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*Standard
for*
FUSES ABOVE 600 VOLTS

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Standard *of the* American Institute of Electrical Engineers

FUSES ABOVE 600 VOLTS

SCOPE

This Standard applies to the following types of devices designed for operation above 600 volts whether for indoor or outdoor service.

- (a) Fuses (see paragraph 25-50).
- (b) Fuse cutouts (see paragraph 25-64).
- (c) Fuse parts of combined equipment.

SERVICE CONDITIONS

25-1 Usual Temperature and Altitude Service Conditions—Equipment conforming to these Standards shall be suitable for operation at its standard rating, provided that:

(a) The temperature of the cooling air (ambient temperature) does not exceed 40C and copper-to-copper contacts, or equivalent are used for fuse terminals and all conducting joints except those of the conducting element.

(b) The temperature of the cooling air (ambient temperature) does not exceed 55C if the fuse has all contacts silver surfaced or equivalent, and in addition has all conducting joints, except those of the conducting element, including terminal connections, either:

- (1) Separately held mechanically and either soldered or silver surfaced, or
- (2) Brazed, welded or silver soldered and provided that such operation does not result in temperatures in excess of 90C for Class O, 105C for Class A, or 130C for Class B insulations.

(c) The altitude does not exceed 3300 feet (1000 meters).

Note: Distribution cutouts are generally not suitable for operating in an ambient temperature above 40C and such applications should be considered as unusual ambient temperature conditions. See paragraph 25-2.

25-2 Unusual Temperature and Altitude Service Conditions—The application of equipment at higher ambient temperatures or at higher alti-

tudes than specified in 25-1 shall be considered as special.

Standard equipment may be applied at higher ambient temperatures or at higher altitudes than specified, but its performance may be affected and special consideration should be given to these applications. (See paragraph 25-4).

25-3 Other Conditions Which May Affect Design and Application—Where other unusual conditions exist they should be brought to the attention of those responsible for the design and application of the equipment. Examples of such conditions are:

(a) Damaging fumes or vapors, excessive or abrasive dust, explosive mixtures of dust or gases, steam, salt spray, excessive moisture or dripping water, etc.

(b) Abnormal vibration, shocks, or tilting.

(c) Excessively high or low temperatures.

(d) Unusual transportation or storage conditions.

(e) Unusual space limitations.

(f) Unusual operating duty, frequency of operation, difficulty of maintenance, poor wave form, unbalanced voltage, special insulation requirements, etc.

25-4 Applications at Altitudes Greater than 3300 Feet (1000 Meters)—Equipment that depends on air for its insulating and cooling medium will have a higher temperature rise and a lower dielectric value when operated at altitudes higher than 3300 feet.

Withstand voltage and current ratings should be multiplied by factors shown in Tables Ia and Ib.

Equipment designed for standard temperature rise may be used at its normal current rating without exceeding ultimate standard temperature limits provided that the ambient temperature does not exceed the ambient allowed in paragraph 25-1, multiplied by the factor shown in Table Ic.

TABLE I
Altitude Correction

		Altitude Correction Factor To Be Applied To		
		a	b	c
Altitude		Withstand	Current	Ambient
Feet	Meters	Voltage	Rating	Temperature
3300	1000	1.00	1.00	1.00
4000	1200	.98	.995	.992
5000	1500	.95	.99	.980
6000	1800	.92	.985	.968
7000	2100	.89	.98	.956
8000	2400	.86	.97	.944
9000	2700	.83	.965	.932
10000	3000	.80	.96	.920
12000	3600	.75	.95	.896
14000	4200	.70	.935	.872
16000	4800	.65	.925	.848
18000	5400	.61	.91	.824
20000	6000	.56	.90	.800

The correction factors in columns b and c are not to be applied at the same time.

If the derating as determined from the table is serious, equipment of a suitably higher rating should be chosen to meet requirements, after derating factors have been applied.

DEFINITIONS

Definitions given below apply specifically to the apparatus treated in this Standard. Where possible, definitions given in "American Standard Definitions of Electrical Terms," C42, are used and such definitions are followed by the C42 designating number. Where a slight change is made, the corresponding paragraph number is given with the notation "Mod." Where there is no corresponding definition in C42, no reference is given.

General

- 25-50 Fuse**—A fuse is an overcurrent protective device with a circuit-opening fusible member directly heated and severed by the passage of overcurrent through it. (20.20.005)
- 25-51 Vented Fuse**—A vented fuse is a fuse which during circuit interruption may eject forcibly arc gases, solid particles, liquid or other material into the surrounding atmosphere.
- 25-52 Non-Vented Fuse**—A non-vented fuse is a fuse which during circuit interruption does not eject forcibly arc gases, solid particles, liquid or other material into the surrounding atmosphere.

Construction

- 25-53 Current-Responsive Element** — The current-responsive element of a fuse is the conducting section with predetermined characteristics, the melting

and/or severance of which initiates the interruption function of the fuse. (The current-responsive element may consist of the combination of a fusible element and, when used, a strain element.)

- 25-54 Conducting Element**—The conducting element of a fuse is the conducting means, including the current responsive element, for completing the electric circuit between the terminals of the fuse holder.
- 25-55 Arc Extinguishing Medium**—The arc extinguishing medium of a fuse is the material included in the fuse to facilitate current interruption.
- 25-56 Refill Unit**—A refill unit of a fuse is an assembly comprising a conducting element, the complete arc extinguishing medium and parts normally required to be replaced after each circuit interruption to restore the fuse to its original operating condition.
- 25-57 Fuse Link**—A fuse link is a replaceable part or assembly comprised entirely or principally of the conducting element required to be replaced after each circuit interruption to restore the fuse to operating condition.
- 25-58 Fusible Element**—A fusible element is the current-carrying part of a fuse unit designed to sever under stated conditions.
- 25-59 Fuse Tube**—A fuse tube is a tube of insulating material which encloses the conducting element. (20.20.080 Mod.)
- 25-60 Fuse Holder**—A fuse holder is an assembly of a fuse tube or tubes, together with parts necessary to enclose, and provide means of making contact with, the conducting element and the fuse clips. The fuse holder does not include the conducting element. (20.20.090 Mod.)
- 25-61 Fuse Unit**—A fuse unit is an assembly comprising a conducting element mounted in a fuse holder with parts and materials in the fuse holder essential to the operation of the fuse.
- 25-62 Fuse Clips (Fuse Contacts)**—Fuse clips are current-carrying parts of a fuse support which engage the fuse holder. (20.20.100 Mod.)
- 25-63 Fuse Support (Fuse Mounting)**—A fuse support is an assembly of base, insulating means, and fuse clips for mounting a fuse holder and connecting it into the circuit. (20.20.110 Mod.)
- 25-64 Fuse Cutout**—A fuse cutout is an assembly of a fuse support and fuse holder which may or may not include a fuse link or conducting element. (20.20.115 Mod.)
- (a) *Enclosed Fuse Cutout*—An enclosed fuse cutout is a fuse cutout in which the fuse clips and fuse holder are mounted completely within an enclosure. (20.20.120)

(b) *Open Fuse Cutout*—An open fuse cutout is a fuse cutout in which the fuse support and fuse holder or fuse link are exposed. (20.20.125 Mod.)

(c) *Open Link Fuse Cutout*—An open link fuse cutout is a fuse cutout which does not employ a fuse holder and in which the fuse support directly receives an open link fuse link.

(d) *Oil Fuse Cutout*—An oil fuse cutout is an enclosed fuse cutout in which all or a part of the fuse support is mounted in oil with provision for partial or complete immersion of the conducting element. (20.20.130 Mod.)

Modifying Terms

25-67 Liquid-Fuse Unit—A liquid-fuse unit is a fuse unit in which the arc is drawn through a liquid. (20.20.140 Mod.)

25-68 Solid-Material-Fuse Unit—A solid-material-fuse unit is a fuse unit in which the arc is drawn through a hole in solid material.

25-69 Filled-Fuse Unit—A filled-fuse unit is a fuse unit in which the arc is drawn through powdered, granular or fibrous material.

25-70 Expulsion-Fuse Unit—An expulsion-fuse unit is one characterized by expulsion of arc gases during interruption. (20.20.135 Mod.)

25-71 Renewable-Fuse Unit—A renewable-fuse unit is a fuse unit which, after circuit interruption, may be restored for service.

(a) *Field Renewable-Fuse Unit*—A field renewable-fuse unit is a fuse unit which, after circuit interruption may be readily restored for service by the replacement of the fuse link or refill unit.

(b) *Factory Renewable-Fuse Unit*—A factory renewable-fuse unit is a fuse unit which, after circuit interruption, must be returned to the manufacturer to be restored for service.

25-73 Drop-Out Fuse—A drop-out fuse is a fuse in which the fuse holder automatically drops into an open circuit position after the fuse has interrupted the circuit.

25-75 Fuse Disconnecting Switch (or Disconnecting Fuse)—A fuse disconnecting switch is a disconnecting switch in which a fuse unit forms a part of the blade. (20.20.155)

25-76 Indicating Fuse—An indicating fuse is a fuse which automatically indicates that the fuse has interrupted the circuit.

25-77 Reclosing Fuse—A reclosing fuse is a combination of several fuse holders or fuse units mounted on a fuse support or supports, mechanically or electrically interlocked, so that one fuse

can be connected into the circuit at a time and the functioning of that fuse automatically connects the next fuse into the circuit, with or without additional time delay, thereby permitting one or more service restorations without replacement of fuse links, refill units or fuse units.

25-78 Current-Limiting Fuse—A current-limiting fuse is a fuse which, when interrupting a specified circuit, will consistently limit the short-circuit current of that circuit to a magnitude substantially less than that obtainable in the same circuit with the fuse bypassed.

Performance Terms

25-79 Melting Time of a Fuse—The melting time of a fuse is the time required for the current to sever the current responsive element under specified conditions. (20.20.050 Mod.)

25-80 Arcing Time of a Fuse—The arcing time of a fuse is the time elapsing from the severance of the current responsive element to the final interruption of the circuit under specified conditions. (20.20.055 Mod.)

25-81 Clearing Time (Total Interrupting Time) of a Fuse—The clearing time of a fuse is the total time, measured from the beginning of a specified overcurrent condition to interruption of the circuit at maximum design voltage. The clearing time is equal to the sum of the melting time and the arcing time. (20.20.060 Mod.)

25-82 Current-Limiting Characteristic of a Fuse—The current-limiting characteristic of a fuse is expressed by a curve showing the relation between the rms short-circuit current (including the d-c component) available in the circuit and the maximum instantaneous peak current permitted by the fuse during circuit interruption.

25-83 Recovery Voltage—Recovery voltage is the voltage impressed upon a fuse after the current has been interrupted.

(a) *Normal-Frequency Recovery Voltage*—The normal-frequency recovery voltage is the normal-frequency rms voltage impressed upon a fuse after the current has been interrupted and after high-frequency transients have subsided.

(b) *Transient Recovery Voltage*—The transient recovery voltage is the transient voltage impressed upon a fuse immediately after the current has been interrupted or substantially limited.

(c) *Rate of Rise of Transient Recovery Voltage*—The rate of rise of transient recovery voltage is the rate at which the voltage rises across the contacts of a fuse during the transient period, immediately after the current has been interrupted or substantially limited.

Installation

25-84 Mounting Position—The mounting of a fuse is determined by and corresponds to the position of the base of the fuse support, and may be designated as:

- (a) Vertical.
- (b) Horizontal-Upright. (When fuse holder is to be mounted above the supporting insulators.)
- (c) Horizontal-Underhung. (When fuse holder is to be mounted below the supporting insulators.)
- (d) Angle (from vertical).

Rating

25-100 Rating—A rating of a device is a designated limit of operating characteristics based on definite conditions. Ratings of equipment covered by this Standard shall include the items indicated in the following table.

TABLE II

	Fuse Unit	Fuse Link and Refill Unit	Fuse Cutout Fuse Support and Fuse Holder
Rated Voltage	X	X	X
Maximum Design Voltage	X	X	X
Rated Frequency	X	X	X
Rated Continuous Current	X	X	X
Rated Time-Current Values	X	X	
Rated Interrupting Current	X		X
Rated Withstand Voltage			X
Rated Temperature Rise	X		X

25-101 Rated Voltage—The rated voltage of a device is the nominal system voltage on which it is intended to be applied.

25-102 Maximum Design Voltage — The maximum design voltage of a device is the highest rms voltage at which it is designed to operate.

25-103 Rated Frequency—The rated frequency of a device is the frequency of the circuit for which it is designed.

25-104 Rated Continuous Current—The rated continuous current of a device is the designated limit

in rms alternating current or direct current which it can carry continuously without deteriorating or exceeding the limit of permissible temperature rise.

Note: Transient currents having a magnitude and duration which produce temperatures approaching, but not actually reaching, the melting temperature of the fusible element may alter the fuse characteristic. This factor should be recognized in the application of the fuse.

25-105 Rated Time-Current Values—The rated time-current values (usually shown as a curve) of a fuse is the relation between the rms alternating current or direct current and the time for the fuse to perform the whole or some specified part of its interrupting function.

25-106 Basis of Rated Time-Current Values — The time-current characteristic of a fuse is based on the fuse starting cold in an ambient temperature of 25C. Operation at other ambient temperatures or other previous conditions of loading may affect the time-current characteristic. (For practical reasons, tests may be made at any ambient temperature between 20C and 30C inclusive).

25-107 Rated Interrupting Current (Rated Interrupting Capacity)—The rated interrupting current of a fuse is the highest rms current at a specified operating voltage which the fuse is required to interrupt under the operating duty specified and with a normal-frequency recovery voltage not less than the specified operating voltage.

25-109 Rated Withstand Voltage—The rated withstand voltage is the voltage which the device must withstand without flashover or other electric failure when voltage is applied under specified conditions. The standard voltages are:

TABLE III
Indoor Fuses

Rated Voltage kv	Maximum Design Voltage kv	Withstand Voltages	
		Low-Frequency One Minute (Dry) kv	Impulse 1.5 x 40 Full Wave (Pos. and Neg., Dry) kv
2.4	2.75	15	45
4.8	5.5	19	60
7.2	8.25	26	75
13.8	15	36	95
14.4	15.5	50	110
23	25.8	60	150
34.5	38	80	200