



TECHNICAL SPECIFICATION

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.240.01

ISBN 978-2-8322-6297-9

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

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	10
5.6 Insulation resistance test on each winding to earth and between windings including bushings	10
5.7 Dissipation factor ($\tan \delta$) and capacitance measurement on each winding to earth and between windings.....	10
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	11
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	12
5.16 Applied voltage tests.....	13
6 Circuit breakers	13
6.1 General.....	13
6.2 Dielectric test on main circuit	13
6.3 Dielectric test on auxiliary circuit.....	13
6.4 Measurement of the resistance of the main circuit.....	14
6.5 Checks after installation including gas tightness tests, gas quality, insulation resistance test	14
6.5.1 General	14
6.5.2 General checks.....	14
6.5.3 Checks of electrical circuits	14
6.5.4 Checks of the insulation and/or extinguishing fluid(s).....	14
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.....	16
7.1 General.....	16
7.2 Dielectric tests on the main circuits.....	17
7.3 Dielectric tests on auxiliary circuits	18

7.4	Measurement of the resistance of the main circuit.....	18
7.5	Gas tightness tests	19
7.6	Checks and verifications	19
7.7	Gas quality verifications	19
8	Surge arresters.....	19
8.1	General.....	19
8.2	Insulation resistance test	19
8.3	Insulation resistance test of the base insulator.....	20
8.4	Leakage current test	20
8.5	Checks and verifications	20
8.6	Tests of accessories	20
9	Voltage and current transformers.....	20
9.1	Capacitive voltage transformers (CVTs).....	20
9.1.1	General	20
9.1.2	Insulation resistance measurement of low voltage terminal to earth terminal	21
9.1.3	Capacitance and dissipation factor ($\tan \delta$) measurement	21
9.1.4	Tightness of the liquid-filled capacitor voltage dividers	21
9.1.5	Winding resistance measurement of electromagnetic units	21
9.1.6	Insulation resistance measurement of each component of electromagnetic units.....	21
9.1.7	Connection check between components of electromagnetic units	21
9.1.8	Tightness of electromagnetic units.....	21
9.1.9	Accuracy check (determination of error).....	22
9.1.10	Damper check	22
9.2	Bushing-type CTs	22
9.2.1	General	22
9.2.2	Insulation resistance test	22
9.2.3	Resistance measurement	22
9.2.4	Applied voltage test on secondary windings.....	23
9.2.5	Determination of error and polarity check	23
9.2.6	Excitation test.....	23
10	Shunt reactors	23
10.1	General.....	23
10.2	Leak testing with pressure (tightness test)	24
10.3	Winding resistance measurement	24
10.4	Insulation resistance tests on each winding to earth and between windings including bushings	24
10.5	Dissipation factor ($\tan \delta$) and capacitance measurement on each winding to earth and between windings.....	24
10.6	Core and frame insulation check.....	24
10.7	Tests on bushings.....	24
10.7.1	Visual inspection	24
10.7.2	$\tan \delta$ and capacitance measurement.....	24
10.7.3	Tap withstand voltage.....	25
10.8	Insulating oil tests	25
10.9	DGA test.....	25
10.10	Applied voltage tests.....	25
11	Series compensators	25

11.1	General.....	25
11.2	Test on capacitors	26
11.3	Tests on metal oxide varistors	26
11.4	Tests on damping equipment	26
11.5	Tests on spark gaps.....	27
11.6	Tests on current transformers	28
11.7	Tests on by-pass switches	29
11.8	Tests on disconnectors	29
11.9	Tests on insulators.....	30
11.10	Tests on control and protection systems	30
12	Insulators	30
12.1	General.....	30
12.2	On-site acceptance tests of suspension insulators	30
12.3	On-site acceptance tests of post insulators	30
13	Disconnectors and earthing switches	31
13.1	Air-insulated disconnectors	31
13.1.1	General	31
13.1.2	Dielectric test on control and auxiliary circuits	31
13.1.3	Measurement of the resistance of the main circuit	31
13.1.4	Design and visual Inspection	31
13.1.5	Mechanical test	31
13.2	Air-insulated earthing switches	31
13.2.1	General	31
13.2.2	Appearance check	31
13.2.3	Dielectric tests on control and auxiliary circuits.....	31
13.2.4	Mechanical test	32
14	High-speed earthing switches (HSES)	32
14.1	General.....	32
14.2	Dielectric test on main circuit	32
14.3	Dielectric test on auxiliary circuit.....	32
14.4	Measurement of the resistance of the main circuit.....	32
14.5	Checks and verifications after installation including gas tightness tests, gas quality, insulation resistance test	32
14.6	Mechanical tests and measurements	32
14.7	Tests of accessories	33
14.8	CB and HSES operating sequence test	33
	Bibliography.....	34
	Figure 1 – Delay time of opening resistor and pre-insertion time of closing resistor.....	16
	Table 1 – Requirements of insulating oil	12
	Table 2 – On-site test voltages	18
	Table 3 – Tan δ (%) of bushings	27
	Table 4 – Limiting value of tan δ (%).....	28

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) 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.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

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

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

Enquiry draft	Report on voting
122/57/DTS	122/65A/RVDTS

Full information on the voting for the approval of this technical specification 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 in the IEC 63042 series, published under the general title *UHV AC transmission systems*, 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.

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 UHV AC transmission systems exceeding 800 kV to detect the damages or abnormal conditions that may occur during the transportation and installation processes and to determine whether equipment can be put into operation reliably and safely for power systems.

This Technical Specification proposes on-site acceptance tests, relevant test items, test methods, and evaluation criteria for transformers, circuit breakers, GIS, surge arresters, voltage and current transformers, shunt reactors, series compensators, insulators, disconnectors, earthing switches and high-speed earthing switches.

UHV AC transmission systems –

Part 301: On-site acceptance tests

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.

The electrical equipment exceeding 800 kV includes the following items:

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

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 60376, *Specification of technical grade sulfur hexafluoride (SF₆) for use in electrical equipment*

IEC 60480, *Guidelines for the checking and treatment of sulfur hexafluoride (SF₆) taken from electrical equipment and specification for its re-use*

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

IEC 62271-4, *High-voltage switchgear and controlgear – Part 4: Handling procedures for sulphur hexafluoride (SF₆) and its mixtures*

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

IEC 62271-102:2018, *High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches*

IEC 62271-112:2013, *High-voltage switchgear and controlgear – Part 112: Alternating current high-speed earthing switches for secondary arc extinction on transmission lines*

IEC 62271-203, *High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV*