IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems

IEEE Power & Energy Society

Sponsored by the
Surge Protective Devices Committee

IEEE
3 Park Avenue
New York, NY 10016-5997, USA

3 July 2009

IEEE Std C62.22™-2009
(Revision of
IEEE Std C62.22-1997)

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Approved 19 March 2009

IEEE-SA Standards Board

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Abstract: This guide covers the application of metal-oxide surge arresters to safeguard electric power equipment, with a nominal operating voltage 1000 V and above, against the hazards of abnormally high-voltage surges of various origins. This guide provides information on the characteristics of metal-oxide surge arresters and the protection of substation equipment, distribution systems, overhead lines, and large electrical machines.

Keywords: distribution lines, insulation coordination, lightning, metal-oxide surge arrester, overvoltage, substations, surge arrester, switching surges, transmission lines

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

PDF: ISBN 978-0-7381-5935-5 STD95922
Print: ISBN 978-0-7381-5936-2 STDPD95922

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Introduction

This introduction is not part of IEEE Std C62.22-2009, IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems.

Abnormally high voltages can occur on power systems from a variety of origins, including lightning and switching. These overvoltages can cause insulation breakdown, resulting in equipment failure and interrupting the continuity of electric supply to users. Proper coordination of surge-protective devices with the insulation strength of the protected equipment is essential to protect the reliability of power systems and equipment. Metal-oxide surge arresters are the predominately used overvoltage protective device on ac power systems.

The application of surge protection devices and their coordination with equipment insulation strengths is a broad and complex subject for which the industry has accumulated a large body of knowledge, experience, and practices. This document provides a concise guide to the application of metal-oxide surge arresters to protect power systems and equipment operating at a nominal voltage of 1000 V and greater. This application guide does not cover the application of low-voltage surge protective devices below 1000 V alternating current (ac). However, it references these devices when applied to the secondary of a transformer because they are part of the transformer protection.

Step-by-step directions toward proper solutions for various applications are provided. In many cases, the prescribed steps are adequate. More complex and special situations requiring study by experienced engineers are described, but specific solutions may not be given. These procedures are based on theoretical studies, test results, and experience.

The clauses of this guide cover the various categories of electric power systems and equipment.

- Clause 4 provides fundamental information on overvoltages, metal-oxide surge arrester characteristics, and equipment insulation.
- Clause 5 covers the application of surge arresters to stations and substations.
- Clause 6 covers application of surge arresters for protection of overhead and underground distribution system equipment, including all distribution transformers, and other electric distribution equipment.
- Clause 7 covers the protection of overhead transmission and distribution line insulation, which is an application unique from station equipment and underground protection because the overhead line insulation is self-restoring.
- Clause 8 covers the protection of large electrical machines, including generators and motors, rated 1000 V and above.

This guide is a revision of IEEE Std C62.22™-1997.[a] Substantial reorganization of the guide has been made to help users focus on their areas of interest. Major additions to this revision include substantially increased information on the characteristics of surge arresters and surge arrester energy discharge considerations. Extensive overhead line protection guidelines have been added.

[a] Information on references can be found in Clause 2.

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1. Scope

This guide covers the application of metal-oxide surge arresters (see IEEE Std C62.11™-2005) to safeguard electric power equipment against the hazards of abnormally high voltage surges of various origins. This application guide does not cover the application of low-voltage surge protective devices below 1000 V alternating current (ac), except when applied to the secondary of a transformer.

2. Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

ANSI/IEEE Std C37.06™-2000 American National Standard AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Preferred Ratings and Related Required Capabilities.[1]

ANSI C84.1-2006, Electric Power Systems and Equipment – Voltage Ratings (60 Hz).

IEC 60034-15:1995, Rotating Electrical Machines, Part 15: Impulse Voltage Withstand Levels of Rotating A.C. Machines with Form-Wound Stator Coils.[2]

IEC 60071-2-1997, Insulation Coordination—Part 2: Application Guide.

[1] ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org/).

[2] IEC publications are available from the sales department of the International Electrotechnical Commission, Case Postale 131, 3, rue Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iec.ch). IEC publications are also available in the USA from Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.