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American Standard
for
LIGHTNING ARRESTERS
for
ALTERNATING-CURRENT POWER CIRCUITS

APPROVED

American Standards Association

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FOREWORD

The current issue of this Standard is a revision of the previous issue C62.1—1957 to change many of the definitions, to add a new definition titled "Virtual Duration of Wave Front" which changes the method of measuring time to crest value, to eliminate the word "type" from arrester classification designations as superfluous, to add a 10 kv distribution arrester and 90 kv intermediate and station arresters to the list of standard ratings, to change the standard ratings above 90 kv to multiples of 3, 6, and 12 kv, and to make many editorial changes for purposes of clarification or conciseness.

C62.1—1962, with the exception of Paragraphs 1-2.58, 1-8, 1-8.1 and 1-8.2, has been approved by the National Electrical Manufacturers Association as a NEMA Standard. C62.1—1962 constitutes, by reference only, an integral part of the NEMA Standards Publication for Lightning Arresters, LA 1—1962.

Prior to and during development of this issue of C62.1, close liaison has been maintained with the International Electrotechnical Commission's lightning arrester standardizing activity, with the result that contributions have both been made to the development of International specifications and received for the benefit of this American Standard.

ACKNOWLEDGMENT

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American Standard

for

LIGHTNING ARRESTERS FOR ALTERNATING-CURRENT POWER CIRCUITS

1-1. SCOPE

- 1-1.1 This Standard applies to lightning protective devices designed to limit repeatedly voltage surges on 50 or 60 cycle per second power circuits by passing surge discharge current and subsequently automatically interrupting the flow of follow current. This Standard applies to devices for separate mounting and to those supplied integrally with other equipment.

1-2. DEFINITIONS†

- 1-2.1 **Lightning Arrester** (20.31.015)
A lightning arrester is a protective device for limiting surge voltages on equipment by discharging or bypassing surge current; it prevents continued flow of follow current to ground, and is capable of repeating these functions as specified.
Note: Hereafter, the term *arrester* as used in this Standard shall be understood to mean *lightning arrester*.
- 1-2.2 **Valve Element** (20.31.XXX)**
A valve element of an arrester is a resistor that, because of its non-linear volt-ampere characteristic, limits the voltage across the arrester terminals during the flow of discharge current and contributes to the limitation of follow current at normal power-frequency voltage.
- 1-2.3 **Expulsion Element** (20.31.XXX)**
An expulsion element of an arrester is a chamber in which an arc is confined and brought into contact with gas evolving material.
- 1-2.4 **Series Gap** (20.31.185)**
The series gap(s) of an arrester is an intentional gap(s) between spaced electrodes; it is in series with the valve or expulsion element of the arrester, substantially isolating the element from line or ground or both under normal line voltage conditions.

† *Note:* The three-part number in parenthesis (without asterisk) shown for certain definitions indicates that the definition, exclusive of any note that may accompany it, is identical in language to the corresponding C42 definition. A single asterisk serves to indicate that this term and definition are not identical with the C42 definition which they replace; however this term and definition have been approved for use by ASA Sectional Committee C42 and will be included in the next edition of C42. A double asterisk serves to indicate a revised or new term and definition which have been recommended to ASA Sectional Committee C42 by ASA Sectional Committee C62 acting in its capacity as C42's Subcommittee on Group 20 Section 31 Definitions, and will be included in the next edition of C42.

- 1-2.5 **Valve Arrester** (20.31.025)**
A valve arrester is an arrester that includes a valve element.

- 1-2.6 **Expulsion Arrester** (20.31.020)**
An expulsion arrester is an arrester that includes an expulsion element.

- 1-2.7 **Protector Tube** (20.31.XXX)**
A protector tube is an expulsion arrester used primarily for the protection of line and switch insulation.

- 1-2.8 **Indoor Arrester** (20.31.XXX)**
An indoor arrester is an arrester that, because of its construction, must be protected from the weather.

- 1-2.9 **Outdoor Arrester** (20.31.XXX)**
An outdoor arrester is an arrester that is designed for outdoor use.

- 1-2.10 **Classification of Arresters** (20.31.XXX)**
Arrester classification is determined by prescribed test requirements. These classifications are:

- Station Valve Arrester
- Intermediate Valve Arrester
- Distribution Valve Arrester
- Distribution Expulsion Arrester
- Secondary Valve Arrester
- Protector Tube

Note: See Section 1-4.2 for the test requirements.

- 1-2.11 **Terminals** (20.31.XXX)**
The terminals of an arrester are the conducting parts provided for connecting the arrester across the insulation to be protected.

- 1-2.11.1 **Ground Terminal**—The ground terminal of an arrester is the conducting part provided for connecting the arrester to ground. (20.31.175)**

- 1-2.11.2 **Line Terminal**—The line terminal of an arrester is the conducting part provided for connecting the arrester to the circuit conductor. (20.31.180)**
Note: When a line terminal is not supplied as an integral part of the arrester, and the series gap is obtained by providing a specified air clearance between the line end of the arrester and a conductor, or arcing electrode, etc., the words "line terminal" used in the definition refer to the conducting part which is at line potential and which is used as the line electrode of the series gap.

- 1-2.12 **Grading or Control Ring** (20.31.XXX)**
A grading or control ring of an arrester is a metal part, usually circular or oval in shape, mounted to modify electrostatically the voltage gradient or distribution.
- 1-2.13 **Vent** (20.31.190)**
A vent of an arrester is an intentional opening for the escape of gases to the outside.
- 1-2.14 **Deflector** (20.31.170)**
A deflector of an arrester is a means for directing the flow of the gas discharge from the vent of the arrester.
- 1-2.15 **Discharge Indicator** (20.31.070)**
A discharge indicator of an arrester is a means for indicating that the arrester has discharged.
- 1-2.16 **Discharge Counter** (20.31.065)**
A discharge counter of an arrester is a means for recording the number of arrester discharge operations.
- 1-2.17 **Prorated Section** (20.31.XXX)**
A prorated section of a valve arrester is a complete, suitably housed section including series gap and valve element components in the same proportion as in the complete arrester.
- 1-2.18 **Lightning** (20.31.005)
Lightning is an electric discharge which occurs in the atmosphere between clouds or between clouds and ground.
- 1-2.19 **Lightning Surge** (20.31.010)
A lightning surge is a transient electric disturbance in an electric circuit caused by lightning.
- 1-2.20 **Wave** (35.90.050)*
A wave in an electric circuit is the variation with time of current, potential, or power at any point in the electric circuit.
- 1-2.21 **Surge** (35.90.075)*
A surge in an electric circuit is a transient wave of current, potential, or power.
- 1-2.22 **Impulse** (35.90.100)
An impulse is a surge of unidirectional polarity.
- 1-2.23 **Oscillatory Surge** (35.90.080)
An oscillatory surge is a surge which includes both positive and negative polarity values.
- 1-2.24 **Crest (Peak) Value** (35.90.XXX)*
The crest value of a wave, surge, or impulse is the maximum value which it attains.
- 1-2.25 **Wave Front** (35.90.105)*
The wave front of a surge or impulse is that part which occurs prior to the crest value.
- 1-2.26 **Wave Tail** (35.90.110)*
The wave tail of an impulse is that part between the crest value and the end of the impulse.
- 1-2.27 **Wave Shape (of an impulse test wave)** (35.90.115)*
The wave shape of an impulse test wave is the graph of the wave as a function of time.
- 1-2.27A **Wave Shape Designation of an Impulse** (35.90.XXX)*
(a) The wave shape of an impulse (other than rectangular) of current or voltage is designated by a combination of two numbers. The first, an index of the wave front, is the virtual duration of the wave front in microseconds as defined in 1-2.29. The second, an index of the wave tail is the time in microseconds from virtual zero to the instant at which one-half of the crest value is reached on the wave tail. Examples are 1.5×40 and 8×20 waves.
(b) The wave shape of a rectangular impulse of current or voltage is designated by two numbers, the first designates the minimum value of current or voltage which is sustained for the time in microseconds designated by the second number. An example is the $75A \times 1000$ wave.
- 1-2.28 **Virtual Zero Point (of an impulse in a conductor) (Virtual Time Zero)** (35.90.107)
The virtual zero point of an impulse in a conductor is the intersection with the zero axis of a straight line drawn through points on the front of the current wave at 10 percent and 90 percent crest value, or through points on the front of the voltage wave at 30 percent and 90 percent crest value.
- 1-2.29 **Virtual Duration of Wave Front (of an impulse)** (35.90.XXX)*
The virtual value for the duration of the wave front is as follows:
(a) For full voltage waves and voltage waves chopped on the front, crest or tail, 1.67 times the time taken by the voltage to increase from 30 percent to 90 percent of its crest value.
(b) For current waves, 1.25 times the time taken by the current to increase from 10 percent to 90 percent of its crest value.
- 1-2.30 **Nominal Rate of Rise (of an impulse)** (35.90.XXX)*
The nominal rate of rise of a wave front is defined by the slope of the line that determines the virtual zero. It is usually expressed in volts or amperes per microsecond.

- 1-2.31 Disruptive Discharge** (35.90.005)
Disruptive discharge is the sudden and large increase in current through an insulating medium due to the complete failure of the medium under the electrostatic stress.
- 1-2.32 Flashover** (35.90.010)
A flashover is a disruptive discharge around or over the surface of a solid or liquid insulator.
- 1-2.33 Sparkover** (35.90.015)*
A sparkover is a disruptive discharge between electrodes of a measuring gap, voltage control gap, or protective device.
- 1-2.34 Time to Impulse Sparkover** (35.90.155)*
The time to impulse sparkover is defined as the time between virtual zero of the voltage impulse causing sparkover and the point on the voltage wave at which sparkover occurs.
- 1-2.35 Impulse Sparkover Volt-Time Characteristic** (20.31.XXX)**
The impulse sparkover volt-time characteristic of a device is the sparkover response of the device to impulses of a designated wave shape and polarity, but of varying magnitudes.
Note: This characteristic for an arrester is shown by a graph of values of crest voltage plotted against time-to-sparkover.
- 1-2.36 Power-Frequency Withstand Voltage** (35.90.XXX)*
The power-frequency withstand voltage is a specified rms test voltage which will not cause a disruptive discharge.
- 1-2.37 Impulse Withstand Voltage** (35.90.117)*
An impulse withstand voltage is the crest value of an impulse that, under specified conditions, can be applied without causing a disruptive discharge.
- 1-2.38 Basic Impulse Insulation Level (BIL)** (20.16.320)*
A basic impulse insulation level is a reference impulse insulation strength expressed in terms of the crest value of withstand voltage of a standard full impulse voltage wave.
Note: See latest revision of American Standard C92 for standard wave shape.
- 1-2.39 System (Circuit) Voltage** (35.20.XXX)*
System voltage is the rms power-frequency voltage from line to line as distinguished from the voltage from line to neutral.
- 1-2.40 Nominal System Voltage** (20.06.125)
The nominal system voltage is a nominal value assigned to designate a system of a given voltage class.
Note: See "Preferred Voltage Ratings for A-C Systems and Equipment," ASA C84.1—1954, or latest revision.
- 1-2.41 Maximum (Highest) System Voltage** (35.20.XXX)*
The maximum system voltage is the highest voltage at which a system is operated.
Note: This is generally considered to be the maximum tolerable system voltage as prescribed in "Preferred Voltage Ratings for A-C Systems and Equipment," ASA C84.1—1954, or latest revision.
- 1-2.42 Fault Current** (35.40.210)*
A fault current is the current from the connected power system which flows in a short circuit.
- 1-2.43 Recovery Voltage** (20.06.085)
Recovery voltage is the voltage which occurs across the terminals of a pole of a circuit interrupting device upon the interruption of the current.
Note: For an arrester, this occurs as a result of interruption of the follow current.
- 1-2.44 Grounded System** (35.15.075)
A grounded system is an electric system in which at least one conductor or point (usually the neutral conductor or neutral point of transformer or generator windings) is intentionally grounded, either solidly or through a grounding device.
- 1-2.44.1 Effectively Grounded Neutral System**
An effectively grounded neutral system is one in which, during a phase-to-ground fault, the highest rms voltage to ground of the sound phase or phases, expressed as a percentage of the highest phase-to-phase voltage, does not exceed 80 percent irrespective of the fault location.
Note: A value not exceeding 80 percent is obtained approximately when for all system conditions the ratio of zero sequence reactance to positive sequence reactance is positive and less than three, and the ratio of zero sequence resistance to positive sequence reactance is positive and less than one.
- 1-2.45 Rating** (20.31.XXX)**
A rating of a device is the designation of an operating limit.
- 1-2.46 Voltage Rating** (20.31.125)**
The voltage rating of an arrester is the designated maximum permissible operating voltage between its terminals at which it is designated to perform its duty cycle. It is the voltage rating specified on the nameplate.
- 1-2.47 Power-Frequency Current Interrupting Rating of an Expulsion Arrester** (20.31.120)**
The power-frequency current interrupting rating of an expulsion arrester is a designation of the range of the symmetrical rms fault currents