60 A, 600 V, 1.02 mm (±0.40 inch)
Column B: ±0.51 mm (±0.20 inch)
Column C: ±0.15 mm (±0.006 inch). Diameter of body is less than ferrules.
Columns D and E: ±0.15 mm (±0.006 inch)
Column F: minus 0.15 mm plus 0.41 mm (minus 0.006 inch plus 0.015).

[b]Rejection feature may be square or round.



0 - 60 A, 300 V
0 - 30 A, 600 V



31 - 60 A, 600 V

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Table 5-9
DIMENSIONS[a] OF KNIFE BLADE TYPE T FUSES IN mm (INCHES)

Rating		Overall Length of Fuse	Distance Between Mounting Centers	Maximum Length of Body	Width of Blade	Diameter of Mounting Holes	Maximum Diameter of Fuses	Minimum Length of Insulated Body	Thickness of Blade	Minimum Length of Blade	Distance of Mounting Holes From End
Volts	Amperes	A	B	C	D	E	F	G	H	I	J
300	61-100	54.8 (2.16)	39.5 (1.56)	21.6 (0.85)	19.1 (0.75)	7.1 (0.28)	21.0 (0.25)	6.4 (0.25)	3.2 (0.13)	16.4 (0.65)	7.6 (0.30)
	101-200	61.9 (2.44)	43.1 (1.70)	21.6 (0.85)	22.2 (0.88)	8.7 (0.34)	27.4 (1.08)	6.4 (0.25)	4.8 (0.19)	20.0 (0.79)	9.5 (0.37)
	201-400	69.9 (2.75)	46.8 (1.88)	21.8 (0.86)	25.4 (1.00)	10.3 (0.41)N	34.1 (1.34)	6.4 (0.25)N	6.4 (0.25)	23.5 (0.93)	11.5 (0.45)
	401-600	77.8 (3.06)	61.6 (2.03)	22.4 (0.88)	31.8 (1.25)	12.3 (0.48)	41.3 (1.63)	6.4 (0.25)	7.9 (0.31)	27.4 (1.07)	13.1 (0.52)
	601-800	85.7 (3.38)	56.4 (2.22)	22.6 (0.89	44.5 (1.75)	13.9 (O.55)	52.8 (2.08)	6.4 (0.25)	9.5 (0.38)	31.0 (1.22)	14.7 (0.58)
	801-1200	101.6 (4.00)	64.3 (2.53)	27.4 (1.07)	50.8 (2.00)	15.5 (0.61)	63.9 (2.52)	6.4 (0.25)	11.1 (0.44)	36.6 (1.44)	18.7 (0.74)
600	61-100	75.0 (2.95)	59.7 (2.53)	41.7 (1.64)	19.1 (0.75)	. 7.1 (0.28)	21.0 (0.83)	12.7 (0.50)	3.2 (0.13)	16.4 (0.65)	7.6 (0.30)
	101-200	82.6 (3.25)	63.7 (2.51)	42.2 (1.66)	22.2 (0.88)	8.7 (0.34)	27.4 (1.08)	12.7 (0.50)	4.8 (0.19)	20.0 (0.79)	9.5 (0.37)
	201-400	92.1 (3.63)	69.1 (2.72)	43.9 (1.73)	25.4 (1.00)	10.3 (0.41)	41.3 (1.63)	12.7 (0.50)	6.4 (0.25)	23.5 (0.93)	11.5 (0.45)
	401-600	101.2 (3.98)	75.0 (2.95)	45.2 (1.78)	31.8 (1.25)	12.3 (0.48)	53.2 (2.09)	12.7 (0.50)	7.9 (0.31)	27.3 (1.07)	13.1 (0.52)
	601-800	109.9 (4.33)	80.6 (3.17)	47.6 (1.88)	44.5 (1.75)	13.9 (0.55)	63.9 (2.52)	12.7 (0.50)	9.5 (0.38)	30.7 (1.21)	14.7 (0.58)
	801-1200	133.7 (6.27)	95.6 (3.8)	58.7 (2.31)	50.8 (2.0)	15.5 (.61)	66.7 (2.63)	12.7 (.9)	11.0 (.44)	27.6 (1.47)	18.7 (.74)

[a]Tolerances:

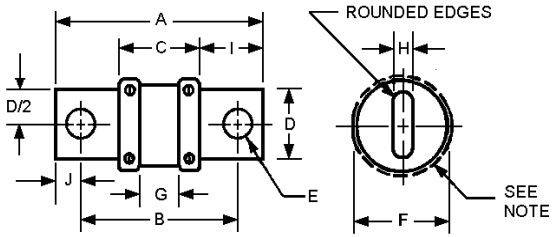
Column A: 61-200 A, 300 V, ±0.51 mm (±0.020 inch); 201-1200 A, 300 V and 61-800 A, 600 V, ±1.02 mm (±0.40 inch)

Column B: ±1.02mm (±0.040 inch)

Columns D and J: 0.51 mm (±0.020 inch), except J tolerance ±0.71 mm (±0.028 inch) for 801-1200 A, 300 V

Column E: minus 0.00 mm (minus 0.000 inch); 61-100 A, plus 0.13 mm (plus 0.005 inch); 101-200 A, plus 0.15 mm (plus 0.006 inch); 201-400 A, plus 0.18 mm (plus 0.007 inch); 401-1200 A, plus 0.20 mm (plus 0.008 inch)

Column H: ±0.15 mm (±0.006 inch)

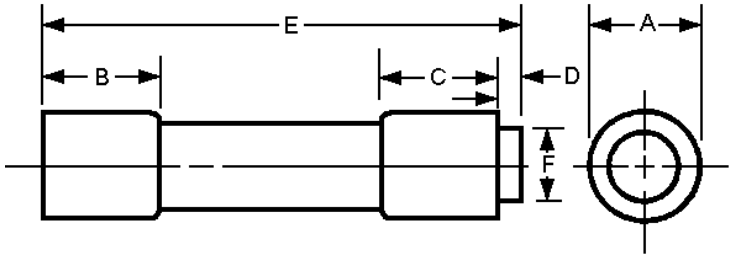


Note - The dashed line represents the limit of the maximum 1.58 mm (0.063 Inch) projection of screw, rivet or the like.

Table 5-10
DIMENSIONS[a] OF CLASS CC FUSES IN mm (INCHES)

Rating		Ferrule Diameter	Ferrule Length	Ferrule Length	Rejection Length	Overall Length	Rejection Diameter
Volts	Amperes	A	B	C	D	E	F
600	0-30	10.3 (0.41)	9.5 (0.38)	9.5 (0.38)	3.2 (0.13)	38.1 (1.50)	6.4 (0.25)

[a]Tolerances:
Columns A, B, C, D and F: ±0.13 mm (±0.005 inch)
Column E: ±0.79 mm (±0.031 inch)



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Section 6
PERFORMANCE

6.1 GENERAL

6.1.1 All alternating current rated fuses shall be subjected to the following AC tests at a frequency of 48 to 62 Hertz:

1. Current carrying capacity
2. Temperature rise
3. Overload opening time
4. Interrupting ability at rated voltage; overload and 10,000 ampere short circuit.

6.1.2 Fuses with alternating current interrupting ratings above 10,000 amperes shall be subjected to the following additional AC tests at a frequency of 60 ±2 Hertz:

1. Interrupting rating short circuit
2. Intermediate interrupting short circuit
3. Maximum energy
4. Threshold

I^2t and peak let-through currents shall be measured during the interrupting rating short circuit test and intermediate interrupting short circuit test. Peak let-through current shall be measured during the maximum energy test.

6.1.3 All direct current rated fuses shall be subjected to the following DC tests:

1. Current carrying capacity*
2. Temperature rise*
3. Overload opening time*
4. Overload and interrupting rating at rated voltage

*For fuses rated for both alternating current and direct current, only the AC test shall be conducted.

6.2 CURRENT CARRYING CAPACITY AND TEMPERATURE RISE TESTS

6.2.1 Fuses rated 600 amperes or less (Classes G, H, J, K, R, T, and CC) shall carry 100 percent of rated current until thermally stable.

The temperature rise of the exterior of the fuse shall be not more than that shown in Tables 6-1 and 6-2 when the fuse carries 100 percent of its rated current.

An alternating current or a direct current at any convenient voltage shall be used.

6.2.1.1 Each fuse shall be supported in a single-pole fuseholder. Each fuseholder shall be mounted horizontally on a test board of nonconducting material so arranged that each fuse under test will be held in a horizontal position above the board.

If the test board is constructed for the testing of two or more fuses in series, fuseholders shall be located so there shall be a spacing of not less than 150mm (6 inches) between any two fuses under test. The fuseholders and the ammeter shall be connected to each other and to the source of supply by a copper wire of the size shown in Table 6-3.

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6.2.1.2 A conductor larger than 8.4 mm^2 (No. 8 AWG) shall employ a soldering lug or pressure wire connector.

6.2.1.3 For fuses rated 60 amperes or less, a fuseholder with reinforced clips shall be used.

6.2.1.4 For fuses rated more than 60 amperes utilizing fuse clips, C clamps or clip clamps shall be permitted to press the fuseholder clips against the blades of the fuse. When employing nonreinforced fuseholder clips, each C clamp shall be of iron or steel and shall weigh not more than 85 g (3 oz). Neither of the two faces of the clamp making contact with the fuseholder clips shall have an area of more than 323 mm^2 (one-half square inch).

Table 6-1
MAXIMUM TEMPERATURE RISES
(Classes H, J, K, R, and T Fuses)

Above the Temperature of the Ambient Air	
Fuse Rating Amperes	**Thermocouples Contacts**
0-30	55° C
31-60	55° C
61-100	55° C
101-200	75° C
201-400	75° C
401-600	75° C

Table 6-2
MAXIMUM TEMPERATURE RISES
(Classes CC and G Fuses)

Above the Temperature of the Ambient Air	
Fuse Rating Amperes	**Thermocouples Contacts**
0-30	95° C
31-60	95° C

Table 6-3
TEST CONDUCTOR SIZE

Fuse Ratings In Amperes	Minimum Length Between Fuseholders m (feet)	mm^2	(Wire Size)
0-30	0.6 (2)	8.4	(8 AWG)
31-60	0.6 (2)	21.1	(4 AWG)
61-100	0.6 (2)	42.4	(1 AWG)
101-200	0.6 (2)	107	(4/0 AWG)
201-400	1.2 (4)	253	(500 MCM)
401-600	1.2 (4)	507	(1,000 MCM)

NOTE—Any connection to the source of supply shall be not less than 1.2 m (4ft) long.

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6.2.1.5 The temperatures of the fuse shall be measured by a thermocouple.
Thermocouples shall be secured by Fuller's Earth and water glass, or by epoxy, welding, soldering or peening, or other method that provides thermal contact. Thermocouples shall be placed on each ferrule or blade at the top center of the fuse clip. The thermocouples shall consist of iron and constantan, or chromel and alumel wires not larger than 0.21 mm^2 (No. 24 AWG).

The ambient temperature shall not vary more than 5° C (9° F) during the test and shall be within the limits of 25 ± 5° C (77 ± 9° F). Stabilization shall be considered to have occurred when no individual temperature rise reading of 4 consecutive readings taken at 5 min intervals exceeds the average reading of these 4 readings by more than 2° C and no indication of increasing temperature rise is observed. This average temperature rise reading shall be deemed to be the temperature rise of the fuse.

6.2.2 Fuses rated more than 600 amperes (Classes L and T) shall carry 110% of rated current until temperature stabilization occurs.

The temperature rise on the terminal of the Class L fuse shall be not more than 65° C (117° F) above the calibration temperature rise of the test equipment.

The temperature rise on the terminal of the Class T fuse shall be not more than 65° C (117° F) for 800 ampere cartridge size and not more than 85° C (153° F) for the 1200 ampere cartridge size, above the calibration temperature rise of the test equipment.

6.2.2.1 An alternating current of any convenient voltage shall be used. The fuse shall carry 110% of its rated current until thermally stable. Stabilization shall be considered to have occurred when no individual temperature rise reading of 4 consecutive readings taken at 10 min intervals exceeds the average reading of these 4 readings by more than 2° C and no indication of increasing temperature rise is observed. This average temperature rise reading shall be deemed to be the temperature rise of the fuse.

6.2.2.2 The major axis of the fuse shall be horizontal. Each terminal of the fuse shall be connected to a copper bus bar that is silver plated at points of contact with the fuse. Each bus bar shall be rectangular in cross-section and not exceed the area shown in Table 6-4. The bus bar shall be at least as wide as the fuse terminal. Mounting screw holes shall be provided in the bus bar to correspond with those of the fuse to be tested.

6.2.2.3 The test equipment shall be calibrated with a shorting bar substituted for the fuse to be tested, to produce a temperature rise on the shorting bar within the limits shown in Table 6-4 in a room ambient temperature of 25 ± 5° C (77 ± 9° F).

The shorting bar shall be the same length as the fuse for which it is substituted. The cross-sectional dimensions of the shorting bar shall be the same as those of the bus bar. The shorting bar shall be of copper, shall be silver-plated at the terminal connections, shall have holes to permit mounting to the bus bar, and shall be one-piece or laminated without space between the laminations.

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Table 6-4
BUS BAR CROSS-SECTION AND SHORTING BAR TEMPERATURE RISES

Ampere Rating	Maximum Bus-Bar Cross Section		Shorting Bar Temperature Rise Above Room Ambient	
			Maximum	Minimum
	cm^2	(Square Inches)	° C	° C
800	4.84	(¾)	35	20
1200	6.45	(1)	35	20
1600	12.9	(2)	35	20
2000	19.4	(3)	35	20
2500	25.8	(4)	35	20
3000	29.0	(4 ½)	45	30
4000	38.7	(6)	60	40
5000	58.1	(9)	70	50
6000	58.1	(9)	85	65

6.2.2.4 Temperature measurements shall be made by thermocouples and an indicating instrument. The thermocouples shall be secured by Fuller's Earth and water glass, epoxy, welding, soldering, or peening.

During calibration, a thermocouple shall be located at the top center of the shorting bar.

During the temperature test, a thermocouple shall be secured at the top center of each fuse contact, approximately 6.4 mm (¼ inch) from the end of the fuse body.

The thermocouples shall consist of iron and constantan or chromel and alumel wires not larger than 0.21 mm^2 (No. 24 AWG).

6.3 OVERLOAD OPENING TIME

A fuse shall open the circuit within the time limits indicated in Tables 6-5 and 6-6.

The fuse shall clear without causing any external soldered connections to melt.

To determine whether a fuse complies with the overload opening time requirements, it shall be tested in the test circuit specified for the current carrying capacity and temperature rise tests. The fuse and test terminals shall be at room temperature at the start of each test. The ambient temperature shall not vary more than 5° C during the test and shall be within the limits of 25 ± 5° C.

Time-delay fuses rated 0-600 amperes shall meet the minimum clearing time requirements shown in Tables 6-5 and 6-6.

Table 6-5
OVERLOAD OPENING TIME
Classes CC and G Fuses

Ampere Rating	Maximum Clearing Time		Minimum Clearing Time for Time-delay Fuses
	135-percent Rating	200-percent Rating	200-percent Rating
0-30	60 minutes	2 minutes	12 seconds
31-60	60 minutes	4 minutes	12 seconds

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Table 6-6
OVERLOAD OPENING TIME
Classes H, J, K, L, R, and T Fuses

Ampere Rating	Maximum Clearing Time			Minimum Clearing Time For Time-Delay Fuses
	135-Percent Rating	150-Percent Rating	200-Percent Rating	500-Percent Rating
0-30	60 minutes	-	4 minutes	10 seconds[a]
31-60	60 minutes	-	6 minutes	10 seconds
61-100	120 minutes	-	8 minutes	10 seconds
101-200	120 minutes	-	10 minutes	10 seconds
201-400	120 minutes	-	12 minutes	10 seconds
401-600	120 minutes	-	14 minutes	10 seconds
601-6000	-	240 minutes	-	-

[a] 8 seconds for 0-30A, 250V.

6.4 INTERRUPTING TESTS AT RATED VOLTAGE

The fuse shall be securely mounted so that its major axis is either horizontal or vertical.

The fuse shall be tested between 100 percent and 105 percent of its rated voltage.

After each interrupting test, the voltage shall be continued for one minute for overload test and 30 seconds for short circuit tests after interruption of the current by the fuse. There shall not be any re-establishment of current or any indication of a tendency to restrike before the end of the one minute interval. If there is evidence of a tendency to restrike, the recovery voltage shall be continued for an additional minute.

6.4.1 Overload Tests

Fuses containing filler shall be subjected to the following tests at a power factor of 0.80 or less lagging.

6.4.1.1 Classes G, H, J, R, and CC fuses shall be tested at rated voltage and 200 percent of rated current.

6.4.1.2 Class T fuses rated 600 amperes or less shall be tested at rated voltage and 200 percent of rated current.

6.4.1.3 Class T fuses rated above 600 amperes shall be tested at rated voltage and 300 percent of rated current.

6.4.2 10,000 Amperes Short Circuit Tests

Class H fuses shall be subjected to a short circuit current of 10,000 amperes.

The source of supply and the test circuit shall deliver 10,000 rms symmetrical amperes.

The resistive and reactive components of the test circuit shall be connected in series and shall result in a power factor of 0.45-0.50. Class H fuses rated 100 amperes or less shall be tested at a power factor of 0.85-0.95. The manufacturer shall be allowed to use a lower power factor when the test station is not capable of providing a specified value. The power factor shall be lagging. The instant of closure of the circuit shall be at random with reference to the phase of the voltage wave.

For a renewable fuse, two successive renewal links shall be tested in the same case. The fuse shall be capable of being renewed after the first test. The fuse need not be renewed after the second test.

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6.4.3 Interrupting Rating and Intermediate Interruption Level Tests

6.4.3.1 Fuses shall be tested at the interrupting levels shown in Table 6-7.

6.4.3.2 The interrupting ratings for Classes J, R, L, T, and CC fuses shall be 200,000 amperes.

6.4.3.3 The interrupting rating for Class G fuses shall be 100,000 amperes.

6.4.3.4 The interrupting rating for Class K fuses shall be 200,000, 100,000 or 50,000 amperes. (Class H fuses have an interrupting rating of 10,000 amperes and are covered under the 10,000 ampere short circuit tests).

Table 6-7
TEST LEVELS FOR HIGH INTERRUPTING RATING FUSES (ABOVE 10 kA)

Required Tests	Fuse Interrupting Rating		
	200 kA	100 kA	50 kA
200 kA	X	-	-
100 kA	X	X	-
50KA	X	X	X
Maximum Energy	X	X	X
Threshold	X	X	-

6.4.3.5 The clearing I^2t and peak let-through currents shall be measured during these tests. The power factors of all the currents shall be 0.20 or less lagging. The closing angle shall be adjusted to cause start of arcing within 30 electrical degrees prior to system peak voltage. Fuses shall not exceed the limits of clearing I^2t and peak let-through currents shown in Table 6-8 through 6-16.

If a fuse cannot start arcing within 30 electrical degrees of system peak voltage, the fuse shall be tested on the circuit with the closing angle adjusted for maximum offset (approximately zero degrees on the voltage wave).

6.4.3.6 The test current shall be between 100 percent and 110 percent of the interrupting test level.

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Table 6-8
CLASS CC FUSES (600 V)
MAXIMUM PEAK LET-THROUGH CURRENT I_p (AMPERES) AND CLEARING I^2t (AMPERES SQUARED SECONDS)

Cartridge Size Amperes	Fuse Rating Amperes	Threshold Through 50 kA		100 kA		200 kA	
		$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$
0-15	15	2.0	3.0	2.0	3.0	3.0	4.0
16-20	20	2.0	3.0	3.0	4.0	3.0	5.0
21-30	30	7.0	6.0	7.0	7.5	7.0	12.0

Table 6-9
CLASS G FUSES
MAXIMUM PEAK LET-THROUGH CURRENT I_p (AMPERES)
AND CLEARING I^2t (AMPERES SQUARED SECONDS)

Cartridge Size Amperes	Fuse Rating Amperes	Threshold Through 100kA	
		$I^2t \times 10^3$	$I_p \times 10^3$
0-15	1	0.8	1.0
	3	1.2	1.5
	6	1.8	2.0
	10	2.8	3.0
	15	3.8	4.0
16-20	20	5.0	5.0
21-30	25	6.0	6.0
	30	7.0	7.0
31-60	35	14.0	8.0
	40	17.0	8.5
	45	18.5	9.0
	50	21.0	9.5
	60	25.0	10.5

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Table 6-10
CLASS J FUSES (600 V)
MAXIMUM PEAK LET-THROUGH CURRENT I_p (AMPERES) AND CLEARING I^2t (AMPERES SQUARED SECONDS)

Cartridge Size	Fuse Rating Amperes	Threshold Through 50 kA		100 kA		200 kA	
		$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$
0-30	1			0.8	1.0		
	3			1.2	1.5		
	6			2.0	2.3		
	10			3.0	3.3		
	15			4.0	4.0		
	20			5.0	5.0		
	25			5.5	6.0		
	30	7	6	7.0	7.5	7	12
31-60	35			12	7.5		
	40			17	8.0		
	45			18	8.5		
	50			22	9.0		
	60	30	8	30	10	30	16
61-100	70			50	11.5		
	80			60	12.5		
	90			75	13.5		
	100	60	12	80	14	80	20
101-200	110			100	14.5		
	125			150	15.5		
	150			175	17		
	175			225	18.5		
	200	200	16	300	20	300	30
201-400	225			350	22.5		
	250			450	24		
	300			600	26		
	350			800	29		
	400	1000	25	1100	30	1100	45
401-600	450			1500	36		
	500			2000	42		
	600	2500	35	2500	45	2500	70

Table 6-11
CLASS K FUSES (250 & 600 V)
MAXIMUM PEAK LET-THROUGH CURRENT I_p (AMPERES) AND CLEARING I^2t (AMPERES SQUARED SECONDS)

Cartridge Size In Amperes	Class K1		Class K5		Class K9	
	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$
0-30	10	10	50	11	50	14
31-40	40	12	200	21	250	25
61-100	100	16	500	25	650	35
101-200	400	22	1600	40	3500	60
201-400	1200	35	5000	60	15,000	80
401-600	3000	50	10,000	80	40,000	130

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Table 6-12
CLASS RK1 FUSES (250 & 600 V)
MAXIMUM PEAK LET-THROUGH CURRENT I_p (AMPERES)
AND CLEARING I^2t (AMPERES SQUARED SECONDS)

Cartridge Size In Amperes	Threshold Through 50 kA		100 kA		200 kA	
	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$
0-30	10	6	10	10	11	12
31-40	40	10	40	12	50	16
61-100	100	14	100	16	100	20
101-200	400	18	400	22	400	30
201-400	1200	33	1200	35	1600	50
401-600	3000	43	3000	50	4000	70

Table 6-13
CLASS RK1 FUSES (250 & 600 V)
MAXIMUM PEAK LET-THROUGH CURRENT I_p (AMPERES)
AND CLEARING I^2t (AMPERES SQUARED SECONDS)

Cartridge Size In Amperes	Threshold Through 50 kA		100 kA		200 kA	
	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$
0-30	50	11	50	11	50	14
31-40	200	20	200	21	200	26
61-100	500	22	500	25	500	32
101-200	1600	32	1600	40	2000	50
201-400	5000	50	5000	60	6000	75
401-600	10,000	65	10,000	80	12,000	100

Table 6-14
CLASS L FUSES (600 V)
MAXIMUM PEAK LET-THROUGH CURRENT I_p (AMPERES) AND
CLEARING I^2t (AMPERES SQUARED SECONDS)

Cartridge Size	Fuse Rating	50 kA		100 kA		200 kA	
		$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$
601-800	800	10	80	10	80	10	80
801-1200	1200	12	80	12	80	15	120
1201-1600	1600	22	100	22	100	30	150
1601-2000	2000	35	110	35	120	40	165
2001-2500	2500	-	-	75	165	75	180
2501-3000	3000	-	-	100	175	100	200
3001-4000	4000	-	-	150	220	150	250
4001-5000	5000	-	-	350	-	350	300
5001-6000	6000	-	-	350	-	500	350

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Table 6-15
CLASS T FUSES (300 V)
MAXIMUM PEAK LET-THROUGH CURRENT I_p (AMPERES) AND CLEARING I^2t (AMPERES SQUARED SECONDS)

Cartridge Size Amperes	Fuse Rating Amperes	Threshold Through 50 kA		100 kA		200 kA	
		$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$
0-30	1			0.4	0.8		
	3			0.6	1.3		
	6			1.0	2.0		
	10			1.5	3.0		
	15			2.0	4.0		
	20			2.5	4.5		
	25			2.7	5.5		
	30	3.5	5	3.5	7.0	3.5	9
31-60	25			6.0	7.0		
	40			8.5	7.2		
	45			9	7.6		
	50			11	8.0		
	60	15	7	15	9.0	15	12
61-100	70			25	10.0		
	80			30	10.7		
	90			38	11.6		
	100	40	9	40	12.0	40	15
101-200	110			50	12		
	125			75	13		
	150			88	14		
	175			115	15		
	200	150	13	150	16	150	20
201-400	225			175	21		
	250			225	22		
	300			300	24		
	350			400	27		
	400	550	22	550	28	550	35
401-600	450			600	32		
	500			800	37		
	600	1000	29	1000	37	1000	46
601-800	700			1250	45		
	800	1500	37	1500	50	1500	65
801-1200	1000	-	-	3500	65	-	-
	1200	3500	50	3500	65	4000	80

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Table 6-16
CLASS T FUSES (600 V)
MAXIMUM PEAK LET-THROUGH CURRENT I_p (AMPERES)
AND CLEARING I^2t (AMPERES SQUARED SECONDS)

Cartridge Size Amperes	Fuse Rating Amperes	Threshold Through 50 kA		100 kA		200 kA	
		$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$	$I^2t \times 10^3$	$I_p \times 10^3$
0-30	1			0.8	1.0		
	3			1.2	1.5		
	6			2.0	2.3		
	10			3.0	3.3		
	15			4.0	4.0		
	20			5.0	5.0		
	25			5.5	6.0		
	30	7	6	7.0	7.5	7	12
31-60	35			12	7.5		
	40			17	8.0		
	45			18	8.5		
	50			22	9.0		
	60	30	8	30	10	30	16
61-100	70			50	11.5		
	80			60	12.5		
	90			75	13.5		
	100	60	12	80	14	80	20
101-200	110			100	14.5		
	125			150	15.5		
	150			175	17		
	175			225	18.5		
	200	200	16	300	20	300	30
201-400	225			350	22.5		
	250			450	24		
	300			600	26		
	350			800	29		
	400	1000	25	1110	30	1100	45
401-600	450			1500	36		
	500			2000	42		
	600	2500	35	2500	45	2500	70
601-800	700			3500	50		
	800	4000	50	4000	55	4000	75
801-1200	1000			8000	65		
	1200	8000	55.5	8000	70	10,000	88

NOTE—The test current shall be between l00 percent and 120 percent of the interrupting test level.

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6.5 MAXIMUM ENERGY

Fuses having interrupting ratings above 10,000 amperes shall interrupt a circuit having an available rms symmetrical current (but not greater than their interrupting rating) that permits a peak current let-through of 70 percent to 100 percent of the peak current value of the available symmetrical component. The power factor shall be 0.20 or less. The closing angles shall produce the start of arcing within 30 electrical degrees prior to system peak voltage. This test is not required for ratings of less than 30 A, if they employ the same filler as the 30 A fuse. Fuses rated 1 A or less that do not employ a filler, are represented by the 30 A fuse.

6.6 MAXIMUM THRESHOLD RATIO

Fuses having interrupting ratings above 10,000 amperes shall interrupt a circuit having an available rms symmetrical current of not more than the product of the fuse current rating and the maximum threshold ratio and shall clear in the first half-cycle after closing. The maximum threshold ratios are shown in Table 6-17.

Table 6-17
MAXIMUM THRESHOLD RATIOS

Fuse Class	Ratio
CC	60
G	60
H	*
J	30
K	*
RK1	30
RK5	65
T	30
L (601-1200A)	30
L (1201-2000A)	35
L (2001-4000A)	40
L (4001-6000A)	*

* Not applicable

The test circuit power factor for the maximum threshold ratio test shall be 0.20 or less and the circuit closing angle shall be adjusted for minimum offset (approximately 90 degrees on the voltage wave).

6.7 DIRECT CURRENT TESTS

Direct Current only fuses shall comply with 6.7 and 6.7.1. Fuses shall be tested in a direct current circuit between 100 percent and 110 percent of their rated voltage.

After each interrupting test, the voltage shall be continued for one minute for overload test and 30 seconds for the short circuit test after interruption of the current by the fuse. There shall not be any re-establishment of current or any indication of a tendency to restrike before the end of the one minute interval. If there is evidence of a tendency to restrike, the recovery voltage shall be continued for an additional minute.

6.7.1 Overload Test

To determine whether a fuse complies with the direct current overload requirements, it shall be tested in the test circuit specified for the current carrying capacity and temperature rise tests.

The fuse and test terminals shall be at room temperature at the start of each test. The ambient temperature shall not vary more than 5° C during the test and shall be within the limits of 25 ± 5° C.

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The fuse classes CC, J, G, R, H, and K shall interrupt a circuit adjusted to obtain 200 percent (-0, + 10%) of current rating. The fuses classes T and L shall interrupt a circuit adjusted to obtain 300 percent (-0, + 10%) of current rating. A fuse designated "Time-Delay" shall also be tested on a circuit adjusted to 900% of rated current.

The time constant (T) of the test circuit shall be as shown in Table 6-18.

Table 6-18
MAXIMUM TIME CONSTANTS

Test Current Amperes	Time Constant in Milliseconds (T)
60	1.7
120	2.1
200	2.5
270	2.7
400	3.0
540	3.3
800	3.7
900	3.8
1200	4.2
1800	4.7
3600	5.8
5400	6.6

NOTES—
The time constraints were derived from the formula:

$T = ½ (I_{test})^{0.3}$, $\leq$ 10 msec

T = time constant in milliseconds
I = test current

6.7.2 Short Circuit Test

The fuse shall interrupt a circuit having an available current of 10,000 amperes and also an available current as specified by the manufacturer for the maximum interrupting rating of the fuse. The time constant shall be not less than 10 milliseconds.

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