



IEEE Standard for Performance and Test Requirements for Instrument Transformers of a Nominal System Voltage of 115 kV and Above

Power & Energy Society

Sponsored by the
Transformers Committee



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IEEE Standard for Performance and Test Requirements for Instrument Transformers of a Nominal System Voltage of 115 kV and Above

Sponsor

**Transformers Committee
of the
IEEE Power & Energy Society**

Approved 11 September 2009

IEEE-SA Standards Board

Abstract: Single-phase instrument transformers of a nominal system voltage of 115 kV and above with capacitive insulation system for line-to-ground connection and for both indoor and outdoor application is discussed in this standard. This standard is intended for use as a supplement to IEEE Std C57.13™-2008 and as a basis for performance and safety of equipment. It also describes test sequences, criteria, methods, and documentation for the test.

Keywords: design test, high-voltage, instrument transformers, routine tests, special tests, test criteria, test method, test requirements, test sequence

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Introduction

This introduction is not part of IEEE Std C57.13.5-2009, IEEE Standard for Performance and Test Requirements for Instrument Transformers of a Nominal System Voltage of 115 kV and Above.

The mission of the IEEE PC57.13.5 Working Group is to develop a comprehensive set of performance and test requirements for instrument transformers of a nominal system voltage of 115 kV and above. The objective is to improve the performance and safety of the instrument transformers in response to the concern indicated in the publication EPRI Workshop on Failed High Voltage Instrument Transformers, held in September 1990.

The first edition was published in 2003.

The main changes introduced in this revision are:

- Update of references
- Addition of temperature rise limits of terminals
- Additional requirements concerning the use of non-corrosive oil
- Revision of mechanical requirements
- Addition of a new annex related to current transformers used for the detection of unbalance current of capacitor banks
- Addition of a new annex related to current transformers having transient performance requirements
- Addition of a new informative annex giving additional information regarding the Electrical endurance test

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1. Overview

1.1 Scope

This standard applies to ~~new~~ single-phase instrument transformers of a nominal system voltage of 115 kV and above with capacitive insulation system for line-to-ground connection and for both indoor and outdoor application.

This standard is intended for use as a supplement to IEEE Std C57.13™-2008¹ and as a basis for performance and safety of equipment. It also describes test sequences, criteria, methods and documentation for the test.

1.1 Purpose

The ~~intended~~ purpose of this standard is to supplement the IEEE Std C57.13-2008, with specific requirements

~~a) Up-to-date of performance characteristics and test for to single-phase~~ instrument transformers of a nominal system voltage of 115 kV and above, with capacitive insulation system for line-ground connection and for both indoor and outdoor applications.

~~b) Information related test procedures, which have not been adequately covered in the present standard~~

~~e) Information related to the new test items.~~

¹ Information on reference can be found in Clause 2.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

~~This standard shall be used in conjunction with the following publications. When the following standards are superseded by an approved revision, the revision shall apply~~

ASTM D1275-06, Standard Test Method for Corrosive Sulfur in Electrical Insulating Oils.²

~~[†]CSA publications are available from the Canadian Standards Association (Standards Sales), 178 Rexdale Blvd., Etobicoke, Ontario, Canada M9W 1R3 (<http://www.csa.ca/>).~~

~~CAN/CSA-C1264-99, Ceramic Pressurized Hollow Insulators for High Voltage Switchgear and Controlgear.~~

IEC 60270: 2000 , High-Voltage Test Techniques— Partial discharge measurements.³

~~IEC 61181 (1993-06), Impregnated Insulation Materials—Application of Dissolved Gas Analysis (DGA) to Factory Tests on Electrical Equipment.~~

IEEE Std 4TM-1995, IEEE Standard Techniques for High Voltage Testing.⁴

~~IEEE Std C57.12.90TM-1999, Standard Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers.~~

IEEE Std 693TM-2005, IEEE Recommended Practices for Seismic Design for Substations.

IEEE Std C57.13-2008, IEEE Standard Requirements for Instrument Transformers.

IEEE Std C57.19.01TM-2000, IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings.

~~IEEE Std C57.98TM-1994, IEEE Guide for Transformer Impulse Tests.~~

IEEE Std C57.106TM-2006, IEEE Guide for Acceptance and Maintenance of Insulating Oil in Equipment.

IEEE Std C62.11TM-2005, IEEE Standard for Metal-Oxide Surge Arresters for AC Power circuits (>1 kV).

NEMA Standards Publication No 107-1987 ~~(R-1993)~~, Methods of Measurement of Radio Influence Voltage (RIV) of High Voltage Apparatus.⁵

~~1997 Uniform Building Code (Version 1.3).⁶~~

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⁵NEMA publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado 80112, USA (<http://global.ihs.com/>).

⁶ICBO publications are available from the International Conference Board of Officials, 5360 Workman Mills Road, Whittier, CA 90601-2298, USA (<http://www.iebo.org/>).

3. Definitions

For the purposes of this document, the following terms and definitions apply. The *Authoritative IEEE Standards Dictionary: Glossary of Terms & Definitions* should be referenced for terms not defined in this clause.⁶

capacitive insulation system: An arrangement of internal insulation and electrodes to distribute both the alternating and impulse voltages along the bushing of the instrument transformer with capacitive dielectric layers and/or electrode(s) to achieve an improved co-ordination between the internal and external insulation for the purpose of increasing the over-voltage withstand capability.

Internal arc protection class I: A special transformer design with a feature that, during an internal line-to-ground arc test with the arc taking place at a location, which is technically the most probable, the debris of the transformer will be confined to a circle, centered at the transformer. The diameter of this circle is equal to the sum of twice the height of the transformer and the diameter of the transformer.

Internal arc protection class II: A special transformer design with a feature that, during an internal line-to-ground arc test with the arc taking place at a location, which is technically the most probable, will not fracture the insulator or housing of the transformer.

²ASTM publications are available from the ASTM Customer Services, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA, (<http://www.astm.org/>).

³IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3 rue de Varembe, CH-1211, Geneve 20, Switzerland/Suisse, (<http://www.iec.ch/>).

⁴IEEE publications are available from the Sales Department, the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (<http://standards.ieee.org/>).

⁵NEMA publications are available from the Sales Department, National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA, 22209, USA, (<http://www.nema.org/>).

⁶The IEEE Standards Dictionary: Glossary of Terms & Definitions is available at <http://shop.ieee.org/>.

NOTE—The above definitions ~~regarding the classification~~ Internal arc protection [class I and Internal arc protection Class II regarding the classification of internal arc protection](#) apply only to the test conditions specified in this standard. The instrument [transformers](#) may have different performance during an in-service internal arc fault. Refer to Annex D for more information regarding the interpretation of internal arc protection. The performance does not apply to any internal pressure relief device (e.g., rupture disc) provided with the transformers.⁷

prescribed extinction voltage: The lowest line-to-ground voltage required for the transformer at which the partial discharge is determined to exist if the reference intensity is met when the voltage applied to the transformer is gradually decreased without interruption from the power frequency withstand voltage or pre-stress voltage value during the partial discharge test. The reference partial discharge intensity for the transformers covered in this standard is 10 pC.

rated voltage factor: A multiplier applied to the rated (primary) voltage to derive the maximum voltage at which a transformer must comply with the relevant ~~thermal~~ requirements for a specified time and with the relevant accuracy requirements.

NOTE—Refer to Annex F for additional information.

terminals: Conductive element belonging to the instrument transformer provided for connecting that instrument transformer to one or more external conductors. Terminals are normally connected to one or more conductors by means of connectors that are generally not considered to be part of the instrument transformer itself.

thermal current rating factor: A multiplier applied to the rated primary and secondary current to derive the maximum current that can be carried continuously without exceeding either the limiting temperature rises or the accuracy class limitation.

4. General

For the performance and safety, the instrument transformers shall comply with IEEE Std C57.13-2008, supplemented with the requirements provided in this clause. If any conflicts or inconsistencies exist between IEEE Std C57.13-2008 and this standard, the clauses in this standard shall take precedence.

4.1 Insulation requirements

4.1.1 Voltage ratings, dielectric test levels, and prescribed extinction voltages

The voltage ratings, dielectric test levels, and prescribed extinction voltages for instrument transformers are given in Table 1.

⁷~~The numbers in brackets correspond to those in the bibliography in Annex G.~~

NOTE 1—For nominal system voltage 230 kV, 345 kV, and 500 kV, a good service experiences with instrument transformers of reduction insulation levels have been reported. The users should review their own records and decide accordingly. This standard recommends the use of the standard insulation voltage levels which are higher values for each system voltage.

NOTE 2—The dielectric levels and prescribed extinction voltages are applicable to instrument transformers used in grounded or effectively grounded neutral systems.

⁷ Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

Table 1— Voltage ratings, dielectric test levels, and prescribed extinction voltages

Nominal system voltage (rms) (line-to-line) kV	Maximum system voltage (rms) (line-to-line) kV	Lightning impulse voltage (peak) Chopped wave ^a kV		Switching impulse voltage (peak) kV	Power frequency withstand voltage ^b (rms) (line-to-ground) [Dry] [Wet] kV		Prescribed extinction voltage ^c (rms) (line-to-ground) kV
		Full wave					
115	121	550	630	—	230	230	121
138	145	650	750	—	275	275	145
161	169	750	860	—	325	325	169
230	242	950	1090	—	395	395	242
		1050	1210	—	460	460	
345	362	1175	1350	950	510	—	362
		1300	1500	975	575	—	
500	550	1550	1785	1175	680	—	550
		1800	2070	1300	830	—	
765	800	2100	2420	1550	975	—	800

^aThe minimum time to chopping shall be 3 μ s.

^bThe duration for the power frequency withstand test shall be in accordance with 4.1.8 for both dry and wet test conditions.

^cThe definition is provided in Clause 3. The reference partial discharge intensity for the instrument transformers is 10 pC and shall be measured in accordance with IEC 60270 (2000-12).

4.1.2 Capacitance and dissipation factor requirements

The capacitance and dissipation factor of the transformer shall be measured at power frequency at **maximum** the following test voltages:

- 10 kV ^(rms)⁸
- Maximum rated voltage

The test shall be performed before and after the dielectric tests. The increase of capacitance measured after compared with that measured before the dielectric tests shall be less than the value produced by the breakdown of one capacitive element.

The dissipation factor shall be in accordance with the following requirements.

a) For oil-immersed transformers

- 1) The dissipation factor shall be 0.5% maximum [at a reference ambient temperature of 20 °C](#)
- 2) The absolute increase of the dissipation factor value measured after compared with the value measured before the dielectric tests shall be less than 0.1%

b) For gas-filled transformers⁹

- 1) The dissipation factor shall be 0.15% maximum at a reference ambient temperature of 20 °C
- 2) The absolute increase of the dissipation factor value measured after compared with the value measured before the dielectric tests shall be less than 0.03%

4.1.3 Creepage distance requirements

The ratio of minimum creepage distance on the external surface of the porcelain insulator to the nominal line-to-ground voltage shall be in accordance with IEEE Std C57.19.01-2000. The ratios for light and heavy pollution levels shall be 28 mm/kV and 44 mm/kV respectively. Table 2 provides minimum creepage distances as a function of nominal system voltage and level of pollution.

⁸The measurement at 10 kV is optional as the values are useful as a reference for commissioning.

⁹As the inherent capacitance of gas-filled instrument transformers is very low (in the range of 100–300 pF), the laboratory should take the necessary precautions to reduce the stray effects of the neighboring equipment on the capacitance measurement, and also the effects of the leakage current over the insulator surface on the dissipation factor measurement.

Table 2—Creepage distance

Nominal system voltage (rms) kV	Maximum system voltage (rms) kV	Minimum creepage distance mm	
		(Light pollution)	(Heavy pollution)
115	~~123~~ 121	1860	2920
138	145	~~2-230~~ 2235	3510
161	~~170~~ 169	~~2-600~~ 2605	4090
230	~~245~~ 242	3720	~~5-850~~ 5845
345	362	5580	~~8-770~~ 8765
500	550	~~8-080~~ 8085	12 ~~700~~ 705
765	800	12 ~~400~~ 370	19 ~~400~~ 435

NOTE 1—The definitions of light and heavy pollution levels are provided in IEEE Std C57.19.00™-1995 [B17]. [For medium and extra heavy pollution levels, additional information regarding creepage distances can also be found in IEEE Std C57.100™-1995.](#)

NOTE 2—The creepage distance for composite insulator with silicone rubber sheds has not been established. This standard recommends the use of the same creepage distance as that for the porcelain insulator.

4.1.4 External radio influence voltage (RIV) requirements

The maximum external radio influence voltage (RIV) of the instrument transformer shall be in accordance with Table 3 when the test voltage is applied to the primary terminal. The transformer shall be assembled as in service for the test. Any external electrodes, if not part of the transformer, shall not be used for the test.

Table 3—External radio influence voltage (RIV)

Nominal system voltage (line-to-line) (rms) kV	Maximum system voltage (line-to-line) (rms) kV	Radio influence test voltage (line-to-ground) (rms) kV	Maximum radio influence voltage ¹⁰ μV
115	121	71	200
138	145	84	200
161	169	98	200
230	242	142	250
345	362	209	250
500	550	303	350
765	800	462	500

¹⁰ The background noise level shall not be higher than half the maximum RIV.

4.1.5 Routine partial discharge test

The partial discharge intensity measured at the voltage corresponding to the prescribed extinction voltage level as provided in Table 4 shall be less than or equal to the reference intensity of 10 pC. The measuring method shall be in accordance with IEC 60270: 2000 .

⁸As the inherent capacitance of gas-filled instrument transformers is very low range of 100–300 pF laboratory should take the necessary precautions to reduce the stray effects of the neighboring equipment on the capacitance measurement, and also the effects of the leakage current over the insulator surface on the dissipation factor measurement

The partial discharge test shall be carried out subsequent¹¹ to the power frequency voltage withstand test as described in 7.7.

The transformer shall withstand, for an appropriate duration in accordance with 4.1.8, the pre-stress voltage provided in Table 4 before the partial discharge is measured. ~~Insulation resistance requirements~~

Table 4—Routine partial discharge tests voltage

Nominal system voltage (rms) (line-to-line) kV	Maximum system voltage (rms) (line-to-line) kV	Pre-stress voltage (rms) (line-to-ground) kV	Prescribed extinction voltage (rms) (line-to-ground) kV
115	121	185	121
138	145	220	145
161	169	260	169
230	242	315 ^a	242
		370	
345	362	410 ^a	300 ^b
		460	
500	550	545 ^a	435 ^b
		665	
765	800	780	665 ^b
^a The values shown are for the reduced insulation levels in reference to Table 1. ^b The standard recognizes the difficulties of partial discharge measurement at these voltage levels in the industrial environments with high level of background noise. The problem is aggravated if the test laboratories are undersized. Sometimes extra-high-voltage test services with specialized capabilities are required. For the transformers of these voltage ratings, therefore, the prescribed extinction voltages are reduced to 1.5 times the rated voltages in order to allow the test to be performed in manufacturers' laboratories. The reduced voltage levels are considered still acceptable since the ground fault factor for a system with a grounded or effectively grounded neutral does not exceed 1.4.			

4.1.6 Insulation resistance requirements

The insulation resistances between individual winding and ground and between windings shall be measured at a voltage not less than 1.0 kV (dc). The values shall not be less than 200 MΩ.

¹¹ An exception case is under the situation of repeating the partial discharge test after the sealing test during which dry air is in contact with the oil of the transformer.

4.1.7 Power frequency voltage withstand test

The power frequency withstand voltage shall be in accordance with the value provided in Table 1.

For current transformers, the voltage shall be applied to the primary winding.

For voltage transformers, the test voltage shall be either impressed between the primary and neutral terminals or induced from the secondary winding with the primary winding open-circuit. The neutral terminal shall be grounded during the test.

The voltage shall be maintained for 60 s. The time may be reduced in accordance with 4.1.8 if the frequency is higher than 120 Hz.

NOTE—This test can also be called induced voltage withstand test for voltage transformers.

4.1.8 Duration of power frequency voltage withstand test for test frequency higher than 120 Hz

If the test frequency of higher than 120 Hz is used for the power frequency voltage withstand test or for the prestress voltage for partial discharge measurement, the duration of the test may be reduced as shown in Equation (1).

$$Time (s) = \frac{7200}{Test Frequency (Hz)} \quad (1)$$

The duration shall not be less than 18 s and the test frequency shall not be greater than 400 Hz.

4.2 Mineral oil requirements

The mineral oil used for oil-immersed instrument transformers shall be processed from the naphthenic base crude oil or its equivalent.¹² It shall be in accordance with 4.2 of IEEE Std C57.106-2006. The characteristics of the new processed oil shall be in accordance with 4.3 and 4.4 of IEEE Std C57.106-2006.

In addition it shall be demonstrated the oil is non corrosive in accordance with the extended ASTM D1275 Method B test. For the extreme cold climate, the manufacturers and users have to agree on the mineral oil specification.

4.3 Requirements for accuracy and accuracy calibration systems

The accuracy performance shall be in accordance with the requirements of IEEE Std C57.13-2008.

Accuracy performance for all transformers ~~with accuracy ratings of 0.3 or 0.6~~ shall be determined using calibration techniques and methods ~~that shall give adequate results within 0.1% of~~ having an inherent accuracy of at least 4 times better than the maximum guaranteed accuracy for the ratio and ± 2 minutes for phase angle. ~~transformers with accuracy ratings of 1.2 shall be determined using calibration techniques and methods that shall give adequate results within 0.3% of the ratio and 6 minutes of phase angle.~~ The test burdens shall be in accordance with Table 9 and Table 15 of IEEE Std C57.13-2008 for current transformers and voltage transformers respectively.

¹² New insulating oil processed with the latest technology may be commercially available from the refinery. The user should check with the manufacturer for more information.

The equipment used for accuracy tests shall be traceable to the national standards. Records of accuracy verification for the calibration systems by an independent laboratory shall be regularly maintained.

The maximum interval shall be five years for non-electronic equipment and ~~two~~ one years for electronic devices, unless specified otherwise by the measuring equipment manufacturer.

4.4 Mechanical performance requirements

All instrument transformers shall comply with the following mechanical performance requirements described in 4.4.1 and 4.4.2.

4.4.1 Sealing tests

All instrument transformers shall be sealed against leakage of insulating fluid for the normal service conditions stated in IEEE Std C57.13-2008.

4.4.1.1 Oil-immersed instrument transformers

For oil-immersed transformers, The manufacturers shall review the typical examples sealing tests outlined in Table 5 and adopt the one most suitable for their transformers. Other test methods could also be fully acceptable.

Table 5—Sealing—Typical examples of sealing test for oil-immersed instrument transformers

Test	Average oil temperature °C	Internal pressure kPa	Time h
(I)	50	35	24
(II)	50	103	12
(III) ¹³	85	0	12
(IV)	25	35	60
(V)	25	103	24

4.4.1.2 Gas-filled instrument transformers

The construction of the tank shall be in accordance with the national standards¹⁴ on enclosures for gas-filled electrical equipment. The manufacturer shall submit the certificate of the tank to the user for approval before the routine tests.

The maximum leakage-rates of transformers designed for various ranges of ambient temperature shall be as follows:

¹³ This standard recommends this procedure for transformers equipped with oil expansion diaphragms or bellows. Other procedures as shown in Table 5, with application of pressure, (e.g., by clamping the oil expansion diaphragms or bellows, instead of raising the average oil temperature of the transformer to 85 °C should also be considered acceptable).

¹⁴ [Additional informative documentation \(Canadian and European Standards\) about pressure vessels used in electrical equipment not containing corrosive gas such as oxygen and/or water are listed in Annex J.](#)

¹⁴~~The Canadian standards are listed in Clause 2.~~

a) For average ambient temperature (20 °C):	0.5% / year
b) For low ambient temperature ($T_L = -5, -10, -15$ or -25 °C):	1.5% / year
c) For extra low ambient temperature ($T_L = -40$ °C):	3.0% / year
d) For ultra low ambient temperature ($T_L = -50$ °C):	6.0% / year

T_L is the lower limit of the ambient temperature range.

The manufacturer shall submit the routine sealing test procedure and acceptance criteria to the user for approval.

4.4.2 Mechanical strength of the transformer

All instrument transformers intended for pedestal mounting shall be capable of withstanding the following non-simultaneous ~~cantilever forces equivalent to those produced and the~~ [mechanical stresses](#):

- [Static terminal loads according to load values shown in Table 6](#)
- Winds of 160 km/h
- [Resulting mechanical stresses produced by an ice coating of 20 mm](#)
- Horizontal seismic force resulting from a zero-period acceleration of 0.1 g [as defined as low qualification level in IEEE Std 693-2005](#)

All instrument transformers intended for suspension mounting shall be capable of withstanding a tension equal to 13 kN in addition to its own weight.

Table 6—Static terminal loads

<u>Maximum system voltage (kV)</u>	<u>Static terminal load (N)</u>	
	<u>Voltage transformers</u>	<u>Current transformers</u>
<u>≤ 170</u>	<u>1000</u>	<u>2000</u>
<u>245 to 362</u>	<u>1250</u>	<u>2500</u>
<u>≥ 550</u>	<u>1500</u>	<u>4500</u>

NOTE 1—The sum of loads acting in routinely operating conditions should not exceed 50% of the specified terminal load.

NOTE 2—In sum applications, instrument transformers with through current terminals, should withstand rarely occurring extreme dynamic load conditions such as short-circuits not exceeding 1.4 times the static terminal load.

NOTE 3—For some applications, it may be necessary to establish the resistance to rotation of the primary terminals. The moment to be applied during tests has to be agreed between the manufacturer and purchaser

4.5 Thermal performance requirements

The limits of observable ~~shall not exceed~~ temperature rise in instrument transformers when tested in accordance with their ratings shall be as given in Table 4 of IEEE Std C57.13-2008.

Terminals for use in air shall be designed so that their maximum operating temperature when tested with their ratings do not exceed the values provided in Table 7.

Table 7—Maximum operating temperature of power terminals intended for bolted connection in air

<u>Performance</u>	<u>Bare copper or bare aluminum terminals</u>	<u>Tin-plated terminals</u>	<u>Silver-plated terminals</u>
<u>Maximum operating temperature (°C)</u>	<u>90</u>	<u>105</u>	<u>115</u>

4.6 Ground shield requirements

The instrument transformers shall be provided with a ground shield between the primary winding and the secondary windings.

NOTE—The ground shield provides some degree of protection in the secondary circuit against an insulation failure between the primary and secondary windings.

4.7 Dissolved gas and water content requirements for new oil-immersed transformers

For new oil-immersed transformers, the maximum concentration of the dissolved gas and water content in the oil, after the test program, shall be in accordance with the values in Table 8.

The minimum sensitivity of gas spectrum analyzer shall be in accordance with the last column of Table 8.

Table 8—Dissolved gas and water content for new oil-immersed instrument transformers

Component	Maximum Concentration (p. p.m.)	Minimum Sensitivity (p. p.m.)
Hydrogen H ₂	15.0	3.0
Carbon monoxide CO	40.0	5.0
Methane CH ₄	5.0	0.1
Ethane C ₂ H ₄	2.0	0.1
Ethylene C ₂ H ₆	3.0	0.1
Acetylene C ₂ H ₂	0.5 ¹⁵	0.1
Water H ₂ O	10.0	3.0

NOTE—The values are in reference to Table A-1 of Annex A of IEC 61181: 2007 [B16] with the exception of the concentration for acetylene.

¹⁵ An acceptable transformer is indicated with the absence of acetylene. However, this standard has made allowances for the residual acetylene present in the oil even after the oil processing.

4.8 Endurance capability for fast high voltage transient

All instrument transformers of a nominal system voltage of 345 kV and above shall be suitably designed to endure the fast high voltage transient stress induced during the operation of the line disconnect switch located in its vicinity. For more information see Annex I.

NOTE—To verify the transformer design will comply with the requirement, the user should specify the endurance chopped wave test 12.1).

~~12 The acceleration value corresponds to the conventional 0.2g in seismic terminology.~~

4.9 Performance of internal arc protection

The transformer design with the safety features of limiting hazardous effects of an internal arc shall conform, during the test, with the requirements defined for their classes as provided in Clause 3.

The special features of internal arc protection for instrument transformers shall be specified at the enquiry.

4.10 Identification of test sample in the type test report

For the purpose of traceability, the test sample used for the type tests shall be uniquely identified. Information related to the design and construction of the sample shall form part of the type test report.

4.11 Secondary short-circuit capability for voltage transformers

The voltage transformer shall be designed and constructed to have the following withstand capabilities:

a) With rated voltage maintained on the primary winding, each secondary winding including the tapped portion shall be capable of withstanding both the thermal and mechanical effects resulting from the secondary short circuit for duration of 1 s, and