

JIS

JAPANESE INDUSTRIAL STANDARD

Lightning arresters for 6.6 kV
cubicle type unit substation

JIS C 4608—1991

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

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1. Scope

This Japanese Industrial Standard specifies the high voltage lightning arrester, hereinafter referred to as the "lightning arresters", of nominal discharge current 2500 A or 5000 A to be used for the cubicle type high voltage unit substation of rated frequency 50 Hz and 60 Hz and nominal voltage 6.6 kV specified in JIS C 4620.

Remarks 1. Applicable Standards are as follows:

JIS C 3801-Testing Method for Insulators

JIS C 4620-Cubicle Type High Voltage Power Receiving Units

JIS Z 8703-Standard Atmospheric Conditions for Testing

2. The units and numerical values given in { } in this Standard are based on the traditional units and are appended for informative reference.

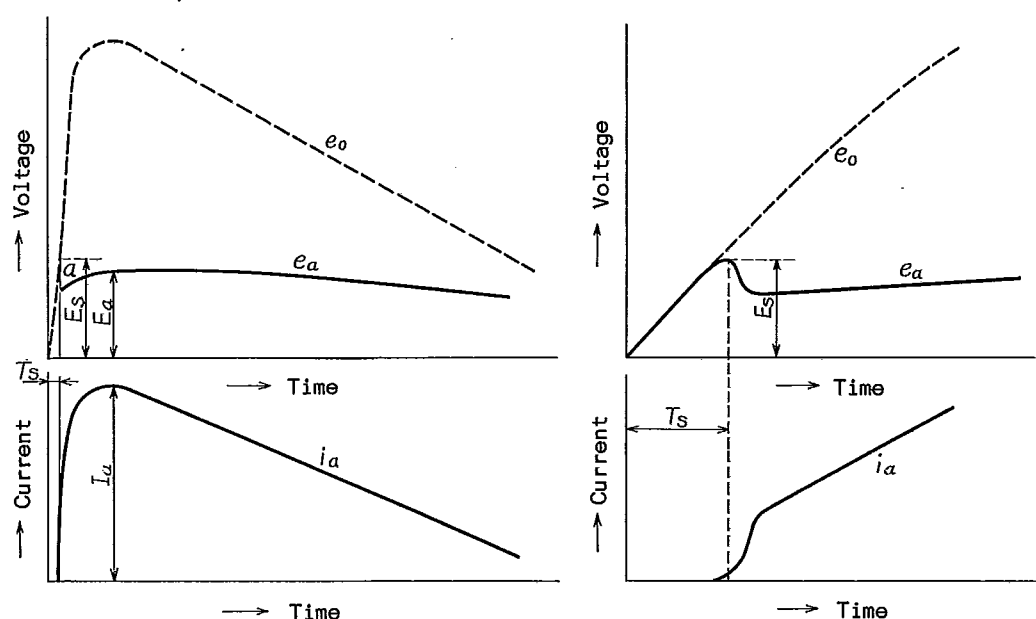
2. Definition

For the purpose of this standard, the following definitions apply:

- (1) lightning arrester A device designed to protect the insulation of electrical equipment by limiting the over-voltage by means of shunting the current due to impulse over-voltage resulted from lightning, switching of a circuit, etc., to the earth, as well as to have a self-restoring function to original condition without disturbing the regular condition of the circuit, by breaking the follow current in a short time.
- (2) characteristic element A component of a lightning arrester which, at discharge, limits the terminal voltage by allowing the flow of large current, utilizing the non-linearity of its non-linear voltage-current characteristic, and after the discharge, arrests the follow current substantially or functions to limit the current to a degree capable of being broken with the series gap.
- (3) series gap Series gap means a component of an arrester consisting of either single or several gaps in series being connected in series with the characteristic element, which normally opens the lightning arrester circuit substantially, closes the circuit by sparkover when an over-voltage is applied, and after completion of the discharge phenomenon, functions to break the follow current which is limited by the characteristic element.
- (4) rated voltage The highest limit of the effective value of power-frequency sine-wave voltage of the rated frequency applied across the terminals, at which the arrester is capable of repeatedly executing prescribed unit operating duty for prescribed number of times.

- (5) rated frequency The frequency of the electric circuit in which the lightning arrester is used.
- (6) discharge The action of a lightning arrester that limits the over-voltage by passing an impulse current which accompanies an impulse over-voltage applied between the both terminals.
- (7) discharge current The impulse current that flows through a lightning arrester during discharge, and normally that is indicated by the peak value (I_a and i_a of Fig. 1).
- (8) nominal discharge current A prescribed value of discharge current to be used for expressing the protecting and recovery performances, and this is expressed in the peak value of an impulse current of prescribed waveshape. Classification according to uses of lightning arrester are normally established on the basis of this value.
- (9) follow current The current that flows through the lightning arrester being supplied from a power-frequency supply circuit successively after the discharge phenomenon has substantially finished.
- (10) power-frequency sparkover voltage The lowest effective value of power-frequency sine wave voltage applied between the both terminals under which a current initiates to flow through the lightning arrester substantially, due to a spark discharge which takes place adjacent to the peak value.
- (11) impulse sparkover voltage The highest instantaneous value of terminal voltage which can be attained prior to initiation of terminal voltage drop due to sufficient formation of discharge current, at the first stage of the lightning arrester discharge by the application of impulse voltage across the terminal (E_s of Fig. 1 and Fig. 2).
- (12) 100 % impulse sparkover voltage The lowest limit of peak value of a certain polarity and certain waveshape impulse voltage which causes discharge every time when application is repeated many times.

Fig. 1. Examples of terminal voltage and discharge current in the case of lightning arrester discharge



(a)

(b) Extended scale of time

E_s ... impulse sparkover voltage

i_a ... discharge current

e_a (after point a) ... limit voltage

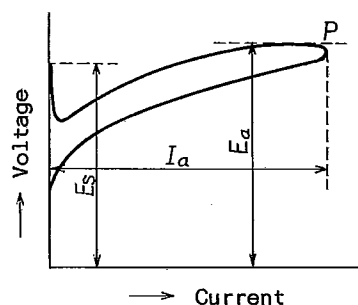
I_a ... discharge current peak value

E_a ... limit voltage peak value

T_s ... time to impulse sparkover

e_0 ... original voltage (terminal voltage if the lightning arrester does not discharge)

Fig. 2. Sparkover voltage and limit voltage



E_s ... impulse sparkover voltage

E_a ... limit voltage peak value

I_a ... discharge current peak value

P ... limit voltage (a point on the current curve)

- (13) time to impulse sparkover A time from the virtual origin of applied impulse voltage to the time corresponding to the impulse sparkover voltage (T_s of Fig. 1).
- (14) impulse sparkover voltage-time characteristic ($V-t$ characteristic) and impulse sparkover voltage - time curve ($V-t$ curve) The impulse sparkover voltage - time characteristic ($V-t$ characteristic) means the relationship between the sparkover voltage and the time to sparkover, when a lightning arrester is discharged by applying various impulse voltages of a certain polarity and waveshape with different peak values, and the diagram indicating such relationship is called as the impulse sparkover voltage-time curve ($V-t$ curve).
- (15) limit voltage The impulse voltage which remains across both terminals, when the over-voltage is limited during discharge of a lightning arrester, and which is determined by the peak value and waveshape of the discharge current. Normally this voltage is expressed in the peak value (e_a and E_a of Figs. 1 and 2).
- (16) discharge capacity The largest limit of discharge current peak value of prescribed waveshape which is capable of flowing a prescribed number of times without causing any substantial trouble on the lightning arrester.
- (17) unit operating duty A series of operation that the lightning arrester connected with a source of prescribed frequency and voltage is subjected to a impulse voltage, passes a prescribed discharge current, arrests or breaks the follow current, and returns to the original conditions.
- (18) operating duty test A test to be carried out by simulating the operational conditions in actual system, for the purpose of verifying that the lightning arrester is capable of repeatedly executing a prescribed number of times of a prescribed unit operating duty.
- (19) over-voltage A voltage which appears between respective parts of the power line and installation each other or between the respective parts and the earth, which is considerably higher than the normal value and which is likely to impair the insulation of each part.
- (20) impulse voltage A voltage that appears transiently for a short period. In this standard, only the voltage with single polarity without over-lapping of remarkable oscillatory wave specified, and the impulse voltage is determined by the three parameters of (a) polarity, (b) waveshape and (c) peak value (see Fig. 3).
- (21) impulse current A current that appears transiently for a short time. In this standard, only the current with single polarity without over-lapping of remarkable oscillatory wave is specified, and the impulse current is determined by three parameters of (a) polarity, (b) waveshape and (c) peak value (see Fig. 4).