



IEC TS 63042-301

Edition 2.0 2026-02

# INTERNATIONAL STANDARD

REDLINE VERSION

**UHV AC transmission systems -  
Part 301: On-site acceptance tests**

## CONTENTS

|   |    |
|---|----|
| FOREWORD .....  | 5  |
| INTRODUCTION .....  | 7  |
| 1 Scope .....   | 8  |
| 2 Normative references .....  | 8  |
| 3 Terms and definitions .....   | 9  |
| 4 General .....   | 9  |
| 5 Power transformers .....  | 9  |
| 5.1 General .....   | 9  |
| 5.2 Leak testing with pressure (tightness test) .....   | 10 |
| 5.3 Winding resistance measurement .....  | 10 |
| 5.4 Ratio test .....  | 10 |
| 5.5 Polarity check .....  | 11 |
| 5.6 Insulation resistance test on each winding to earth and between windings<br>including bushings .....                    | 11 |
| 5.7 Dissipation factor ( $\tan \delta$ ) and capacitance measurement on each winding to<br>earth and between windings ..... | 11 |
| 5.8 Core and frame insulation check .....   | 11 |
| 5.9 Tests on bushings .....   | 11 |
| 5.9.1 Visual inspection .....   | 11 |
| 5.9.2 $\tan \delta$ and capacitance measurement .....   | 11 |
| 5.9.3 Tap withstand voltage .....   | 11 |
| 5.10 Insulating oil tests .....   | 12 |
| 5.11 Dissolved gas analysis (DGA) test .....  | 12 |
| 5.12 Excitation current measurements at reduced voltage .....   | 12 |
| 5.13 Frequency-response analysis (FRA) .....  | 12 |
| 5.14 Short-circuit impedance measurement at reduced current .....   | 12 |
| 5.15 Induced voltage tests with partial discharge measurement .....   | 13 |
| 5.16 Applied voltage tests .....  | 13 |
| 5.17 Measurement of short-circuit impedance and load loss (for an on-site<br>assembly transformer) .....                    | 13 |
| 5.18 Measurement of no-load loss and current (for an on-site assembly<br>transformer) .....                                 | 13 |
| 6 Circuit-breakers (CB) .....   | 13 |
| 6.1 General .....   | 13 |
| 6.2 Dielectric test on main circuit .....   | 14 |
| 6.3 Dielectric test on auxiliary circuit .....  | 14 |
| 6.4 Measurement of the resistance of the main circuit .....   | 14 |
| 6.5 Checks after installation including gas tightness tests, gas quality, insulation<br>resistance test .....               | 14 |
| 6.5.1 General .....   | 14 |
| 6.5.2 General checks .....  | 14 |
| 6.5.3 Checks of electrical circuits .....   | 15 |
| 6.5.4 Checks of the insulation and/or extinguishing fluid(s) .....  | 15 |
| 6.5.5 Checks on operating fluid(s), where filled or added to on-site .....  | 15 |
| 6.5.6 Site operations .....   | 15 |
| 6.6 Mechanical test and measurement .....   | 15 |
| 6.7 Test of accessories .....   | 16 |

|        |   |    |
|--------|---|----|
| 7      | GIS and GIL .....   | 17 |
| 7.1    | General.....  | 17 |
| 7.2    | Dielectric tests on the main circuits.....  | 17 |
| 7.3    | Dielectric tests on auxiliary circuits .....  | 19 |
| 7.4    | Measurement of the resistance of the main circuit.....  | 19 |
| 7.5    | Gas tightness tests .....   | 19 |
| 7.6    | Checks and verifications .....  | 20 |
| 7.7    | Gas quality verifications .....   | 20 |
| 8      | Surge arresters.....  | 20 |
| 8.1    | General.....  | 20 |
| 8.2    | Insulation resistance test .....  | 21 |
| 8.3    | Insulation resistance test of the base insulator.....   | 21 |
| 8.4    | Leakage current test .....  | 21 |
| 8.5    | Checks and verifications .....  | 21 |
| 8.6    | Tests of accessories .....  | 21 |
| 9      | Voltage and current transformers.....   | 21 |
| 9.1    | Capacitive voltage transformers (CVTs).....   | 21 |
| 9.1.1  | General .....   | 21 |
| 9.1.2  | Insulation resistance measurement of low voltage terminal to earth terminal .....                                   | 22 |
| 9.1.3  | Capacitance and dissipation factor ( $\tan \delta$ ) measurement .....  | 22 |
| 9.1.4  | Tightness of the liquid-filled capacitor voltage dividers .....   | 22 |
| 9.1.5  | Winding resistance measurement of electromagnetic units .....   | 22 |
| 9.1.6  | Insulation resistance measurement of each component of electromagnetic units.....                                   | 22 |
| 9.1.7  | Connection check between components of electromagnetic units .....  | 22 |
| 9.1.8  | Tightness of electromagnetic units.....   | 23 |
| 9.1.9  | Accuracy check (determination of error).....  | 23 |
| 9.1.10 | Damper check .....  | 23 |
| 9.2    | Bushing-type current transformers (CT) .....  | 23 |
| 9.2.1  | General .....   | 23 |
| 9.2.2  | Insulation resistance test .....  | 23 |
| 9.2.3  | Resistance measurement .....  | 24 |
| 9.2.4  | Applied voltage test on secondary windings.....   | 24 |
| 9.2.5  | Determination of error and polarity check .....   | 24 |
| 9.2.6  | Excitation test.....  | 24 |
| 10     | Shunt reactors .....  | 24 |
| 10.1   | General.....  | 24 |
| 10.2   | Leak testing with pressure (tightness test) .....   | 25 |
| 10.3   | Winding resistance measurement .....  | 25 |
| 10.4   | Insulation resistance tests on each winding to earth and between windings including bushings .....                  | 25 |
| 10.5   | Dissipation factor ( $\tan \delta$ ) and capacitance measurement on each winding to earth and between windings..... | 25 |
| 10.6   | Core and frame insulation check .....   | 25 |
| 10.7   | Tests on bushings.....  | 25 |
| 10.7.1 | Visual inspection .....   | 25 |
| 10.7.2 | Tan $\delta$ and capacitance measurement.....   | 25 |
| 10.7.3 | Tap withstand voltage .....   | 26 |

|        |  |    |
|--------|--|----|
| 10.8   | Insulating oil tests .....   | 26 |
| 10.9   | DGA test .....   | 26 |
| 10.10  | Applied voltage tests .....  | 26 |
| 11     | Series compensators .....  | 26 |
| 11.1   | General .....  | 26 |
| 11.2   | Test on capacitors .....   | 26 |
| 11.3   | Tests on metal oxide varistors .....   | 27 |
| 11.4   | Tests on damping equipment .....   | 27 |
| 11.5   | Tests on spark gaps .....  | 28 |
| 11.6   | Tests on current transformers .....  | 29 |
| 11.7   | Tests on by-pass switches .....  | 29 |
| 11.8   | Tests on disconnectors .....   | 30 |
| 11.9   | Tests on insulators .....  | 30 |
| 11.10  | Tests on control and protection systems of series compensator .....  | 31 |
| 12     | Insulators .....   | 31 |
| 12.1   | General .....  | 31 |
| 12.2   | On-site acceptance tests of suspension insulators .....  | 31 |
| 12.3   | On-site acceptance tests of post insulators .....  | 31 |
| 13     | Air-insulated disconnectors and earthing switches .....  | 32 |
| 13.1   | Air-insulated disconnectors .....  | 32 |
| 13.1.1 | General .....  | 32 |
| 13.1.2 | Dielectric test on control and auxiliary circuits .....  | 32 |
| 13.1.3 | Measurement of the resistance of the main circuit .....  | 32 |
| 13.1.4 | Design and visual <del>inspection</del> checks .....   | 32 |
| 13.1.5 | Mechanical test .....  | 32 |
| 13.2   | Air-insulated earthing switches .....  | 32 |
| 13.2.1 | General .....  | 32 |
| 13.2.2 | <del>Appearance</del> Design and visual checks .....   | 32 |
| 13.2.3 | Dielectric tests on control and auxiliary circuits .....   | 33 |
| 13.2.4 | Mechanical test .....  | 33 |
| 14     | High-speed earthing switches (HSES) .....  | 33 |
| 14.1   | General .....  | 33 |
| 14.2   | Dielectric test on main circuit .....  | 33 |
| 14.3   | Dielectric test on auxiliary circuit .....   | 33 |
| 14.4   | Measurement of the resistance of the main circuit .....  | 33 |
| 14.5   | Checks and verifications after installation including gas tightness tests, gas quality, insulation resistance test ..... | 33 |
| 14.6   | Mechanical tests and measurements .....  | 33 |
| 14.7   | Tests of accessories .....   | 34 |
| 14.8   | CB and HSES operating sequence test .....  | 34 |
| 15     | Protection and control system .....  | 34 |
| 15.1   | General .....  | 34 |
| 15.2   | Visual inspection .....  | 34 |
| 15.3   | Wiring check .....   | 34 |
| 15.4   | Insulation test .....  | 35 |
| 15.5   | AC/DC power supply check .....   | 35 |
| 15.6   | Device current and voltage sampling test .....   | 35 |
| 15.7   | Binary input/output contact and signal check .....   | 35 |

|   |  |               |
|---|--|---------------|
| 15.8  | Protection function verification ..... | 35            |
| 15.9  | Control function verification.....     | 35            |
| 15.10   | Auxiliary relay test .....             | 35            |
| Bibliography.....   |  | 36            |
| Figure 1 – Delay time of opening resistor and pre-insertion time of closing resistor..... |  | 16            |
| Table 1 – Requirements of insulating oil .....  |  | 12            |
| <del>Table 2 – On-site test voltages .....</del>  |  | <del>28</del> |
| Table 2 – Tan $\delta$ (%) of bushings.....   |  | 28            |
| Table 3 – Limiting value of tan $\delta$ (%) .....  |  | 29            |

INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**UHV AC transmission systems -  
Part 301: On-site acceptance tests**

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC TS 63042-301:2018. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC TS 63042-301 has been prepared by IEC technical committee 122: UHV AC transmission systems. It is a Technical Specification.

This second edition cancels and replaces the first edition published in 2018. This edition constitutes a technical revision.

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

- a) new subclause with measurement of short-circuit impedance and load loss for on-site assembly transformer has been added;
- b) new subclause with measurement of no-load loss and current for on-site assembly transformer has been added;
- c) on-site acceptance test requirement for GIL has been added;
- d) new clause with protection and control system on-site acceptance tests has been added.

The text of this Technical Specification is based on the following documents:

| Draft       | Report on voting |
|-------------|------------------|
| 122/199/DTS | 122/211/RVDTS    |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

A list of all parts in the IEC 63042 series, published under the general title *UHV AC transmission systems*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

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

- reconfirmed,
- withdrawn, or
- revised.

## INTRODUCTION

With the increase in voltage levels, the reliability and safety of high-voltage electric equipment is facing new challenges. There is a need to have consensus on a series of technical criteria and requirements for on-site acceptance tests for electrical equipment of ultra-high voltage (UHV) AC transmission systems exceeding 800 kV to detect the damages or abnormal conditions that ~~may~~ can occur during the transportation and installation processes and to determine whether equipment can be put into operation reliably and safely for power systems.

This document proposes on-site acceptance tests, relevant test items, test methods, and evaluation criteria for transformers, circuit-breakers, gas insulated switchgear (GIS) and gas insulated transmission line (GIL), surge arresters, voltage and current transformers, shunt reactors, series compensators, insulators, disconnectors, earthing switches and high-speed earthing switches.



## 1 Scope

This part of IEC 63042, which is a technical specification, applies to on-site acceptance tests of electrical equipment with the highest voltages of AC transmission system exceeding 800 kV and its protection and control system.

The electrical equipment exceeding 800 kV includes the following items:

- power transformers;
- circuit-breakers (CBs);
- gas insulated switchgear (GIS);
- gas insulated transmission line (GIL);
- surge arresters;
- voltage and current transformers;
- shunt reactors;
- series compensators;
- insulators;
- disconnectors and earthing switches;
- high-speed earthing switches (HSES).

## 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 60076-18, *Power transformers – Part 18: Measurement of frequency response*

IEC 60137:2017, *Insulated bushings for alternating voltages above 1 000 V*

~~IEC 60376, Specification of technical grade sulfur hexafluoride (SF<sub>6</sub>) for use in electrical equipment~~

IEC 60383-1:2023, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 1: Ceramic or glass insulator units for a.c. systems – Definitions, test methods and acceptance criteria*

IEC 60480, ~~Guidelines for the checking and treatment of sulfur hexafluoride (SF<sub>6</sub>) taken from electrical equipment and specification for its re-use~~ Specifications for the re-use of sulphur hexafluoride (SF<sub>6</sub>) and its mixtures in electrical equipment

IEC 62271-1:2017, *High-voltage switchgear and controlgear – Part 1: Common specifications for alternating current switchgear and controlgear*  
IEC 62271-1:2017/AMD1:2021

IEC 62271-4, *High-voltage switchgear and controlgear – Part 4: Handling procedures for sulphur hexafluoride (SF<sub>6</sub>) and its mixtures* gases for insulation and/or switching

IEC 62271-100:2008/2021, *High-voltage switchgear and controlgear – Part 100: Alternating-current circuit-breakers*  
IEC 62271-100:2021/AMD1:2024

## Bibliography

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

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

~~IEC 60060-3, High-voltage test techniques – Part 3: Definitions and requirements for on-site testing~~

IEC 60071-1:2006, *Insulation co-ordination – Part 1: Definitions, principles and rules*

~~IEC 60071-1:2006/AMD1:2010~~

IEC 60076-1, *Power transformers – Part 1: General*

IEC 60076-3, *Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air*

~~IEC 60076-18, Power transformers – Part 18: Measurement of frequency response~~

~~IEC 60137:2017, Insulated bushings for alternating voltages above 1 000 V~~

IEC 60143-1:2015, *Series capacitors for power systems – Part 1: General*

IEC 60143-2:2012, *Series capacitors for power systems – Part 2: Protective equipment for series capacitor banks*

IEC 60296, *Fluids for electrotechnical applications – ~~Unused Mineral insulating oils for transformers and switchgear~~ Mineral insulating oils for electrical equipment*

~~IEC 60383-1:1993, Insulators for overhead lines with a nominal voltage above 1 000 V – Part 1: Ceramic or glass insulator units for a.c. systems – Definitions, test methods and acceptance criteria~~

IEC 60376, *Specification of technical grade sulphur hexafluoride (SF<sub>6</sub>) and complementary gases to be used in its mixtures for use in electrical equipment*

IEC 60422, *Mineral insulating oils in electrical equipment – Supervision and maintenance guidance*

IEC 60599, *Mineral oil-filled electrical equipment in service – Guidance on the interpretation of dissolved and free gases analysis*

~~IEC 61869-2, Instrument transformers – Part 2: Additional requirements for current transformers~~

~~IEC 61869-4, Instrument transformers – Part 4: Additional requirements for combined transformers~~

IEC 61869-5, *Instrument transformers – Part 5: Additional requirements for capacitor voltage transformers*

~~IEC 61936-1, Power installations exceeding 1 kV a.c. – Part 1: Common rules~~

~~IEEE 1861, IEEE guide for on-site accept tests of electrical equipment and system commissioning of 1 000 kV ac and above~~

IEC 62271-109:2019, *High-voltage switchgear and controlgear – Part 109: Alternating-current series capacitor by-pass switches*

IEC 62271-112:2021, *High-voltage switchgear and controlgear – Part 112: Alternating current high-speed earthing switches for secondary arc extinction on transmission lines*

---