

American Standard
for
LIGHTNING ARRESTERS
for
ALTERNATING - CURRENT POWER CIRCUITS

APPROVED

American Standards Association

January 24, 1957



IEEE STANDARDS
ARCHIVES
DO NOT REMOVE

SPONSOR

American Institute of Electrical Engineers

Published by

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

33 West Thirty-ninth Street, New York

C62.1 (AIEE No. 28)

✓
621.3
A00325
no.28

FOREWORD

The basic material for this Standard is derived from AIEE Report No. 28B of March 1956, titled "Revised Report on Standards for Valve and Expulsion Type Lightning Arresters," and from NEMA Publication No. LA1-2-3-4-5 dated March 1952, titled "Standards for Lightning Arresters" including its revisions through March 1953.

Certain new and revised material has been added for purposes of clarification or consistency, and attention is called to the substitution of the term "Intermediate Type Arrester" for its predecessor term "Line Type Arrester."

ACKNOWLEDGMENT

The American Standards Association and the American Institute of Electrical Engineers wish to acknowledge their indebtedness to the members of ASA Sectional Committee C62, who have so freely given of their time and knowledge in compiling this Standard. The membership of this Committee is as follows:

H. R. Stewart, <i>Chairman</i>	G. K. Ditlow	L. S. Inskip
H. R. Armstrong	T. I. Eldridge	J. W. Kalb
E. Beck	R. W. Ferguson	G. F. Lincks
F. M. Defandorf	W. F. Griffard (alt.)	W. S. Price
E. F. DeTurk	A. T. Higgins (alt.)	H. O. Stoelting
		L. B. Yarbrough

Others who participated in the work for a portion of the time are:

W. H. Eason	E. L. Harder
I. W. Gross	J. R. North
T. R. Halman	

INDEX

	PAGE
1. Scope	5
2. Definitions	5
3. Service Conditions	8
4. Voltage Ratings	8
5. Performance Characteristics and Tests	8
6. Test Procedures	9
7. Design Tests	9
7.1 Voltage Withstand Tests of Arrester Insulation	9
7.2 Power-Frequency Sparkover and Withstand Tests of Complete Arresters	9
7.3 Impulse Voltage Characteristic Tests	10
7.3.1 Impulse Sparkover Characteristics	10
7.3.2 Discharge Voltage Characteristics	10
7.4 Discharge Current Withstand Tests	11
7.4.1 High Current Short Duration Tests	11
7.4.2 Low Current Long Duration Tests	11
7.5 Duty Cycle Tests	11
7.5.1 Duty Cycle Tests on Valve-Type Arresters	11
7.5.2 Duty Cycle Tests on Expulsion-Type Arresters including Protector Tubes	12
7.6 Radio Influence Tests	14
8. Acceptance Tests	14
9. Construction	14
10. Protective Characteristics	15
TABLE I Insulation Withstand Test Voltages	16

American Standard

for

LIGHTNING ARRESTERS FOR ALTERNATING-CURRENT POWER CIRCUITS

1. SCOPE

1.1 These standards apply 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.

2. DEFINITIONS¹

- 2.1 **Lightning Arrester.** A lightning arrester is a protective device for limiting surge voltages on equipment by discharging surge current. It prevents continued flow of follow current and is capable of repeating these functions. Hereafter the term *arrester* as used in these standards shall be understood to mean *lightning arrester*.
- 2.2 **Characteristic Element.** The characteristic element of an arrester is that element which, in a valve arrester, determines the discharge voltage and the follow current, and in an expulsion arrester, determines the discharge voltage and interrupts the follow current.
- 2.3 **Series Gap.** The series gap (or gaps) of an arrester is an intentional external or internal gap between spaced electrodes and is in series with the characteristic element of the arrester.
- 2.4 **Valve-Type Arrester.** A valve-type arrester is an arrester having a characteristic element consisting of a resistor with a non-linear volt-

ampere characteristic which limits the follow current to a value the series gap can interrupt. If the arrester has no series gap the characteristic element limits the follow current to a magnitude which does not interfere with the operation of the system.

- 2.5 **Expulsion-Type Arrester.** An expulsion-type arrester is an arrester having a characteristic element in which the arc is confined and brought in contact with gas evolving or other arc extinguishing material in a manner which enables it to interrupt follow current. The term, *expulsion arrester* includes any external series gap designed to serve as part of the complete device as installed for service.
- 2.6 **Protector Tube.** A protector tube is an expulsion arrester used primarily for the protection of line and switch insulation.
- 2.7 **Indoor Arrester.** An indoor arrester is an arrester which, because of its construction, must be protected from the weather.
- 2.8 **Outdoor Arrester.** An outdoor arrester is an arrester which is designed for outdoor use.
- 2.9 **Type Classification of Arresters.** Arresters are classified as follows:

Station-Type Valve Arresters

Intermediate-Type Valve Arresters (Recommended to replace the term *Line-Type Arrester*)

Distribution-Type Valve Arresters

Distribution-Type Expulsion Arresters

Secondary-Type Valve Arresters

Protector Tubes (Recommended to replace the term *Line-Expulsion Arresters*)

¹ Either American Standard Definitions of Electrical Terms, ASA C42-1941 or more recent definitions that will probably be adopted are used throughout in this standard.

They shall meet the test requirements listed below:

<i>Arrester Type</i>	<i>Standard Ratings, kv</i>	<i>Duty Cycle Test</i>	<i>Discharge Current Withstand Tests</i>	<i>Insulation Withstand Tests</i>
Station-Type Valve	3 thru 242	Sec. 7.5.1	Secs. 7.4.1 and 7.4.2	Sec. 7.1
Intermediate Type Valve	3 thru 121	Sec. 7.5.1	Secs. 7.4.1 and 7.4.2	Sec. 7.1
Distribution-Type Valve	1 thru 18	Sec. 7.5.1	Secs. 7.4.1 and 7.4.2	Sec. 7.1
Distribution-Type Expulsion	3 thru 18	Sec. 7.5.2	Sec. 7.4.1	Sec. 7.1
Secondary-Type Valve	0.175 and 0.650	Sec. 7.5.1	Sec. 7.4.1	Sec. 7.1
Protector Tubes	13.8 to 138	Sec. 7.5.2	Sec. 7.4.1	Table 1, note (b)

- 2.10 Terminals.** The line and ground terminals of an arrester are the conducting parts provided for connecting the arrester in parallel with the insulation to be protected. When the series gap is not an integral part of the arrester, the line terminal is the line electrode of the prescribed series gap.
- 2.11 Shield or Grading Ring.** A shield or grading ring is a metallic element which is used across gaps, insulators, or arresters to modify the voltage gradient or distribution electrostatically.
- 2.12 Vent.** A vent of an arrester is an opening through which the gases may escape to the outside.
- 2.13 Deflector.** A deflector of an arrester is a vent fitting for diverting the flow of gas discharged from an arrester.
- 2.14 Arcing Horn of an Arrester.** An arcing horn of an arrester is a metallic bar or rod which is connected to the arrester in such a way as to form an electrode of a series gap, such as is used in protector tubes
- 2.15 Discharge Indicator.** A discharge indicator of an arrester is an attachable accessory for the purpose of indicating that the arrester has discharged.
- 2.16 Discharge Counter.** A discharge counter of an arrester is an attachable accessory for the purpose of recording the number of discharge operations.
- 2.17 Prorated Section of an Arrester.** A prorated section of a valve-type arrester is a complete, suitably housed section including series gaps and characteristic elements in the same proportion as in the complete arrester.
- 2.18 Lightning.** Lightning is an electric discharge which occurs in the atmosphere between clouds or between clouds and ground.
- 2.19 Lightning Surge.** A lightning surge is a transient electric disturbance in an electric circuit caused by lightning.
- 2.20 Wave.** A wave in an electric circuit is the variation as a function of time of current or potential at a point in the electric circuit.
- 2.21 Surge.** A surge in an electric circuit is a transient variation in the current or potential at a point in the circuit.
- 2.22 Impulse.** An impulse is a surge of unidirectional polarity.
- 2.23 Oscillatory Surge.** An oscillatory surge is a surge which includes both positive and negative polarity values.
- 2.24 Crest Value.** The crest value of a wave is the maximum value which it attains.
- 2.25 Wave Front.** The wave front of a surge or impulse is that part which occurs prior to the crest value.
- 2.26 Wave Tail.** The wave tail of an impulse is that part between the crest value and the end of the impulse.
- 2.27 Wave Shape.** The wave shape of an impulse is the variation of voltage or current with time. For test purposes it is expressed as a combination of two numbers. The first, an index of the wave front, is the time in microseconds from virtual zero to the instant at which the crest value is reached. 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 10×20 waves.
- 2.28 Virtual Zero.** Virtual zero for a surge or impulse is determined by the intersection with the zero axis of a straight line drawn through two points on the front of the wave as follows:
- (a) For voltage waves the two points shall be 30 percent and 90 percent of the crest value.
 - (b) For current waves the two points shall be 10 percent and 90 percent of the crest value.
- 2.29 Nominal Rate of Rise.** The nominal rate of rise of a wave front is the slope of the line that determines the virtual zero. It is usually expressed in volts or amperes per microsecond
- 2.30 Time to Impulse Sparkover.** The time to impulse sparkover is the time between virtual zero of the voltage impulse causing sparkover and the point on the voltage wave at which sparkover occurs.
- 2.31 Impulse Sparkover Volt-Time Characteristic.** The impulse sparkover volt-time characteristic of a device is a graph plotted between impulse sparkover voltage and time to impulse sparkover obtained by varying the crest value of voltage impulses of specified wave shape and polarity.
- 2.32 Disruptive Discharge.** A disruptive discharge is the sudden and large increase in current through an insulative medium resulting from the complete failure of the medium under the electrostatic stress.
- 2.33 Flashover.** A flashover is a disruptive discharge around or over the surface of a solid or liquid insulator.
- 2.34 Sparkover.** A sparkover is a disruptive discharge between electrodes of a measuring gap, voltage control gap, or protective device.