



INTERNATIONAL STANDARD



**Surge arresters –
Part 8: Metal-oxide surge arresters with external series gap (EGLA) for overhead
transmission and distribution lines of a.c. systems above 1 kV**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.240.10

ISBN 978-2-8322-4987-1

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

| | |
|---|----|
| FOREWORD | 6 |
| INTRODUCTION | 8 |
| 1 Scope | 9 |
| 2 Normative references | 9 |
| 3 Terms and definitions | 10 |
| 4 Identification and classification | 13 |
| 4.1 EGLA identification | 13 |
| 4.2 EGLA classification | 13 |
| 5 Standard ratings and service conditions | 14 |
| 5.1 Standard rated voltages | 14 |
| 5.2 Standard rated frequencies | 14 |
| 5.3 Standard nominal discharge currents | 14 |
| 5.4 Service conditions | 14 |
| 5.4.1 Normal service conditions | 14 |
| 5.4.2 Special service conditions | 14 |
| 6 Requirements | 15 |
| 6.1 Insulation withstand of the SVU and the complete EGLA | 15 |
| 6.1.1 Insulation withstand of the housing of the SVU | 15 |
| 6.1.2 Insulation withstand of EGLA with shorted (failed) SVU | 15 |
| 6.2 Residual voltages | 15 |
| 6.3 High current duty | 15 |
| 6.4 Lightning discharge capability | 15 |
| 6.5 Short-circuit performance of the SVU | 15 |
| 6.6 Mechanical performance | 16 |
| 6.7 Weather aging of SVU | 16 |
| 6.8 Reference voltage of the SVU | 16 |
| 6.9 Internal partial discharges | 16 |
| 6.10 Coordination between insulator withstand and EGLA protective level | 16 |
| 6.11 Follow current interrupting | 17 |
| 6.12 Electromagnetic compatibility | 17 |
| 6.13 End of life | 17 |
| 7 General testing procedure | 17 |
| 7.1 Measuring equipment and uncertainty | 17 |
| 7.2 Test samples | 17 |
| 8 Type tests | 18 |
| 8.1 General | 18 |
| 8.2 Insulation withstand tests on the SVU housing and on the EGLA with failed SVU | 18 |
| 8.2.1 General | 18 |
| 8.2.2 Insulation withstand test on the SVU housing | 19 |
| 8.2.3 Insulation withstand tests on EGLA with failed SVU | 19 |
| 8.3 Residual voltage tests | 20 |
| 8.3.1 General | 20 |
| 8.3.2 Procedure for correction and calculation of inductive voltages | 20 |
| 8.3.3 Lightning current impulse residual voltage test | 21 |

| | | |
|--------|--|----|
| 8.3.4 | High current impulse residual voltage test | 22 |
| 8.4 | Standard lightning impulse sparkover test | 22 |
| 8.5 | High current impulse withstand test..... | 23 |
| 8.5.1 | Selection of test samples | 23 |
| 8.5.2 | Test procedure | 23 |
| 8.5.3 | Test evaluation | 24 |
| 8.6 | Test to verify the repetitive charge transfer rating, Q_{RS} with lightning discharges | 24 |
| 8.6.1 | MO resistors | 24 |
| 8.6.2 | Series gap | 26 |
| 8.7 | Short-circuit tests..... | 27 |
| 8.7.1 | General | 27 |
| 8.7.2 | Preparation of the test samples | 28 |
| 8.7.3 | Mounting of the test sample..... | 29 |
| 8.7.4 | High-current short-circuit tests..... | 30 |
| 8.7.5 | Low-current short-circuit test | 32 |
| 8.7.6 | Evaluation of test results | 32 |
| 8.8 | Follow current interrupting test..... | 38 |
| 8.8.1 | General | 38 |
| 8.8.2 | "Test method A"..... | 38 |
| 8.8.3 | "Test method B"..... | 40 |
| 8.9 | Mechanical load tests on the SVU..... | 42 |
| 8.9.1 | General | 42 |
| 8.9.2 | Bending test | 42 |
| 8.9.3 | Vibration test | 51 |
| 8.10 | Weather aging tests | 52 |
| 8.10.1 | General | 52 |
| 8.10.2 | Sample preparation | 52 |
| 8.10.3 | Test procedure | 52 |
| 8.10.4 | Test evaluation | 52 |
| 8.10.5 | Additional test procedure for polymer (composite and cast resin) housed SVUs..... | 53 |
| 8.11 | Radio interference voltage (RIV) test | 53 |
| 9 | Routine tests | 53 |
| 9.1 | General..... | 53 |
| 10 | Acceptance tests | 54 |
| 10.1 | General..... | 54 |
| 10.2 | Reference voltage measurement of SVU..... | 54 |
| 10.3 | Internal partial discharge test of SVU..... | 55 |
| 10.4 | Radio interference voltage (RIV) test | 55 |
| 10.5 | Test for coordination between insulator withstand and EGLA protective level..... | 55 |
| 10.5.1 | General | 55 |
| 10.5.2 | Steep front impulse test..... | 55 |
| 10.5.3 | Standard lightning impulse sparkover test..... | 56 |
| 10.6 | Follow current interrupting test..... | 56 |
| 10.6.1 | General | 56 |
| 10.6.2 | Test procedure | 57 |
| 10.6.3 | Test sequence | 57 |
| 10.6.4 | Test evaluation | 57 |

| | | |
|-----------------------|--|----|
| 10.7 | Vibration test on the SVU with attached electrode | 57 |
| 10.7.1 | General | 57 |
| 10.7.2 | Sample preparation | 57 |
| 10.7.3 | Test procedure and test condition | 57 |
| 10.7.4 | Test evaluation | 58 |
| Annex A (informative) | Example of a test circuit for the follow current interrupting test | 59 |
| Annex B (normative) | Mechanical considerations | 60 |
| B.1 | Test of bending moment..... | 60 |
| B.2 | Definition of mechanical loads | 61 |
| B.3 | Definition of seal leak rate | 62 |
| B.4 | Calculation of wind-bending-moment..... | 63 |
| B.5 | Flow chart – Procedures of tests of bending moment for porcelain/cast resin and polymer-housed SVUs..... | 64 |
| Annex C (normative) | Special service conditions | 65 |
| C.1 | General..... | 65 |
| C.2 | Temperature in excess of +40 °C or below –40 °C | 65 |
| C.3 | Application at altitudes higher than 1 000 m..... | 65 |
| C.4 | Fumes or vapours that may cause deterioration of insulating surface or mounting hardware | 65 |
| C.5 | Excessive contamination by smoke, dirt, salt spray or other conducting materials..... | 65 |
| C.6 | Excessive exposure to moisture, humidity, dripping water, or steam | 65 |
| C.7 | Live washing of arrester..... | 65 |
| C.8 | Unusual transportation or storage | 65 |
| C.9 | Non-vertical erection and suspended erection..... | 66 |
| C.10 | Wind speed > 34 m/s | 66 |
| C.11 | Earthquake | 66 |
| C.12 | Torsional loading of the arrester | 66 |
| Bibliography | | 67 |
| Figure 1 | – Configuration of an EGLA with insulator and arcing horn..... | 8 |
| Figure 2 | – Test procedure to verify the repetitive charge transfer rating, Q_{RS} | 25 |
| Figure 3 | – Test procedure to verify the repetitive charge withstand of the series gap | 27 |
| Figure 4 | – Examples of SVU units..... | 36 |
| Figure 5 | – Short-circuit test setup | 37 |
| Figure 6 | – Example of a test circuit for re-applying pre-failing circuit immediately before applying the short-circuit test current | 38 |
| Figure 7 | – Thermo-mechanical test..... | 46 |
| Figure 8 | – Example of the test arrangement for the thermo-mechanical test and direction of the cantilever load | 47 |
| Figure 9 | – Test sequence of the water immersion test | 48 |
| Figure A.1 | – Example of a test circuit for the follow current interrupting test | 59 |
| Figure B.1 | – Bending moment – Multi-unit SVU..... | 60 |
| Figure B.2 | – Definition of mechanical loads | 61 |
| Figure B.3 | – SVU unit | 62 |
| Figure B.4 | – SVU dimensions | 63 |

| | |
|---|----|
| Figure B.5 – Procedures of tests of bending moment for porcelain/cast resin and polymer-housed SVUs | 64 |
| Table 1 – EGLA classification – “Series X” and “Series Y” | 13 |
| Table 2 – Steps of rated voltages (r.m.s. values) | 14 |
| Table 3 – Type tests (all tests to be performed with or without insulator assembly; by manufacturer's decision) | 18 |
| Table 4 – Test requirements | 34 |
| Table 5 – Required currents for short-circuit tests | 35 |
| Table 6 – Acceptance tests | 54 |
| Table 7 – Virtual steepness of wave front of steep front impulses | 55 |

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SURGE ARRESTERS –

Part 8: Metal-oxide surge arresters with external series gap (EGLA) for overhead transmission and distribution lines of a.c. systems above 1 kV

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60099-8 has been prepared by IEC technical committee 37: Surge arresters.

This second edition cancels and replaces the first edition published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) The Lightning discharge capability test has been completely re-written and re-named to Test to verify the repetitive charge transfer rating, Qrs with lightning discharges to reflect changes introduced in IEC 60099-4 Ed. 3 (2014) regarding new methods for rating the energy and charge handling capability of metal-oxide arresters. In addition to testing to

evaluate the performance of the MO resistors, procedures for evaluating the performance of the EGLA series gaps have been introduced.

- b) Omissions from Ed. 1 of this standard have been included, notably an RIV test and a means for determining the thermal time constant of the SUV portion of the EGLA.
- c) Definitions for new terms have been added
- d) A number of NOTES in Ed. 1 have been converted to normative requirements

A number of editorial changes have been made throughout the document to improve grammar and general flow of information.

The text of this International Standard is based on the following documents:

| FDIS | Report on voting |
|-------------|------------------|
| 37/436/FDIS | 37/438/RVD |

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 60098 series, under the general title *Surge arresters*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 60099 applies to the externally gapped line arrester (EGLA)

This type of surge arrester is connected directly in parallel with an insulator assembly. It comprises a series varistor unit (SVU), made up from non-linear metal-oxide resistors encapsulated in a polymer or porcelain housing, and an external series gap (see Figure 1).

The purpose of an EGLA is to protect the parallel-connected insulator assembly from lightning-caused over-voltages. The external series gap, therefore, should spark over only due to fast-front over-voltages. The gap should withstand all power-frequency and slow-front over-voltages occurring on the system.

In the event of SVU failure, the external series gap should be able to isolate the SVU from the system.

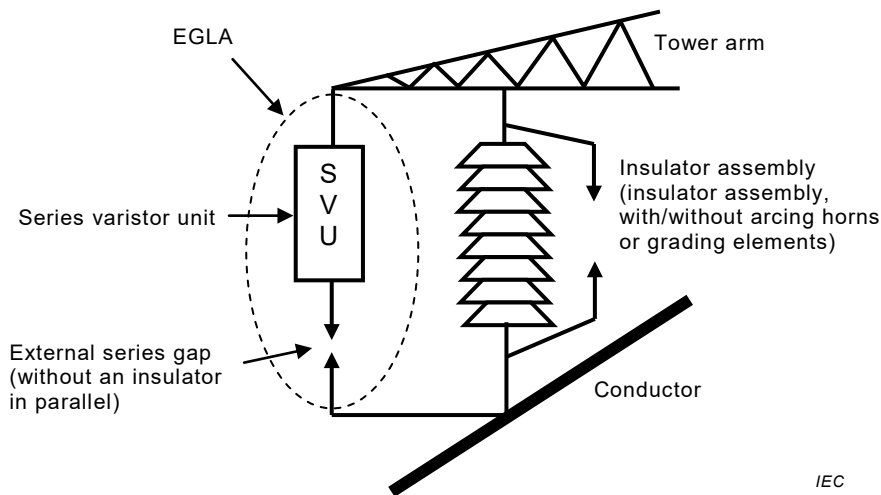


Figure 1 – Configuration of an EGLA with insulator and arcing horn

SURGE ARRESTERS –

Part 8: Metal-oxide surge arresters with external series gap (EGLA) for overhead transmission and distribution lines of a.c. systems above 1 kV

1 Scope

This part of IEC 60099 covers metal-oxide surge arresters with external series gap (externally gapped line arresters (EGLA)) that are applied on overhead transmission and distribution lines, only to protect insulator assemblies from lightning-caused flashovers.

This document defines surge arresters to protect the insulator assembly from lightning-caused over-voltages only. Therefore, and since metal-oxide resistors are not permanently connected to the line, the following items are not considered for this document:

- switching impulse spark-over voltage;
- residual voltage at steep current and switching current impulse;
- thermal stability;
- long-duration current impulse withstand duty;
- power-frequency voltage versus time characteristics of an arrester;
- disconnecter test;
- aging duties by power-frequency voltage.

Considering the particular design concept and the special application on overhead transmission and distribution lines, some unique requirements and tests are introduced, such as the verification test for coordination between insulator withstand and EGLA protective level, the follow current interrupting test, mechanical load tests, etc.

Designs with the EGLA's external series gap installed in parallel to an insulator are not covered by this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60060-2:2010, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60068-2-11:1981, *Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60099-4:2014, *Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems*

IEC 60270:2000, *High-voltage test techniques – Partial discharge measurements*

IEC 60507:2013, *Artificial pollution tests on high-voltage ceramic and glass insulators to be used on a.c. systems*

IEC TS 60815-1:2008, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

IEC 62217:2012, *Polymeric HV insulators for indoor and outdoor use – General definitions, test methods and acceptance criteria*

ISO 4287, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters*

ISO 4892-1, *Plastics – Methods of exposure to laboratory light sources – Part 1: General Guidance*

ISO 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc sources*

ISO 4892-3, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*