NABL 104

NABL

NATIONAL ACCREDITATION
BOARD FOR TESTING AND
CALIBRATION LABORATORIES

SPECIFIC CRITERIA *for* ELECTRICAL TESTING LABORATORIES

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AMENDMENT SHEET

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1. INTRODUCTION

In the broad field of Electrical Engineering, various equipment and systems are used to cater to the application for Electrical power generation, transmission, distribution, control, instrumentation, Communication and domestic application. Each one of the products/ equipment requires a wide variety of tests and hence a need of specialized testing facility.

The field of Electrical Testing covers tests of an essentially electrical nature performed on instruments, equipment, appliances, components and materials.

2. SCOPE OF DOCUMENT

This document sets out the specific criteria requirements for an electrical testing laboratory, in addition to the general requirements of ISO/ IEC 17025: 2005. The document also guides the laboratory to write the Scope of Accreditation. Instrument accuracy limits for various parameters and ranges have been indicated. Also various tests where the laboratories can participate in Proficiency Testing have been listed.

3. REFERENCES

1.	ISO/ IEC 17025: 2005	General Requirements for the Competence of Testing and Calibration Laboratories
2.	ISO: 10012: 1992	Quality Assurance Requirements for Measuring Equipment
3.	NABL 100	General Information Brochure
4.	NABL 130	Specific Criteria for Site Testing and Site Calibration Laboratories
5.	NABL 131	Terms and Conditions for Maintaining Accreditation
6.	NABL 133	NABL Guidelines to Accredited Laboratories for use of NABL Logo
7.	NABL 141	Guidelines for Estimation and Expression of Uncertainty in Measurement
8.	NABL 142	Policy on Calibration and Traceability of Measurements
9.	NABL 151	Application Form for Testing Laboratories
10.	NABL 160	Guide for Preparing a Quality Manual
11.	NABL 161	Guide for Internal Audit Review and Quality Controls
12.	NABL 162	Proficiency Testing Programme for Testing and Calibration Laboratories
13.	NABL 163	Policies & procedures for Inter-Laboratory Comparisons and/ or Proficiency Testing
14.	NABL 212	Guidance document on Validation of Test Methods
15.	NABL 216	Policies and Procedures for Dealing with Adverse Decisions
16.	NABL 174	Sample Calculation for Uncertainty of Measurement in Electrical Testing

4. CLASSIFICATION OF TESTS

The field of Electrical testing can broadly be classified into following groups of Products & Test facility areas:

Group of Products

1. Switchgear equipment
2. Rotating electrical machines
3. Transformers and Reactors
4. Transmission line equipment and accessories
5. Cables and accessories
6. Power Capacitors
7. Lamps, Luminaries and accessories
8. Wiring accessories
9. Domestic Electrical appliances
10. Power Stabilisers and UPS - Stabilised Power Supplies
    - Uninterrupted Power Systems
    - Servo Operated AC Voltage Stabilisers
11. Batteries
12. Power system protection relays
13. Measuring instruments - Electrical and Electronic Instruments and Transducers
    - Electrical and Electronic (Static) Energy Meters
14. Electrical materials - Solid Insulating material
    - Liquid dielectric materials
    - Magnetic materials
    - Conductors

Test Facilities

15. High Voltage test facility
16. Short Circuit test facility
17. Electromagnetic interference (EMI) / Electromagnetic compatibility (EMC) test facility
18. Environmental test facility

5. SCOPE OF ACCREDITATION

In the field of Electrical Testing the tests have been classified into Product wise grouping e.g. Circuit breaker, Isolator, MCB etc. from 'Switchgear equipment' group. However certain specialized tests, which are performed on a wide range of equipment, have been grouped Test Facility wise e.g. High voltage, EMI/ EMC testing etc.

The laboratories can indicate their scope of accreditation either product-wise or test facility-wise depending upon their requirement (please refer Annexure I).

For the Product wise classification, there are two tables in each group. Table 1 gives the products, alongwith reference to national standard (IS) and international standard (IEC). In the absence of IS/ IEC standards, other international standards such as ASTM, ANSI, BS, VDE etc. have been referred. Wherever the year of the standard is mentioned the laboratory shall ensure to specify the latest amendments/ revisions based on testing facilities. Table 2 gives the list of tests for the products listed in Table 1.

In the Test Facility wise classification, there is only one table – Table 3. It gives the list of tests which are performed on a wide range of equipment. These have been grouped Test Facility wise e.g. High voltage, EMI/ EMC testing etc.

When laboratory prepares an application for accreditation, the laboratory may refer Table 2/ Table 3 for tests and select products from Table 1 and give the range and accuracy of the test performed. The contents of the tables given in the document may not be exhaustive. The laboratory is free to add tests/ products and standards not listed in the tables. The final scope of accreditation applied for, shall be prepared in the format as given in Annexure II.

The electrical instruments and the basic materials used in various electrical products/ applications, subjected to test(s) falling in more than one field, eg. transformer oil (electrical & chemical), energy meters (electrical & electronics), lamps and luminaries (electrical & photometry), domestic appliances (electrical & mechanical), switches and wiring accessories (electrical & mechanical) etc. are to be covered under electrical field. These shall be subjected to test(s) as specified in the relevant test standard for verifying their required properties and the relevant NABL Specific Criteria shall be followed. However the test(s) under electrical field and the other field(s) shall be clearly identified in the scope of accreditation.

6. GRANT OF ACCREDITATION

Accreditation is normally granted for the test facilities for which the laboratory is properly equipped and has demonstrated its capability. The extent of a laboratory's scope of accreditation will therefore vary with the range of work performed, the scope and complexity of the tests involved, the competence of laboratory staff and the capability of equipment available in the laboratory.

The accreditation is accorded to a laboratory for the entire test facilities or to a part of facilities.

Accreditation does not constitute a blanket approval for all activities of the laboratory. The groups of test are an arbitrary subdivision of the potential range of activities involved in electrical testing on the basis of the type of measurements being made, the scientific disciplines involved and the techniques employed. It is therefore possible for a particular test or technique to be included under several groups of test. These groups and subgroups do not however, constitute any restriction on the work which a laboratory can perform but provide a convenient means of expressing an accredited laboratory's capabilities.

When the facility is accredited for testing of one product and it is required to test another product where the same facility can be used, the laboratory can perform the test and issue test report. However this test will need to be evaluated by NABL during subsequent surveillance so that the scope can be appropriately amended.

7. MANAGEMENT REQUIREMENTS

The following specific Management requirements, in addition to ISO/ IEC 17025: 2005 are listed below:

1. Review of request, tenders and contracts (clause 4.4 of ISO/ IEC 17025: 2005)

Client may be requested to extend technical help for mounting, fixing, assembling of test object/ fixture for a particular test such as short-circuit test, impulse test, high voltage test etc. if laboratory desires for the same.

The laboratories are required to keep records of the request, tender and contract documents.

2. Sub-contracting (clause 4.5 of ISO/ IEC 17025: 2005)

In case testing laboratory sub-contracts any part of testing, this work shall be placed with another NABL accredited laboratory only, complying with the requirements of ISO/ IEC 17025: 2005.

8. TECHNICAL REQUIREMENTS

The following specific Technical requirements, in addition to ISO/ IEC 17025: 2005 are listed below:

1. Personnel (clause 5.2 of ISO/ IEC 17025: 2005)

The testing laboratory shall have sufficient personnel to perform testing. Personnel performing specific tasks shall be qualified on the basis of technical education, proper knowledge in electrical field and experience, as given below:

General Requirements

a ***Authorised signatory***: Degree in Engineering/ equivalent or post graduate in science in the relevant field of testing, with at least one year experience in the relevant field of testing. Or, graduate in science/diploma in electrical engineering with an experience of 5 years in the relevant field of testing.

b ***Supervisor***: Graduate in science/ diploma in electrical engineering with at least one year experience in the relevant field of testing or trade certificate with at least three years experience in the relevant field of testing. The personnel shall have sound knowledge of test procedures, the risk & hazards involved in testing.

c ***Operator***: Graduate in science/ diploma in electrical engineering/ trade certificate with at least one year experience in the relevant field of testing. He should have sound knowledge of safety precautions to be taken during testing.

Special requirements for High Voltage Testing & Short Circuit Testing

a ***Authorised signatory*****:** Degree in Electrical Engineering or M.Sc. (Physics) with three years experience in the field of high voltage/ short circuit testing. He shall have sound knowledge of the principles of high voltage/ short circuit testing and analytical acumen to evaluate the test results.

b ***Supervisor*****:** Degree in Electrical Engineering or M.Sc. (Physics) with one year experience or diploma in Electrical Engineering with at least three years experience in high voltage/ short circuit testing. He shall have sound knowledge of test procedures, the risk and hazards involved in testing.

c ***Operator*****:** Diploma in Electrical Engineering with at least one year experience. He should have sound knowledge of safety precautions to be taken during high risk testing.

All persons of the laboratory shall be aware of electrical installations within the laboratory premises; electrical clearances required during testing and the safety norms to be observed during testing. They shall also have knowledge about the safety rules and instructions, use of first-aid-kits, fire-fighting equipment and other safety devices.

Special requirements for EMI/ EMC testing

a ***Authorised signatory*****:** Degree in Electrical/ Electronics/ Communication Engineering or M.Sc. (Physics) with three years experience in the field of EMI/ EMC testing. He shall have sound knowledge of the principles of Electro-magnetic interference & compatibility and evaluation of the test results.

b ***Supervisor*****:** Degree in Electrical/ Electronics/ Communication Engineering or M.Sc. (Physics) with one year experience or Diploma in electrical engineering with at least three years experience in the field of EMI/ EMC testing. He shall have sound knowledge of the principles of Electro-magnetic interference & compatibility, and precautions required during testing.

c ***Operator*****:** Diploma in Electrical Engineering with one year experience in the field of EMI/ EMC testing. He shall have sound knowledge of precautions to be taken during testing.

Note: The Assessment team may however recommend Authorized Signatory who does not meet the above specified minimum experience requirement with specific recommendations to NABL, after adjudging the competence of the Authorized Signatory during on-site assessment.

2. Accommodation and Environmental Conditions (clause 5.3 of ISO/ IEC 17025: 2005)

General Requirements

The accommodation and environmental conditions in the laboratory will vary depending on the nature of electrical testing and as per requirements of relevant standards.

For sensitive measurements such as High Voltage, Partial Discharge (PD), Radio Interference Voltage (RIV), Short Circuit etc. where required, the incoming main supply to the control room shall be stabilized, spike free and filtered.

The laboratory shall have independent and isolated earthing to avoid electrical shocks to the operating personnel and damage to test equipment due to other electrical operations in the vicinity. The earth resistance of the laboratory shall be less than 2 ohm as per IS 3043: 1987 and for high voltage laboratory shall preferably be less than 1 ohm.

Special requirements for High Voltage Testing

For high voltage laboratories, the test hall shall have appropriate dimensions to perform electrical testing as per relevant standards, without causing external flashovers to laboratory walls, other test equipment and earthed structures.

The high voltage laboratory performing high frequency measurements shall also have isolation from electromagnetic interference up to the maximum test frequency, to the extent practicable.

Special requirements for Sensitive measurements

The test area, where required shall be a doubly shielded cage enclosure in order to eliminate interference from high frequency electrical signals emanating from local Radio Station/Police wireless sets etc.

The laboratory shall preferably have single point earthing for impulse, partial discharge and other sensitive measurements/ testing etc.

Special requirements for Rotating Electrical Machines

Rotating electrical machines shall be mounted on platforms isolated from sources of mechanical vibrations and shocks.

3. Estimation of Uncertainty of measurement (clause 5.4.6 of ISO/ IEC 17025: 2005)

Few samples of calculations on measurement uncertainty, following NABL guideline NABL 141 are given in a separate publication under “Uncertainty of Measurements for Electrical Testing Laboratories” and NABL 174 “Sample Calculation for Uncertainty in Measurement in Electrical Testing”. However laboratory shall ensure that all contributory factors are taken into consideration while calculating the uncertainties.

4. Measurement Traceability (clause 5.6 of ISO/ IEC 17025: 2005)

NABL policy on traceability, which has been framed in line with ILAC policy, will apply. For equipment where valid calibration facility is not available, such as High voltage, Short circuit etc., inter laboratory comparison needs to be done and the procedure for the same shall be documented.

The calibration interval shall be justified based on previous information if it is more than 12 months. For guidance refer ISO 10012.

Whenever the accuracy of measuring equipment is not mentioned in the relevant IS/ equivalent International Standards, the minimum accuracies as mentioned in Annexure IV may be ensured.

9. SAFETY

Electrical testing laboratories shall follow Indian Electricity Rules and any Regulatory requirements of the Central and State Government, for safety. If there is a contradiction between ISO/ IEC 17025: 2005 and the regulatory requirements, the regulatory requirements will supersede.

The laboratory layout shall be in such a way as to provide adequate working space at each work center to enable unrestricted movement during working.

Earth resistance of the test area shall be less than 2 ohms as per IS: 3043 and for high voltage laboratories, preferably less than 1 ohm. This shall be monitored at least once a year and records to be maintained.

All electrical test laboratories shall adequately take care of safety aspects on following points and ensure compliance with suitable display, training, guidance etc.

1. The laboratories are expected to comply with the safety requirements of electrical shocks: through use of Earth Leakage Circuit Breaker (ELCB) or any other device and damage to personnel by use of Safety Helmet as per IS 2925, Gloves as per IS: 13774, Safety shoes as per IS 12254 & IS 2071 Part 1, Insulated tools as per IS 13772, Earthing rods as per IS 3043, Fire hazards as per SP 30 and Rubber mats as per IS: 5424.

2. Back up controller where necessary shall be provided in order to control the environmental chambers in case of malfunction of original controller for environmental chambers.

3. A danger notice board with a sign of skull and bones shall be displayed in Electrical testing area with voltages above 400 Volts. SP 30 charts where required shall be displayed.

4. Testing staff working in live electric supply environment shall have knowledge of risk and hazards involved in testing.

5. Supply to vehicles and cranes shall have suitable trip facility and the metal rails shall be electrically continuous and earthed.

6. Instructions for resuscitation of persons suffering from electrical shocks shall be prominently displayed.

7. Switchboard shall have clear space around as specified by statutory authority.

8. Due care shall be taken where the equipment is likely to have emissions in test which may endanger the operator/ equipment.

9. Fire buckets filled with clear and dry sand and water ready for immediate use for extinguishing fires in addition to fire extinguishers for dealing with electric fires shall be available.

10. Fire extinguishers of suitable type depending upon class of fire:

Class of Fire	**Suitable type of Extinguishers**
- Fires in Ordinary combustibles (Wood, rubber, plastic and the like)	Gas expelled, Water type and anti-freeze type extinguisher and water buckets.
- Fires in flammable liquids (paints, grease, solvents & the like) and electrical circuits	Chemical extinguishers of carbon-dioxide & dry powder type, sand buckets and foam type
- Fires in gaseous substances under pressure including liquefied gases	Chemical extinguishers of carbon-dioxide and dry powder type

11. Availability of first aid kit.

12. Ensure minimum safe clearance in air between high voltage terminal and earth during testing at different voltage levels of AC/ DC/ Impulse applications.

13. Ensure proper earthing of equipment before making physical contact.

14. Operation of equipment by only authorised personnel.

15. Use of safety interlocks.

16. Restrict entry with prominent display boards, of un-authorised persons during testing.

17. Where necessary, control desks shall have inter-locks and control shall be with the authorised persons only.

18. In respect of testing Liquid dielectric, provision for body shower and eye-wash shower with exclusive over head tank for these showers.

10. PROFICIENCY TESTING

The applicant and accredited electrical testing laboratories are required to participate in Proficiency Testing Programmes conducted by NABL or the nodal organizations appointed by NABL. Laboratories shall also participate (as far as available and practicable) in international Inter- Laboratory Comparison/ Proficiency Programmes conducted by APLAC, EA or equivalent organizations.

The accredited laboratories shall demonstrate technical competence of its accredited facilities by satisfactory participation in International/ Regional/ National Proficiency Testing Programmes, including APLAC in a manner so that each major sub-areas of major disciplines of a laboratory's scope of accreditation are covered in a cycle of 4 years. This will of course not apply to those special areas where Inter-Laboratory Proficiency Testing Programmes are not available, the laboratory is expected to self-initiate inter-laboratory comparison involving other similar accredited laboratories.

All applicant laboratories are required to successfully participate in at least one Inter – Laboratory Proficiency Testing in accordance with ISO/ IEC Guide-43 (I)- 1996. For this purpose all alternative techniques covered in ISO/ IEC Guide-43 shall be acceptable.

The procedure to conduct Proficiency Testing Programme is described in NABL 162 and ISO/ IEC Guide 43.

Some of the important tests where the laboratory can demonstrate its technical capability are listed at Annexure V.

Annexure I

TESTS UNDER BROAD AREAS

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17.	Electromagnetic interference (EMI) / Electromagnetic compatibility (EMC) test facility		102
18.	Environmental test facility		103

1. SWITCHGEAR EQUIPMENT

Table 1

Sl.	Product/ Material	Standard/ Specification
1	High-voltage alternating current circuit-breakers	IS 13118 (1991) IEC 62271-100 (2001)
2	Alternating current disconnectors and earthing switches	IS 9921 Part 1, 2, 3, 4 & 5 (1981, 1982 & 1985) IEC 62271-102 (2001)
3	Switches for rated voltages above 1 kV and less than 52 kV	IS 9920 Part 1, 3 & 4 (1981, 1982 & 1985) IEC 62271-103 (1998)
4	High voltage switches for rated voltages of 52 kV and above	IS 9920 Part 2 (2001) IEC 62271-104 (1988)
5	High-voltage alternating current switch-fuse combinations	IS 14666 (1999) IEC 62271-105 (2002)
6	High-voltage alternating current contactors and contactor-based motor-starters	IS 9046 (1978), IEC 62271-106 (2000) IS 12661-Part 1 (1988)
7	High-voltage alternating current switchgear-fuse combinations	IEC 62271-107(2002)
8	Switchgear having combined functions	IEC 62271-108(2001)
9	Automatic circuit reclosers	IS 7567 (1993)
10	AC metal enclosed switchgear and controlgear for rated voltages above 1kV and upto and including 52 kV	IS 3427 (1997) IEC 62771-200 (1990)
11	AC insulation enclosed switchgear and controlgear for rated voltages above 1 kV and upto and including 38 kV	IS 14659 (1999) IEC 62271-201 (1987)
12	High-voltage/ low-voltage prefabricated substations	IS 14786 (2000) IEC 62271-202 (1995)

13	Gas-insulated metal-enclosed switchgear for rated voltages of 72.5 kV and above	IEC 62271-203 (1990)
14	Rigid high-voltage gas-insulated transmission lines for rated voltages of 72.5 kV and above	IEC 62271-204 (1998)
15	Cable connections for gas-insulated metal-enclosed switchgear for rated voltages of 72.5 kV and above	IEC 62271-305 (1999)
16	Interconnecting bus-bars for AC voltages above 1 kV and upto and including 36 kV	IS 8084 (1976)
17	High voltage fuses	IS 9385 (1979) IEC 60282 (2002) IS 9402 (1980) IEC 60549 (1976) IS 10024 (1981) IEC 60644 (1979)
18	By-pass circuit breakers	IEC 60143-2 (1994)
19	Electromechanical contactors for house hold purpose	IEC 61095 (2000)
20	Enclosed distribution fuse-board and cut out for voltage not exceeding 1000 V	IS 2675 (1983)
21	Distribution pillar for voltage not exceeding 1000 V	IS 5039 (1983)
22	Thermostatic bimetals	IS 8588 (1977)
23	Low-voltage switchgear and controlgear assemblies	IS 8623 (1993) IEC 60439 (1999)
24	Circuit-breakers for over current protection for house hold and similar installation	IS 8828 (1996) IEC 60898 (2002)
25	Composite units of air break switches and rewirable type fuses for voltage not exceeding 650 Vac	IS 10027 (1981)
26	Specification for control transformer for switchgear and controlgear for voltage not exceeding 1000 Vac.	IS 12021 (1987)

27	Residual current operated circuit breaker for house hold and similar uses	IS 12640 (2000) IEC 61008 (1996) IEC 61009 (1996) IEC 60755 (1983)
28	Semiconductor contactors	IS 12947 Part 4 (1990) IEC 60947-4-3 (1999)
29	Miniature circuit breaker board for voltage upto and including 1000 Vac	IS 13032 (1991)
30	Low Voltage Circuit breakers	IS 13947 Part 2 (1993) IEC 60947-2 (1995)
31	LV Switches, disconnectors, switch-disconnectors, and fuse combination units	IS 13947 Part 3 (1993) IEC 60947-3 (1999)
32	LV Contactors and motor starters	IS 13947 Part 4 (1993) IEC 60947-4 (1990)
33	Control-circuit devices and switching elements for low voltage switchgear and controlgear	IS 13947 Part 5 (1993) IEC 60947-5 (1999)
34	Multiple function equipment	IEC 60947-6 (1994)
35	Ancillary equipment	IEC 60947-7 (1999)
36	Low voltage fuses for voltages not exceeding 1000 Vac or 1500 Vdc	IS 13703 (1993) IEC 60269 (1998)
37	Rewirable type fuses and fuse bases	IS 2086 (1993)
38	D type fuses	IS 8187 (1976) IEC 60269-3 (1987)
39	Miniature Fuses	IEC 60127 (1990)

Table 2

Sl.	Tests
1	Short circuit making and breaking current tests
2	Short line fault tests
3	Out of phase making and breaking tests
4	Capacitive current switching tests
5	Switching of shunt reactors
6	Short time withstand current and peak withstand current tests
7	Temperature rise tests
8	Mechanical operations tests
9	Humidity tests
10	Power frequency voltage withstand tests
11	Lightning impulse tests
12	Artificial pollution tests
13	Test of resistance to tracking
14	RIV tests
15	Visual corona tests
16	Operation and operating limits
17	Dielectric tests on main circuit
18	Dielectric tests on Auxiliary and control circuit / equipment
19	Measurement of the resistance of the main circuit
21	Verification of degree of protection
23	Electromagnetic compatibility (EMC) tests
24	Tightness tests
25	Operational performance
26	Verification of rated making and breaking capacities

27	Constructional requirements
28	Low and high temperature tests
29	Seismic qualification
30	Tests for severe ice conditions
31	Static terminal load tests
32	Test under conditions of arching due to internal fault
33	Thermal ability tests
34	Mechanical strength tests
35	Ageing tests
36	Mechanical endurance tests
37	Induced current switching tests
38	Bus charging switching tests
39	Bus transfer current switching tests
40	Breaking tests on fuses
41	Tests for time-current characteristics
42	Tests for strikers
43	Mechanical tests on fuses
44	Proof test for enclosures
45	Weatherproofing test
46	Making and breaking tests on HV switches
47	Test for tripping limits and characteristics
48	Test for overload performance
49	Verification of releases, contact position, etc.
50	Test for short-circuit breaking capacities
51	Strength of actuator mechanism
52	Rated conditional short-circuit current

53	28 days test
54	Tripping characteristics
55	Mechanical shock and impact
56	Resistance to abnormal heat
57	Resistance to rusting
58	Operating characteristic
59	Immunity tests
60	Reliability
61	Power dissipation and power acceptance

2. ROTATING ELECTRICAL MACHINES

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Induction motors	IS 325 (1996) IEC 60034-2 (1972) IS 7538 (1996)
2	1ph Induction motors and Universal motors	IS 996 (1979)
3	Submersible pumpset	IS 8034 (1989)
4	Monoset	IS 9079 (1989)
5	Self priming pumps	IS 8418 (1999)
6	Self priming Regenerative pumps	IS 8472 (1998)
7	Openwell submersible pumpset	IS 14220 (1994)
8	Jet Centrifugal pumps	IS 12225 (1997)
9	Submersible motors	IS 9283 (1995)
10	Increased Safety motors	IS 6381 (1972)
11	Alternators	IS 13364 Part 1 & 2 (1992)
12	Energy efficient 3 phase squirrel cage induction motor	IS 12615 (1989)

Table 2

PUMPS & MOTORS

Sl.	Test
1	Marking
2	Terminal Marking
3	Earthing
4	Measurement of Stator Resistance
5	No Load test at Rated voltage
6	Reduced voltage Running up test
7	Full Load test
8	Momentary overload test
9	Temperature Rise Test at Rated Voltage
10	Temperature Rise Test at Reduced Voltage
11	Locked Rotor test
12	High voltage test
13	Insulation Resistance test
14	Vibration test
15	Pump performance test
16	Hydrostatic test
17	Direction of rotation
18	Type of Enclosure
19	Pull up & Pull out Torque test
20	Moisture Proofness Test
21	Leakage Current Test
22	Commutation test

23	Dimension test
24	Seat test
25	Housing test
26	K value test
27	Checks for Internal Threads
28	Priming time
29	Impeller & Rotor Balancing
30	Construction details
31	Surface finish of Rotor Shaft
32	Measurement of Shaft Extension
33	Construction and Workmanship
34	Checks against Document
35	Checking of joint
36	Surfaces and gaps
37	Test on Transparent Part of enclosure
38	Pressure test (Static & Dynamic)
39	Constructional Requirement
40	Checking of Creepage and Clearance distances

ALTERNATORS

Sl.	Test
1	Marking
2	Terminal Marking
3	Earthing
4	Measurement of Stator resistance Phase Sequence
5	Regulation test
6	Measurement of Open Circuit characteristics
7	Measurement of Short Circuit characteristics
8	Efficiency test
9	Temperature rise test
10	Overspeed test
11	High voltage & Insulation Resistance test
12	Deviation of voltage waveform from sinusoidal
13	Momentary overcurrent

3. TRANSFORMERS AND REACTORS

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Power Transformers	IS 2026 (1977) IEC 60076 (1993)
2	Dry Type Power Transformers	IS 11171 (1985) IEC 60076 (1993) IEC 60726 (2001)
3	Distribution Transformers (Non-sealed Type)	IS 1180 Part 1 (1989)
4	Distribution Transformers (Sealed Type)	IS 1180 Part 2 (1989)
5	Reactors – Shunt	IS 5553 Part 2 (1989) IEC 60289 (1988)
6	Reactors Current limiting reactors and neutral earthing reactors	IS 5553 Part 3 (1990) IEC 60289 (1988)
7	Reactors – Damping reactors	IS 5553 Part 4 (1989) IEC 60289 (1988)
8	Reactors – Tuning	IS 5553 Part 5 (1989) IEC 60289 (1988)
9	Reactors – Earthing Transformers	IS 5553 Part 6 (1990) IEC 60289 (1988)
10	Reactors – Arc Suppression	IS 5553 Part 7 (1990) IEC 60289 (1988)
11	Reactors – Smoothing	IS 5553 Part 8 (1990) IEC 60289 (1988)

Table 2

Sl.	Tests
1	Measurement of winding resistance
2	Measurement of voltage ratio and check of voltage vector relationship
3	Measurement of impedance (principal tapping) and load loss
4	Measurement of no-load loss and current
5	Measurement of insulation resistance
6	Dielectric tests
7	Temperature rise
8	Tests on on-load tap-changes, where appropriate
9	Measurement of zero-sequence impedance of three phase transformer
10	Short Circuit test
11	Measurement of acoustic noise level
12	Measurement of the harmonics of the no-load current
13	Measurement of the power taken by the fans and oil pumps
14	Dielectric special tests
15	Determination of Capacitances Windings
16	Determination of transient voltage transfer characteristics
17	Measurement of insulation resistance to earth of the windings, and/or measurement of dissipation factor of the insulation system capacitances
18	Measurement of Reactance
19	Measurement of loss
20	Measurement of voltage ratio and short circuit impedance on shunt reactor as with additional loadable winding
21	Measurement of mutual reactance on three phase reactors
22	Measurement of vibration and stress measurement on tank

23	Measurement of magnetization characteristics
24	Measurement of capacitance and tan delta of winding (applicable only to liquid filled reactors)
25	Dissolved gas analysis of mineral oil used before and after heat run tests
26	Measurement of impedance of continuous current if applicable
27	Measurement of loss if applicable
28	Separate-source voltage withstand test
29	Induced over voltage withstand test
30	Lightning impulse test
31	Measurement of Inductance
32	Inter-turn cover overvoltage withstand test
33	Q factor measurement
34	Demonstration of ability to withstand short circuit
35	Measurement of current at all adjustments
36	Measurement of voltage ratio between main winding and auxiliary and secondary windings where appropriate
37	Operation test of tapping or core air gap mechanism, where appropriate
38	Measurement of linearity upto 1.1 times related voltage
39	Separate source voltage withstand test with AC and DC voltages where applicable
40	Switching impulse test
41	Measurement of winding DC resistance
42	DC voltage withstand test
43	Short time current withstand test
44	Measurement of Vibration
45	Measurement of high-frequency impedance

46	Measurement of voltage ratio and short circuit impedance on shunt reactor as with additional loading winding
47	Measurement of magnetic characteristics
48	Short time current test and measurement of impedance at short time current
49	Measurement of current over the whole adjustment range, if reactor has variale inductance
50	Measurement of voltage-current characteristics upto 1.1 time the rated voltage
51	Measurement of incremental inductance
52	Radio Interference Voltage (RIV) test
53	Frequency Response Analysis (FRA) test
54	Residual Spark Over (RSO) test
55	Recovery Voltage (RV) test
56	Discharge detection by acoustic emission (AE) measurement

4. TRANSMISISON LINE EQUIPMENT AND ACCESSORIES

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Insulators and Insulator Strings Single/Twin/Triple/Quad – Tension or Suspension type, Composite Insulators, Hollow Insulators	IS 731 (1971) IS 5300 (1981) IS 283 (1991) IS 2544 (1973) IS 5621 (1980) IEC 61109 (1992) IEC 383- (1993) IEC 60383-2 (1993) IEC 60438 (1973) IEC 60233 (1974) IEC 61211 (1994) IEC 61109 (1992)
2	Low Voltage Switch Gear and Control gear assemblies – Feeder Pillers, Bustrunking System, Busways	IS 8623 Part 1 (1993) IEC 60439 (1985)
3	Inter Connecting Busbars (HT Busducts)	IS 8084 (1976)
4	Carriers and Bases in Rewireable type electric fuses	IS 2086 (1993)
5	HV Fuses	IS 9385 Part 1, 2 & 3 (1980) IEC 60282-2 (1987)
6	Gas Enclosed Metal enclosed Switchgears	IS 14657 (1999) IEC 60517 (1990) IEC 1259 (1994)
7	Bushings	IS 2099 (1996) IEC 60137 (1995)
8	Isolators & Air break switches	IS 9920 Part 1 to 4 (1981, 82, 85) IS 9921 Part 1 to 4 (1981, 82, 85) IEC 62271-102 (2001)

9	Circuit Breakers	IS 2516 Part 5/ Sec 2 1990 IS 13118 (1991) IEC 62271-100 (2001)
10	Current Transformers, Potential Transformers	IS 2075 Part 1 & 4 (1992) IEC 60044 Part 1(1996)
11	Capacitive Voltage Transformers & Coupling Capacitors	IS 3156 Part 1,2,3 & 4 (1992) IEC 60186 (1987) IEC 60044 Part 1 (1996) IEC 60358 (1990)
12	Line Traps	IS 8793 (1995) IS 8792 (1995) IEC 60353 (1989)
13	Lightning Arresters (Both Gap & Gap less)	IS 3070 Part 1 (1985) Part 3 (1993) IEC 60099-4 (1998)
14	Transmission Line Spacers / Dampers	IS 9708 (1993) IS 10162 (1992)
15	Metal Fittings For Overhead Lines	IS 2486 Part 1 (1993) Part 2 (1989) Part 3 (1974) Part 4 (1981)
16	Electric Power Connectors	IS 5561 (1970)
17	Aluminum Conductors for Overhead Transmission Purposes	IS 398 Part 1 to 5 (1992) IEC 60269 (1998) IEC 61089 (1993) IEC 60457 (1997)
18	Conductor and Earth wire Accessories for overhead Powerlines	IS 2121 Part 1 to 3 (1981)

Table 2

Sl.	Test
1	Endurance Test
2	Temperature rise test / Thermal Stability test
3	Millivolt Drop Test
4	Resistance Measurement
5	Heat Cycle Test
6	Current cycle Test
7	Ingress Protection IP 55 Test
8	Power frequency withstand & Flashover tests (Dry & Wet)
9	Direct Voltage withstand & Flashover tests (Dry & Wet)
10	Insulation Resistance Test
11	Lightning Impulse Voltage withstand & Flashover tests (Dry & Wet)
12	Switching Impulse Voltage withstand Flashover test (Dry & Wet)
13	Capacitance and Tan δ measurement
14	Radio Interference voltage test (Dry & Wet)
15	Visible Corona / Corona Inception & Extinction test (Dry & Wet)
16	Pollution tests
17	Voltage Distribution test
18	Fast Transient test
19	Ferro Resonance test
20	Transient Response test
21	Under oil Puncture withstand test
22	Short Circuit test
23	Recovery Voltage Measurement test
24	Steep front Impulse Voltage withstand Puncture test

25	Discharge test
26	Residual Voltage test
27	Long duration Impulse current withstand test
28	High Current Impulse withstand test
29	Reference Voltage test
30	Operating duty test
31	Accuracy test
32	Instrument Security factor test existing
33	Knee Point voltage and current test
34	Winding Resistance test
35	Turns Ratio test
36	Composite Error test
37	Ratio & Phase angle Measurement test
38	Partial Discharge test
39	Test for Temperature Co-efficient
40	Test for Stray Capacitance & Stray Conductance
41	Power Frequency Voltage Vs Time test
42	Discharge Voltage Vs Current test
43	Duty Cycle test
44	Fatigue Test / ISWR Test
45	Damper Efficiency Test
46	Vibration Test
47	Oscillation Test
48	Movement Test
49	Torque Test
50	Tensile Strength

51	Clamp Step Test
52	Long Decrement Test
53	Dynamic Characteristics Test
54	Clamp Bolt Torque Test
55	Compression Pull off Test
56	Mechanical Strength Test
57	Mechanical Failing load Test
58	Galvanising Test
59	Electro Mechanical Failing load test
60	Cantilever load withstand test
61	Snap back test
62	Porosity test on Ceramic Insulators

5. CABLES AND ACCESSORIES

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Power Cables with Extruded insulation/ XLPE insulated cable	IS 7098 Part 1 (1988) Part 2 (1985) Part 3 (1993) IEC 60502 Part 1 (1998) Part 2 (1998) IEC 60840 (1999) BS 6622 (1999) BS 5467 (1997)
2	Elastomer insulated flexible cables for use in mines	IS 14494 (1998)
3	Elastomer insulated cables/ cables with extruded Ethylene- propylene Rubber	IS 9968 Part 1 (1988) Part 2 (1981) IEC 60245 -1 (1994) -2 (1998) -3 (1994) -4 (1994) -5 (1994) -6 (1994) -7 (1994) -8 (1998) BS 6622 (1991)
4	Joints and Terminations of Polymeric cables	IS 13573 (1992) RA (1998) IEC 60502- 04 (1997) VDE 0278-HSD 629.1 (1997) C-81
5	Transition Joints of power cables	IS 13705-1993 RA (1998)
6	PVC insulated wires, control cables & power cables	IS 694 (1990) IS 1554 Part 1 (1988) Part 2 (1988) IEC 60227 Part 1 (1998) BS 6346 (1997) NEMA WC-5 (1973) NEMA WC-7 (1988)

7	Aerial bunched cables /conductor	IS 14255 (1995)
8	Paper insulated lead sheathed cables	IS 692 (1994) IEC 60055 Part 1 (1997) Part 2 (1981) BS 6480 (1988)
9	Automobile cables	IS 2465 (1984)
10	Welding Cables	IS 9857 (1990)
11	Low Frequency wires and cables with PVC insulation and PVC sheath (for use in signaling, telecommunication & electronic devices)	IS 5608 Part 1 (1991) Part 2 (1970) Part 3 (1976) Part 4 (2000) Part 5 (2002) Part 6 (2001)
12	Thermo-couple compensating cables	IS 8784 (1987)

Table 2

Sl.	Test
1	Partial Discharge Test
2	Electrical Heat Cycle test/Load Cycle test/Water penetration test/ Heat Shock Test for LT Joints
3	Conductor resistance test / Armour resistivity test
4	Capacitance Measurement Test
5	Dielectric Loss Angle Measurement test at room temperature and elevated temperature
6	DC Withstand Test
7	Power Frequency Withstand test / Dielectric strength test
8	Dimension of Armour material
9	Water absorption test (electrical)
10	Water absorption test (Gravimetric)
11	Impulse withstand test
12	Wrapping test / Bending test / Winding test
13	Galvanising test (Uniformity of Zinc coating & mass of zinc coating)
14	Thickness & Dimension test
15	Fire resistance / Flammability / Swedish Chimney / Bunch Cable test / Flame retardance test for bunched cable
16	Insulation resistance test / Volume resistivity test / IR constant /Semiconductor resistivity
17	Smoke density test
18	Oxygen Index test
19	Halogen Acid test
20	Drainage test / Dripping test / Test for resistance to cracking / Pressure test as high temperature / Mineral Oil immersion test / Ageing test / Heat shock, Shrinkage, Loss of mass, Hot set / Hot deformation

21	Mechanical test / Tensile test / Breaking strength test / Tear resistance test
22	Mechanical test / Elongation test / Annealing test
23	Mechanical test / Impact test
24	Cold Impact test / Cold bend test / Conditioning test/ Cold elongation test
25	Thermal Stability test for PVC material
26	Water Immersion test
27	Dielectric Retention test
28	Mutual capacitance & Inductance test
29	Capacitance unbalance test
30	Thermal emf test (thermo-couple cable)
31	Drain wire continuity test (thermo-couple cable)

6. POWER CAPACITORS

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Shunt Capacitors	IS 13925 (1998) IEC 60831-1 (1998) -2 (1994) IEC 60871-1 (1997) -2 (1999) -3 (1996) -4 (1996)
2	Surge Protection Capacitors	IS 11548 (1986)
3	Motor Capacitors	IS 2993 (1998) IEC 60252 (1993)
4	Tubular Fluorescent Capacitors	IS 1569 (1976) IEC 61049 (1991) IEC 61048 (1999)
5	Capacitors for electric fan motors	IS 1709 (1995)
6	Shunt Capacitors Self healing type	IS 13340 (1993) IS 13341 Part 1 (1992) IEC 60831-1 (1996) IEC 60831-2 (1995)
7	Shunt Capacitors non-self healing type	IS 13585 (1994) IEC 60931 -1 (1996) -2 (1995) -3 (1996)
8	Series Capacitors	IEC 60143 -1 (1992) -2 (1994) -3 (1998)

Table 2

Sl.	Test
1	Capacitance measurement test @ room temperature and elevated temperature
2	Dielectric loss angle measurement test @ room temperature and elevated temperature
3	Power frequency withstand test / DC withstand test / Dielectric strength / Voltage test between terminals & container
4	Reactive output test
5	Test for discharge device
6	Thermal stability test / Thermal cycling test
7	Sealing test / Leakage test / Heating test
8	Short circuit discharge test / Destruction test
9	Insulation resistance test
10	Lightning voltage withstand test
11	Damp Heat test on LT capacitors
12	Endurance test on motor / fan / lighting capacitors
13	Self healing test
14	Ageing / Conditioning test
15	Mechanical test on motor / fan / lighting capacitors Robustness of termination Flexibility Soldering
16	Endurance test on HT capacitors: Over voltage cycling test (OVC) and Ageing test
17	Partial discharge test
18	Charge / Discharge test
19	Discharge test on internal fuses
20	Visual Examination
21	Disconnecting test on fuses

7. LAMPS, LUMINARIES AND ACCESSORIES

Table 1

Sl.	Product/ Material	Standard/ Specification
1	General purpose luminaires	IS 10322 Part 5/ Sec1 (1985) IEC 60598-2-1(1999)
2	Recessed luminaires	IS 10322 Part 5/ Sec 2 (1985) IEC 60598-2-2(1997)
3	Luminaires for road and street lighting	IS 10322 Part 5/ Sec 3 (1987) IEC 60598-2-3(2001)
4	Portable general purpose luminaires	IS 10322 Part 5/ Sec 4 (1987) IEC 60598-2-4(1997)
5	Flood lights	IS 10322 Part 5/ Sec 5 (1987) IEC 60598-2-5 (1998)
6	Emergency lighting units	IS 9583 (1981) IEC 60598-2-22 (2002)
7	Tungsten filament general service electric lamps	IS 418 (1978) IEC 60064 (1993)
8	High pressure mercury vapour lamps	IS 9900 Part 1,2,3 & 4 (1981) IEC 60188 (2001)
9	High pressure sodium vapour lamps	IS 9974 Part1 & 2 (1982) IEC 60662 (1980)
10	Tubular fluorescent lamps	IS 2418 Part 1,2,3 & 4 (1977) IEC 60081(2002)
11	Tungsten halogen lamps (Non vehicle)	IS 12948 (1990) IEC 60357(2001)
12	Lamps for miners cap lamp	IS 2596 (1980) IEC 60983 (1995)

13	Starters for fluorescent lamps	IS 2215 (1983) IEC 60155 (1993)
14	Ballast for high pressure mercury vapour lamps	IS 6616 (1982) IEC 60922 (1997) IEC 60923 (1995) IEC 61347-2-9 (2000)
15	Ballast for fluorescent lamps (for switch start circuits)	IS 1534 Part1 (1977) IEC 60921 (1988) IEC 61347-2-8 (2000)
16	Capacitors for use in tubular fluorescent, high pressure mercury vapour and low pressure sodium vapour lamps	IS 1569 (1976) IEC 61048 (1991) IEC 61049 (1991)
17	AC supplied electronic ballast for tubular fluorescent lamps	IS 13021 Part 1 & 2 (1991) IEC 60928 (1999) IEC 60929 (1990) IEC 61347-2-3 (2000)
18	Starting devices (Other than glow starters)	IS 12449 Part 1 & 2 (1988) IEC 60927 (1996) IEC 61347-2-1(2000)
19	Bayonet lamp holders	IS 1258 (1987) IEC 61184 (1997)
20	Lamp holders for tubular fluorescent lamps	IS 3323 (1980) IEC 60400 (1999)
21	Holders for starters for tubular fluorescent lamps	IS 3324 (1982) IEC 60400 (1999)
22	Edision screw lamp holders	IS 10276 Part 1 & 2 (1982) IEC 60238 (2000)
23	Self ballasted lamps	IS 15111 Part 1 & 2 (2002) IEC 60968 (1999) IEC 60969 (2001)

24	Industrial luminaire with metal reflector	IS 1777 (1978)
25	Metal Halide Lamps	IEC 61199 (1992)

Table 2

Sl.	Test
1	Test on flammable materials
2	Resistance to corrosion
3	Test for supply connection and external cords
4	Provisions for earthing
5	Protection against electric shock
6	Mechanical test for terminals
7	Screws and connection test
8	Mechanical Strength
9	Contact resistance for terminals
10	Heating test for terminals
11	Dust proof test
12	Jet proof test
13	Constructional requirements
14	Test on Suspension and adjustable devices
15	Function of switches
16	Operating test
17	Insulation resistance
18	Electric strength
19	Endurance test for Emergency Lights
20	Dimensions
21	Torsion test
22	Starting and warm up test (HPMV and HPSV lamps)
23	Lamp electrical and luminous characteristics
24	Lamp voltage (HPMVlamps)

25	Lamp wattage (HPMV lamps)
26	Red Ratio (for fluorescent coated HPMV lamps)
27	Lamp stability (HPMV lamps)
28	Life performance
29	Lumen maintenance
30	Open circuit voltage (HPSV lamps)
31	Starting pulse characteristics (HPSV lamps)
32	Current crest factor (HPSV lamps)
33	Lamp operating limits (HPSV lamps)
34	Voltage increase at lamp terminals (HPSV lamps)
35	Lamp envelope temperature (HPSV lamps)
36	Lamp cap temperature rise
37	Interchangeability
38	Starting characteristics (Tubular fluorescent lamps)
39	Burning test (Tubular fluorescent lamps)
40	Colour characteristics (Tubular fluorescent lamps)
41	Light centre length (Miners cap lamps)
42	Radio interference suppression test (Starters)
43	Deactivated lamp test (Starters)
44	Leakage current test (Starters)
45	Resistance to flame and ignition (Starters)
46	Test for power and current output (Ballast for HPMV lamps)
47	Short circuit current (Ballast for HPMV lamps)
48	Open circuit voltage (Ballast for HPMV lamps)
49	Test for current wave shape (Ballast for HPMV lamps)
50	Protection against magnetic influence (Ballast for HPMV lamps)

51	Limitation of ballast heating (Ballast for HPMV lamps)
52	Resistance to corrosion and brittleness (Ballast for HPMV lamps)
53	Voltage across capacitors (Ballast for tubular fluorescent lamps)
54	Inter turn insulation (Ballast for tubular fluorescent lamps)
55	Thermal endurance (Ballast for tubular fluorescent lamps)
56	Ballast heating (Ballast for tubular fluorescent lamps)
57	Performance (Ballast for tubular fluorescent lamps)
58	Power loss (Ballast for tubular fluorescent lamps)
59	Test for effect of voltage variation (Capacitors for discharge lamps)
60	Test for discharge resistance (Capacitors for discharge lamps)
61	Sealing and heating test (Capacitors for discharge lamps)
62	Voltage proof test (Capacitors for discharge lamps)
63	Capacitors measurement (Capacitors for discharge lamps)
64	Thermal stability (Capacitors for discharge lamps)
65	Self healing test (Capacitors for discharge lamps)
66	Damp heat cycling test Capacitors for discharge lamps)
67	Destruction test (for self healing type)(Capacitors for discharge lamps)
68	Abnormal operation (a.c. supplied electronic ballasts)
69	Test for fault conditions (Short circuit test) (a.c. supplied electronic ballasts)
70	Starting test (a.c. supplied electronic ballasts)
71	Verification of lumen factor (a.c. supplied electronic ballasts)
72	Verification of supply current (a.c. supplied electronic ballasts)
73	Verification of maximum current (a.c. supplied electronic ballasts)
74	Measurement of wave form (a.c. supplied electronic ballasts)
75	Test for magnetic screening (a.c. supplied electronic ballasts)
76	Verification of impedance of audio frequency (a.c. supplied electronic ballasts)

77	Test for mains transients over voltage (a.c. supplied electronic ballasts)
78	Operational test for abnormal conditions (a.c. supplied electronic ballasts)
79	Test for fault conditions (Starting devices, other than glow starter)
80	Measurement of pulse voltage of igniters (Starting devices, other than glow starter)
81	Test with deactivated lamps (Starting devices, other than glow starter)
82	Non-re-operation level test for igniters (Starting devices, other than glow starter)
83	Making and breaking capacity for switched lamp holders
84	Resistance to heat in service (Bayonet lamp holders)
85	Resistance to excessive residual stresses and to rusting (Bayonet lamp holders)
86	Contact pressure and torque of cap pins (Lamp holders for Tubular fluorescent lamps)
87	Non-flammability test (Lamp holders for Tubular fluorescent lamps)
88	Impact test (Lamp holders for Tubular fluorescent lamps)
89	Corrosion test (Lamp holders for Tubular fluorescent lamps)
90	Brittleness test (Lamp holders for Tubular fluorescent lamps)
91	Test for heat resistance (Lamp holders for Tubular fluorescent lamps)
92	Test for contact pressure or torque (Holders for starters for tubular fluorescent lamps)
93	Resistance to heat
94	Resistance to heat, fire and tracking
95	Resistance to cracking and rusting

8. WIRING ACCESSORIES

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Ceiling Roses	IS 371 (1999)
2	Plugs and Socket outlets	IS 1293 (1988) IEC 60884-1 (1994)
3	Switches for domestic and similar purposes	IS 3854 (1997) IEC 60669-1 (2000)
4	Interlocking switch socket outlets	IS 4160 (1967) IEC 60884-2-6 (1996)
5	Switch socket outlets (Non interlocking type)	IS 4165 (1968) IEC 60884-2-3 (1989)
6	Three pin plugs made of resilient material	IS 6538 (1971) IEC 60884-1 (1994)
7	Enclosures for accessories	IS 14772 (2000) IEC 60670 (1989)
8	Conduits for electrical installations, Rigid steel conduits	IS 9537 Part 2 (1981) IEC 60614-2-1 (1982)
9	Conduits for electrical installations, conduits made of insulating material	IS 9537 Part 3 (1983) IEC 60614-2-2 (1980)
10	Conduits for electrical installations, Pliable self recovering conduits of insulating material	IS 9537 Part 4 (1983) IEC 60614 –2-4 (1985)
11	Conduits for electrical installations, Pliable conduits of insulating material	IS 9537 Part 5 (2000) IEC 60614-2-2-3 (1990)
12	Conduits for electrical installations, Pliable conduits of metal or composite material	IS 9537 Part 6 (2000) IEC 60614-2-6 (1992)

13	Fittings for rigid steel conduits	IS 2667 (1988) IEC 61035-2-1 (1993)
14	Fittings for rigid non metallic conduits	IS 3419 (1989) IEC 61035-2-2 (1993)
15	Cable trunking and ducting systems for electrical installations, Cable trunking and ducting systems intended for mounting on walls or ceilings	IS 14927 Part1 & 2 (2001) IEC 61084-1 (1991) IEC 61084-2-1 (1996)
16	Conduit systems for electrical installations, conduit system buried underground	IS 14930 Part 1 & 2 (2001) IEC 61386 (1996)
17	Electronic type fan regulator	IS11037 (1984) IEC 60669-2-1 (1996)

Table 2

Sl.	Test
1	Dimensions
2	Protection against electric shock (accessibility of live parts)
3	Provisions for earthing
4	Terminals and Screws
5	Construction
6	Construction
7	Resistance to moisture and humidity
8	Marking
9	Insulation Resistance and Electric Strength
10	Temperature Rise
11	Resistance to rusting
12	Mechanical Strength
13	Resistance to Heat
14	Screws, Current Carrying Parts and Connections
15	Creepage distances and clearances
16	Glow wire test
17	Tracking Test
18	Resistance to excessive residual stress
19	Interchangeability
20	Resistance to ageing
21	Making and Breaking capacity
22	Effectiveness of contact
23	Endurance test for shutters
24	Water absorption

25	Withdrawal pull
26	Cord grip
27	Resistance to abnormal heat and fire
28	Mechanism for switches
29	Normal operation/ Endurance
30	Electroplating thickness
31	Test for protective coating
32	Resistance to ageing, harmful ingress of water
33	Resistance to chemical reaction
34	Copper test
35	Resistance to oil
36	Resistance to impact
37	Actuating mechanism
38	Interlocking mechanism
39	Over voltage and over current capacity
40	Test for inductive circuit
41	Compression test
42	Resistance to burning
43	External influences
44	Uniformity of wall thickness
45	Collapse test
46	Electrical characteristics
47	Cable supporting test
48	Linear deflection test
49	Access to live parts
50	Cover retention test

51	Flame test
52	Flexing test
53	Tensile test
54	Bonding test
55	Resistance to flame propagation
56	Resistance against corrosion
57	Degree of protection

9. DOMESTIC ELECTRICAL APPLIANCES

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Electric Iron	IS 302 Part 2/ Sec 3 (1992) IEC 60335-2-3 (1993) IS 366 (1991) IEC 60311 (1999)
2	Steam irons	IS 302 Part 2/ Sec 205 (1994) IEC 60335-2-3 (1993) IS 6290 (1986) IEC 60311 (1999)
3	Electric Kettles and Jugs	IS 302 Part 2/ Sec 15 (1994) IEC 60335-2-15 (1995) IS 367 (1993) IEC 60530 (1975)
4	Electric Toasters	IS 302 Part 2/ Sec 9 (1993) IEC 60335-2-9 (1993) IS 1287 (1993) IEC 60442 (1998)
5	Electric grills and roasters	IS 302 Part 2/ Sec 9 (1993) IEC 60335-2-9 (1993)
6	Electric stoves	IS 302 Part 2/ Sec 202 (1992) IS 2994 (1992)
7	Microwave Ovens	IS 302 Part 2/ Sec 25 (1994) IEC 60335-2-25 (1996) IS 11676 (1995) IEC 60705 (1999)
8	Electric Coffee Makers	IS 302 Part 2/ Sec 206 (1994) IEC 60335-2-15 (1995) IS 14144 (1994) IEC 60661 (1980)

9	Hot Plates	IS 302 Part 2/ Sec 207 (1994) IEC 60335-2-9 (1993) IS 365 (1983)
10	Domestic electric food mixers (liquidizers and grinders) and centrifugal juicers	IS 302 Part 2/ Sec 14 (1994) IEC 60335-2-14 (1994) IS 302 Part 2/ Sec 209 (1996) IS 4250 (1967) IEC 60619 (1993)
11	Domestic electric cooking ovens	IS 302 Part 2/ Sec 6 (1993) IEC 60335-2-6 (1997) IS 5790 (1985) IEC 60350 (1999)
12	Single walled baking ovens	IS 302 Part 2/ Sec 208 (1994) IEC 60335-2-6 (1997) IS 8985 (1978)
13	Electric frying pans and deep fat fryers	IS 302 Part 2/ Sec 13 (1994) IEC 60335-2-13 (1999) IS 10436 (1983) IEC 61309 (1995)
14	Electric Steam Cookers	IS 302 Part 2/ Sec 46 (1993) IS 11879 (1986)
15	Warming Plates	IS 302 Part 2/ Sec 12 (1993) IEC 60335-2-12 (1992)
16	Refrigerator (frost free & direct cool), Food freezers and Ice Makers	IS 302 Part 2/ Sec 24 (1994) IEC 60335-2-24 (1999) AS/NES 4474.1:1997 IS 1476 (Part-1):2006
17	Electric Immersion Water Heaters	IS 302 Part 2/ Sec 201 (1992) IEC 60335-2-74 (1994) IS 368 (1992)
18	Stationary storage type electric water heaters	IS 302 Part 2/ Sec 21 (1992) IEC 60335-2-21 (1997) IS 2082 (1993) IEC 60379 (1996)

19	Electric water boiler	IS 302 Part 2/ Sec 204 (1994) IS 3412 (1994)
20	Electric Instantaneous Water Heaters	IS 302 Part 2/ Sec 35 (1993) IEC 60335-2-35 (1997) IS 8978 (1991)
21	Thermostat for use with electric water heaters	IS 3017 (1985) IEC 60730-1 (1999)
22	Mineral filled sheathed heating elements	IS 4159 (2002) IEC 60335-2-73 (1994)
23	Electric Radiator	IS 302 Part 2/ Sec 30 (1992) IEC 60335-2-30 (1996) IS 369 (1993) IEC 60675 (1994)
24	Domestic electric clothes washing machines	IS 302 Part 2/ Sec 7 (1994) IEC 60335-2-7 (1998) IS 14155 (1994) IEC 60456 (1998)
25	Spin Extractors	IS 302 Part 2/ Sec 4 (1993) IEC 60335-2-4 (1993)
26	Tumble Dryers	IS 302 Part 2/ Sec 11 (1994) IEC 60335-2-11 (1993)
27	Vacuum Cleaners and Water Suction Cleaning Appliances	IS 302 Part 2/ Sec 2 (1997) IEC 60335-2-2 (1993)
28	Mains operated electric hair dryers	IS 302 Part 2/ Sec 23 (1995) IEC 60335-2-23 (1996) IS 7154 (1994)
29	Electric shavers	IS 302 Part 2/ Sec 8 (1994) IEC 60335-2-8 (1992) IS 5159 (1969) IEC 61254 (1993)

30	Electric hair clippers	IS 302 Part 2/ Sec 8 (1994) IEC 60335-2-8 (1992)
31	Flexible heating pads	IS 5161 (1969)
32	Appliance for skin and hair care	IS 302 Part 2/ Sec 23 (1995) IEC 60335-2-23 (1996)
33	Portable hand held mains operated electric massagers	IS 302 Part 2/ Sec 32 (1994) IEC 60335-2-32 (1993) IS 7137 (1973)
34	Electric Call Bells and Buzzers	IS 302 Part 2/ Sec 203 (1994) IS 2268 (1988)
35	Insect Killers	IS 302 Part 2/ Sec 59 (1999) IEC 60335-2-59 (1997)
36	Electric Fence Energizers	IS 302 Part 2/ Sec 76 (1999) IEC 60335-2-76 (1999)
37	Air conditioners	ISO 5151:1994 IS 1391 (Part-1) 1992 IS 1392 (Part-2) 1992 AWSI/AHAM RAC-1-2003 AS/NES 3823.1.1 (1998) SASO 385:1995 US 8148:1995

Table 2

Sl.	Test
1	Protection against electric shock
2	Input
3	Temperature rise
4	Operation under overload conditions
5	Electrical insulation and leakage current at operating temperature
6	Radio and television interference separation
7	Moisture resistance
8	Insulation resistance and electric strength (after humidity treatment)
9	Abnormal operation
10	Stability and mechanical hazards
11	Mechanical strength
12	Construction
13	Internal wiring
14	Components
15	Supply connection and external flexible cables and cords
16	Terminals for external conductors
17	Provisions for earthing
18	Screws and connections
19	Creepage distances and clearances
20	Resistance to heat, fire and tracking
21	Resistance to rusting
22	Finish
23	Measurement of Heating up time

24	Measurement of sole plate temperature
25	Measurement of temperature distribution
26	Measurement of initial overswing temperature and heating up excess temperature
27	Measurement of cyclic fluctuation of temperature
28	Measurement of temperature drop under load
29	Measurement of thermostatic stability
30	Determination of electroplated coating of sole plate
31	Determination of adhesive of PTFE coating of sole plate
32	Overall dimensions of electric radiator
33	Overall Mass of electric radiator
34	Water Capacity of electric kettle
35	Time to boil one litre of water of electric kettle
36	Minimum quantity of water that can be boiled of electric kettle
37	Time to boil water capacity of electric kettle
38	Temperature of supporting surface
39	Thermal efficiency
40	Endurance
41	Overall dimensions of electric toaster
42	Mass of appliance (Toaster)
43	Toasting time
44	Evenness of browning
45	Browning control characteristics
46	Functional provisions of toaster
47	Verification of rated capacity (Storage water heaters)
48	Standing loss (Storage water heaters)

49	Hot water output (Storage water heaters)
50	Reheating time
51	Mixing factor
52	Deviation from dial calibration
53	Cyclic temperature variation
54	Determination of the washing performance standard measurement with a load of clean material and standardized soiling. (Washing machines)
55	Determining of wear suffered by textile. (Washing machines)
56	Determination of water retention percentage. (Washing machines)
57	Determination of the water extraction efficiency. (Washing machines)
58	Determination of the water extraction efficiency. (Washing machines)
59	Determination of water and energy consumption. (Washing machines)
60	Determination of mechanical detergent loss in the sump. (Washing machines)
61	Performance of hair dryers
62	Operation of flow switch (Instantaneous water heaters)
63	Dimensions (Microwave ovens)
64	Usable cavity volume (Microwave ovens)
65	Microwave power output (Microwave ovens)
66	Uniform heating (Microwave ovens)
67	Heating performance (Microwave ovens)
68	Cooking performance (Microwave ovens)
69	Defrosting performance (Microwave ovens)
70	Dimensions (Coffee makers)
71	Mass (Coffee makers)
72	Quantity of coffee produced with maximum quantity of cold water (Coffee makers)
73	Quantity of coffee produced with minimum quantity of cold water (Coffee makers)

74	Time to prepare maximum quantity of coffee (Coffee makers)
75	Time to prepare maximum quantity of coffee (Coffee makers)
76	Temperature of the coffee (Coffee makers)
77	Measurement with maximum quantity of ground coffee (Coffee makers)
78	Temperature of the supporting surface (Coffee makers)
79	Test for thermal cut-out and thermal shock (Coffee makers)
80	Dimensions (Thermostat for water heaters)
81	Test for thermal characteristics (Thermostat for water heaters)
82	Leakage and hydrostatic strength test (for oil heating element)
83	Operational tests (Food mixers)
84	Whisking of egg whites (Food mixers)
85	IDLI batter (Food mixers)
86	Operational test for juicers (Food mixers)
87	Performance requirements (Electric shavers)
88	Construction (Flexible heating pads)
89	Heating element (Flexible heating pads)
90	Enclosures and covers (Flexible heating pads)
91	Wiring and connections (Flexible heating pads)
92	Switches and controls (Flexible heating pads)
93	Switches and controls (Flexible heating pads)
94	Switches and controls (Flexible heating pads)
95	Slow burning property (Flexible heating pads)
96	Usage simulation (Flexible heating pads)
97	Strain relief (Flexible heating pads)
98	Water proofness (Flexible heating pads)
99	Moisture proofness (Flexible heating pads)

100	Heating up time (Cooking ovens)
101	Heat losses (Cooking ovens)
102	Uniformity of temperature (Cooking ovens)
103	Thermostat setting and differential (for automatic cooking ovens only)
104	Measurement of heating up time under steaming operation (Steam iron)
105	Measurement of steaming time and steaming rate (Steam iron)
106	Performance requirements (Electric massagers)
107	Uniformity of temperature (Single walled baking ovens)
108	Thermostat setting (Single walled baking ovens)
109	Temperature differential (Single walled baking ovens)
110	Cooking capacity (Room Airconditioners – Window & Spilt)
111	Minimum Cooking / Freeze up air blockage test (Room Airconditioner – Window & Spilt)
112	Maximum cooking / overload (ac)
113	Enclosure Sweat and condensate disposal (ac)
114	Cooking capacity (Room A/C)
115	Pull down (Refrigerator)
116	Tested Energy Consumption (Ref)
117	Measurement of Storage & gross volume (Ref)
118	Operational Temperature Performance (Ref)
119	Ice making Test (Ref)
120	No Load Adjustment (Ref)
121	Thermal Insulation

10. POWER STABLISERS AND UNINTERRUPTED POWER SYSTEMS

10.1 STABILISED POWER SUPPLIES

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Stabilized power supplies DC output	IS 7204 Part 1 (1974) Part 2, 3 & 4 (1980) IEC 60748-2 (1975) IEC 60748-3 (1976) IEC 60748-4 (1976)
2	Stabilized power supplies AC output	IS 11260 Part 1 & 2 (1985) IEC 60686(1980)

Table 2

Sl.	Test
1	Load effect
2	Source effect
3	Periodic and random deviation
4	Drift
5	Output impedance
6	Temperature effect
7	Transient performance measurement
8	Settling effects
9	Other individual effects
10	Combined effects
11	Total effects
12	Measurement of quantities related to the source
13	Capacitance to source terminals
14	Capacitance to frame
15	Common mode measurement
16	Boundary condition measurements
17	Sound level measurement
18	Control effects
19	Isolation voltage
20	Insulation resistance test
21	Insulation test voltage
22	Radio frequency interference test

23	Inrush current
24	Rated source current
25	Efficiency
26	Power factor
27	Relative harmonic content of source current
28	Ripple on dc source current
29	Input power at no load
30	Source voltage effect
31	Source frequency effect
32	Temperature effect
33	Temperature coefficient
34	Other individual effects
35	Combined effect
36	Total effect
37	Tolerance band
38	Harmonic content
39	DC content
40	Voltage unbalance (Poly phase output)
41	Modulation (Periodic Voltage or frequency)
42	Settling effect
43	Settling time
44	Load characteristics
45	Maximum overshoot amplitude
46	Maximum undershoot amplitude
47	Maximum output rate of change

48	Transient delay time
49	Transient –on delay time
50	Transient recovery time
51	Recovery time
52	Turn-on delay time
53	Turn-on recovery time
54	Turn-off decay time
55	Turn-on (turn-off) overshoot
56	Start-up time
57	Warm-up time
58	Output impedance
59	Setting range
60	Control range
61	Discontinuous control (resolution)
62	Incremental control coefficient
63	Control coefficient
64	Control deviation band
65	Control rate
66	Control time constant
67	Intrinsic error
68	Current limiting threshold
69	Voltage limiting threshold
70	Maximum limited current
71	Short circuit current
72	Open circuit voltage

73	Crossover area
74	Over- current protection
75	Over-voltage protection
76	Reverse power protection
77	Electromagnetic interference emanation
78	Cooling medium temperature
79	Protection of enclosures
80	Protection against electric shock
81	Short- Circuit current and current limiting regulation response
82	Steady state current limiting
83	Input current, efficiency power factors, harmonics content of input current
84	Interference
85	Inrush current
86	Insulation resistance
87	Isolation voltage
88	Capacitance to frame, capacitance to source terminals
89	Electromagnetic compatibility (EMC)

10.2 UNINTERRUPTED POWER SYSTEMS

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Uninterruptible power systems (UPS)	IEC 62040-1-1(2002) IEC 62040-1-2 (2002) IEC 62040-3 (1999)

Table 2

Sl.	Test
1	Electrical service conditions and performance
2	Electromagnetic compatibility
3	Signalling circuits
4	UPS functional unit tests
5	Control and monitoring signals
6	Input voltage and frequency tolerance test
7	Inrush current test
8	UPS output characteristic tests-static condition-Normal & stored energy mode of operation
9	UPS output characteristic – Overload and short circuit
10	UPS output dynamic characteristic tests
11	UPS output dynamic load characteristic tests
12	UPS output dynamic characteristics – Reference non-linear loads
13	Stored and restored energy time tests
14	Efficiency and input power factor
15	Backfeed test
16	EMC Test
17	Test specifications
18	Light load test
19	UPS auxiliary device(s) test
20	Synchronisation test
21	AC input failure test
22	AC input return test
23	Simulation of parallel redundant UPS fault test

24	Transfer test
25	Full load test
26	UPS efficiency test
27	Unbalanced load test
28	Balanced load test
29	Test of current division in parallel or parallel redundant UPS
30	Rated stored energy time test
31	Rated restored energy time
32	Battery ripple current measurement
33	Overload capability test
34	Short-circuit test
35	Short circuit protection device test
36	Restart test
37	Output over voltage test
38	Periodic output voltage variation test
39	Frequency variation test
40	Radiofrequency interference and conducted noise test
41	Harmonic components measurement
42	Earth fault test
43	On-site ventilation test
44	Standby generator compatibility test
45	Test specifications
46	Interconnection cable check
47	Light load test
48	Full load test

49	Transfer test (if applicable)
50	Overload capability test
51	Short circuit current capability test
52	Over voltage test (electronic power switches)
53	Radio frequency Interference and conducted noise
54	Audible noise
55	Onsite ventilation test
56	Earth fault
57	Environmental and transportation test methods
58	Environmental storage and operating test methods
59	Acoustic noise

10.3 SERVO OPERATED AC VOLTAGE STABILIZERS

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Servo Operated AC Voltage Stablisers	IS 9815 Part 1 (1994)

Table 2

Sl.	Test
1	Physical examination
2	Insulation Resistance
3	High Voltage test
4	Provision for Earthing
5	Leakage current
6	Output voltage
7	No Load Current
8	Measurement of no-load losses
9	Load loss test and efficiency
10	Induced Voltage test
11	Test for Continuous Operation
12	Temperature Rise Test
13	Test for Rate of Correction
14	Locked Rotor Test for Servo Motor
15	Damp Heat Test
16	Control & Monitoring Signals

11. BATTERIES

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Leclanche type dry batteries for telecommunications, signaling and general purposes	IS 586 (1976)
2	Multipurpose dry batteries	IS 6303 (1984) IS 8144 (1997) IEC 60086-1 (1972) IEC 60086-2 (1972)
3	Heavy duty dry batteries	IS 6303 (1984) IS 9128 (1999) IEC 60086-1 (1972)
4	Button Cells-Silver oxide	IS 11675 (1986) IEC 60086-1 (1972) IEC 60086-2 (1972)
5	Alkaline manganese dioxide cells	IS 15063 (2001) IEC 60086-1 (1972) IEC 60086-2 (1972)
6	Lead acid storage batteries for motor cycles, auto rickshaws and similar vehicles	IS 1145 (1980)
7	Miners cap lamp batteries	IS 2512 (1978)
8	Lead acid traction batteries	IS 5154 (1980) IEC 60254 (1967)
9	Lead acid batteries for train lighting and air-conditioning services	IS 6848 (1979) IEC 60077 (1968)
10	Lead acid storage batteries for motor vehicles	IS 7372 (1995) IEC 60095-1 (1980)
11	Vented type nickel cadmium batteries	IS 10918 (1984) IEC 60623 (1978)

Table 2

Sl.	Test
1	Dimensions
2	Material and construction
3	Leakage test
4	Sealing compound
5	Internal battery connection
6	Terminals
7	Initial life test
8	Delayed life test under atmospheric conditions
9	Delayed life test under dry heat conditions
10	Life test (for inert cells)
11	Insulation resistance test for jars (for sack cells)
12	Life test (for sack cells)
13	Contact pressure resistance for button cells
14	Mass for Leclanche type dry batteries for telecommunication, signalling and general purposes
15	Delayed life test 12 months
16	Physical examination and mass for miners' cap lamp batteries
17	Air pressure test
18	Non – spillability test
19	Capacity test
20	Drop test
21	Vibration
22	High rate discharge at low temperature
23	Retention to charge
24	Storage

25	Resistance to overcharge
26	Polarity and absence of short circuit
27	Ampere-hour capacity
28	Cranking ability
29	Endurance
30	Discharge performance at low temperature
31	Life cycle test
32	Environment tests
33	Insulation resistance
34	Dielectric
35	High temperature float charge

12. Power System Protection Relays

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Power System Protection Relays	IS 3231 (1987)

Table 2

Sl.	Test
1	Measurement of accuracy of specified time under reference condition
2	Pick up test
3	Drop out test
4	Dielectric test
5	Impulse voltage test
6	Temperature Rise Test
7	Mechanical durability Test
8	Contact performance test
9	Rated burden test
10	Vibration test
11	High frequency disturbance test

13. Electrical Measuring Instruments

13.1 Direct Acting Indicating Analogue Electrical & Electronic Instruments, Transducers and their Accessories

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Ammeter & Voltmeter	IS 1248 Part 1, 2 & 9 (1993) IEC 51-1, 2 & 9 (1984, 84, 88)
2	Wattmeters And Varmeters	IS 1248 Part 1, 3 & 9 (1993) IEC 51-1, 3 & 9 (1984, 84, 88)
3	Frequency Meters	IS 1248 Part 1, 4 & 9 (1993) IEC 51-1, 4 & 9 (1984, 84, 88)
4	Phase Meters, Power Factor Meters And Synchroscopes	IS 1248 Part 1, 5 & 9 (1993) IEC 51-1, 5 & 9 (1984, 85, 88)
5	Ohm meters (Impedance Meters) And Conductance Meters	IS 1248 Part 1, 6 & 9 (1993) IEC 51-1, 6 & 9 (1984, 84, 88)
6	Multi-Function Instruments	IS 1248 Part 1, 7 & 9 (1993) IEC 51-1, 7 & 9 (1984, 84, 88)
7	Accessories	IS 1248 Part 1, 8 & 9 (1993) IEC 51-1, 8 & 9 (1984, 84, 88)
8	Electrical Measuring Transducers for converting a.c. electrical quantities to analogue or digital signals	IS 12784 (1989) IEC 688-4 (1992)
9	Direct Current and low-frequency Electronic Measuring Instruments with Digital Display	BS 7194 (1990)
10	Digital Measuring Instruments for Measurement and Control	IS 13875 Part 1 (1993)
11	Insulation Resistance Tester	IS 10658 (1983) IS 11287 (1985) IS 11994 (1986) IEC 61557-1 & 2 (1997)
12	Earth Resistance tester	IS 9223 (1979) IEC 61557-1 & 5 (1997)

Table 2

Sl.	Test
1	Insulation Resistance
2	High Voltage
3	Intrinsic Error
4	Variation due to Influential Quantities
	a. Ambient Temperature
	b. Humidity
	c. Ripple on DC Measured Quantity
	d. Distortion of AC Voltage and Current components of measured power
	e. Frequency of AC Voltage and Current components measured power
	f. Position
	g. Variation due to Ferromagnetic Supports
	h. Variation due to Conductive Support
	i. Magnetic Field of External Origin
	j. Electric Field of External Origin
	k. Variation due to Auxiliary Supply Voltage
	l. Variation due to Auxiliary Supply Frequency
	m. Voltage Component of the Measured Power
	n. Variation due to Power Factor
	o. Variation due to Unbalance Current
	p. Variation due to Simultaneous influence of Voltage & Power Factor
	q. Variation due to Interaction between the Different Measuring Elements of Polyphase Instruments
5	Damping
6	Self Heating
7	Continuous Over load

8	Overload of Short Duration
9	Environmental Tests
	i. Temperature Cycling Test
	Category I
	Category II
	ii. Damp Heat Cyclic Test
	Category I
	Category II
10	Deviation from Zero
11	Special Requirements for Synchroscope
12	Vibration Test
13	Shock Test
14	Life Cycle Test
15	Additional Tests for Variation due to Influential Quantities
	a. Variation due to the frequency of the input quantity(ies)
	b. Variation due to input Voltage
	c. Variation due to input Current
	d. Variation due to Output load
	e. Variation due to distortion of the input quantities
	f. Variation due to self heating
	g. Variation due to continuous operation
	h. Variation due to Common mode interference
	i. Variation due to series mode interference
	j. Variation due to Permissible excessive inputs
	k. Variation due to Effect of earth potential
16	Tests for other Safety requirements
17	Impulse Voltage Test
18	High Frequency Disturbance Test

19	Drop & Topple
20	Electromagnetic Compatibility
21	Additional Tests for Variation of Influential Quantities
	a. Variation due to peak factor of measurand
	b. Limiting Values of Temperature
22	Response Time
23	Deviation form Electric Zero
24	Permanence of marking
25	Dust Test
26	Bump Test
27	Dry Heat Test
28	Dry Cold Test
29	Mechanical Endurance Test

13.2 Electrical and Electronic (Static) Energy Meters

Table 1

Sl.	Product/ Material	Standard/ Specification
1	A C Static Watthour Meters Class 1 & 2	IS 13779 (1999) IEC 61036 (2000) CBIP (1988)
2	A C Watthour Meters Class 0.5, 1 and 2	IS 13010 (1990) IEC 60521 (1988) CBIP (1988)

Table 2

Sl.	Test
1	Dimensions of terminal holes
2	Clearances and creepage distance
3	Protective earth terminal
4	Terminal cover
5	Non-flammability
6	Register
7	Direction of rotating and marking of rotor
8	Marking of meters
9	Impulse Voltage Test
10	A-C High Voltage Test / Dielectric Strength
11	Insulation Test
12	Test on limits of Error
13	Interpretation of test results
14	Test of meter Constant
15	Test of starting Condition
16	Test of No load Condition
17	Test of Ambient influence
18	Test of repeatability of error
19	Test of Influence Quantities
	a. Voltage Variation
	b. Frequency Variation
	c. Harmonic components in the current circuit and voltage circuit
	d. Odd harmonics in the ac current circuit
	e. Sub harmonics in the ac current circuit

	f.	Reverse phase sequence
	g.	Voltage Unbalance
	h.	DC Component in ac Current Circuit
	i.	Continuous Magnetic Induction of External Origin (DC Field)
	j.	Magnetic Induction of External Origin (AC Field)
	k.	Electromagnetic HF Fields
	l.	Operation of accessories / Magnetic Field of an Accessory
20	Test of Power Consumption / Power Loss	
21	Test of Influence of Supply Voltage	
22	Test of Influence of Short time: Over Currents / Effect of Short Circuits	
23	Test of influence of Self Heating	
24	Test of Influence of Heating	
25	Test of Influence of Immunity to Earth Fault	
26	Radio Interference Measurement	
27	Fast Transient Burst Test	
28	Test of Immunity to Electrostatic Discharge	
29	Test of Immunity to Electrostatic HF field	
30	Conducted disturbances induced by radio frequency fields	
31	Dry Heat Test	
32	Cold Test	
33	Damp Heat Cyclic Test	
34	Vibration Test	
35	Shock Test	
36	Spring Hammer Test	
37	Protection against Penetration of Dust & Water	
38	Test of Resistance to Heat & Fire	

39	Additional Tests of Influence Quantities
	a. Oblique Suspension
	b. Mechanical Load of either Single or Multi Rate Register
40	Range of Adjustment
41	Independence of Adjustment
42	Sustained Accuracy Test
43	Running at Low Load
44	Test for material used in Dial
45	Driving Torque Measurement

14. ELECTRICAL MATERIALS

14.1 SOLID INSULATING MATERIALS

Table 1

Sl.	Product/ Material	Standard/ Specification
1	**Electrical Grade Paper** Capacitor Tissue paper / Creepe paper / Kraft paper / Manila paper / Grease proof paper / Asbestos / Nomax	IS 8570 (1977) IS 9335 (1979) IEC 554 (1977) BS 5626 (1981)
	Pressboards & Press paper	IS 1576 (1992) IEC 641 (1979) IEC 763 (1983) IS 8570 (1977) IS 4248 (1967)
2	**Materials for Cable insulation, sheath & compounds** LDPE / MDPE / HDPE PVC XLPE / Nylon PTFE Polyester	IEC 60250 (1969) IS 3396 (1979) IEC 60243 (1988) IS 2584 (1963) IS 2076 (1981)
3	**Films** Polypropylene Polyester PTFE Polyamide	IS 11298 (1985) IEC 674-2 (1988)
4	**Laminates (includes sheets, rods, tubes)** Phenolic Epoxy glass, Polyester FRP, Polycarbonate PTFE, Epoxy Mica	IS 1998 (1962) IS 10192 (1982) IS 867 (1963)
5	**Ceramics**	IS 8765 (1978)

6	**Rubber products** Mats	IS 5424 (1969)
	Gloves	IS-13774 (1993) IEC 903 (1988) IS 3400 (1987)
7	**Tapes** Pressure sensitive / adhesive tapes	IS 7809 (1975) IS 2448 (1963)
	Cotton, nylon, glass fiber, Epoxy, PTFE, Glass tape varnished / unvarnished, Heat resistant glass tape, Mica paper tape	IS 7809 (1975) IS 5352 (1988) IEC 371 (1980) IS 2464 (1963) IS 5351 (2001)
8	**Sleevings** Cotton, Nylon, Glass fiber, Epoxy, PTFE, Varnished Sleeves	IS 11654 (1986) BS 6469 (1999) BS 2782 (1983)
9	**Rubber / Cork sheet**	IS 3400 (1987) IS 4253 (1980)
10	**Antistatic materials**	BS 2050 (1978)
11	**Insulating Varnish**	IS10026 (1998)

Table 2

Sl.	Test
1	Breakdown voltage test
2	Electric strength test
3	Dissipation factor test
4	Dielectric constant test
5	Surface resistivity test
6	Insulation resistance test / Volume resistivity test / IR constant
7	Comparative tracking resistance test
8	Arc resistance test
9	Shrinkage test
10	Tensile strength / Elongation test
11	Impact strength test
12	Breaking / Bending test
13	Moisture content test
14	Compressibility test
15	Thickness test
16	Density / Substance
17	Tear strength test
18	Oil absorption test
19	Thermal ageing test
20	Bursting strength test
21	Peel strength test
22	Adhesive strength test
23	Flexural / Cross breaking strength test

24	Test for direction of Slitting
25	Marking
26	Pin hole test
27	Freedom from corrosive elements test
28	Electrolytic corrosion test
29	Flammability test

14.2 LIQUID DIELECTRIC MATERIALS

Table 1

Sl.	Product/ Material	Standard/ Specification
1	New insulating oil	IS 335 (1993)
2	Inhibited mineral insulating oil	IS 12463 (1998)
3	Mineral insulating oil in equipment	IS 1866 (1983)
4	Unused & reclaimed mineral insulating oil	BS 148 (1984)
5	Unused mineral insulating oil	IEC 296 (1982)

Table 2

Sl.	Test
1	Appearance
2	Density
3	Kinematic viscosity
4	Interfacial tension
5	Flash point
6	Pour point
7	Neutralisation value
8	Corrosive sulphur
9	Electric strength
10	Dielectric dissipation factor
11	Specific resistance
12	Oxidation stability
13	Ageing characteristics
14	Presence of oxidation inhibitor
15	Water content
16	SK Value
17	Oxidation stability (RBT)
18	Oxidation inhibitor content
19	Sediment &/or precipitable sludge
20	Dissolved gas analysis
21	Determination of DBPC

14.3 MAGNETIC MATERIALS

Table 1

Sl.	Product/ Material	Standard/ Specification
1	Magnetic Sheet steel – CRNO / CRGO	IS 649 (1997) IS 648 (1994)

Table 2

Sl.	Test
1	Total specific iron loss
2	Surface insulation resistively
3	AC magnetization / Permeability
4	Specific core loss
5	Brittleness
6	Stacking factor
7	Ageing test
8	B-H Curve

14.4 CONDUCTORS

Table 1

Sl.	Product/ Material	Standard/ Specification
1 ?	**Bare conductors** Copper Aluminum	 IS 3635 (1982) IS 613 (1979) ASTM B 193 (1983) ASTM E 1004 (1985)
2	**Aluminum conductor** All Aluminum conductor ACSR AAAC ACSR for EHV application	IS 398 Part 1,2,3,4 & 5 (1992)
3	**Winding Wires -** Aluminum/ Copper (including round, rectangular, enameled/insulated) PVA, Polyester, Polyurethene, Polyamide, Polyestermide, Polyester with polyamide – emide overcoat enameled, Glass fiber wound varnished, Paper covered	 IS 13778 Part 1 to 6 (1993) IEC 851 (1985) IS 7404 (1991)
4	**Winding wires for submersible motors** HRPVC XLPE & Polyamide jacketed Polyester or polypropylene insulated	 IS 8783 (1978)
5	**Paper covered conductors** – Aluminum/ Copper	IS 13778 Part 1 to 6 (1993) IEC 851 (1985) IS 7404 (1991) IS 6162 (1971)

Table 2

Sl.	Test
1	Dimension test/ Diameter test
2	Elongation test
3	Springiness test
4	Mandrel Winding test
5	Stretching test
6	Jerk test
7	Peel test
8	Adherence test
9	Resistance to abrasion
10	Heat & solvent bonding test
11	Solvent test
12	Solder test
13	Electrical resistance test
14	Breakdown voltage test
15	Continuity of covering test
16	Electrical loss tangent test
17	Heat shock test
18	Cut through test
19	Thermal ageing in air / oil / Thermal Endurance test
20	Insulation resistance test
21	Diameter
22	Lay ratio
23	Breaking load

24	Wrapping
25	Torsion
26	Galvanising
27	Visible corona

15. HIGH VOLTAGE TEST FACILITY

Table 3

Sl.	Test	Standard/ Specification
1	Tests with alternating voltage	IS 2071 (1993)
2	Tests with direct voltage	IS 2071 (1993)
3	Tests with lightning impulse voltage	IS 2071 (1993)
4	Tests with switching impulse voltage	IS 2071 (1993)
5	Tests with impulse current	IS 2071 (1993)
6	Partial discharge test	IS 6209 (1982) IEC 60270 (1981)
7	Radio interference voltage test	CISPR-16-1 (1993) CISPR-18-1 (1982) CISPR-1 (1961)
8	Wet tests	IS 2071 (1993) IEC 60060-1 (1989)
9	Artificial pollution tests	IS 2071 (1993) IS 8704 (1995) IEC 507 (1991) IEC 1109 (1992)
10	Visible discharge test, carona Inception & Extinction test	IS 2071 (1993)
11	Steep front Impulse Spark over test	IEC 60211 (1994)
12	Impulse Spark over test	IS 3070 Part 1 (1985) Part 3 (1993) IEC 60094-4 (1988)
13	Power frequency Spark over Dry & Wet test	IS 3070 Part 1 (1985) Part 3 (1993) IEC 60094-4 (1998)

14	Transient Response and Ferro Resonance tests	IS 3156 Part 4 (1992) IEC 60186 (1987)
15	Fast Transient test	IEC 60044 Part I (1996)

16. SHORT-CIRCUIT TEST FACILITY

Table 3

Sl.	Test	Standard/ Specification
1	Common specifications for high-voltage switchgear controlgear standards.	IS 12729 (1988) IEC 62271-1 (2001) IEC 60694 (2002)
2	Synthetic testing of high-voltage alternating current circuit-breakers.	IS 13516 (1993) IEC 62271-101 (2002) IEC 60427 (2000)
3	High-voltage alternating current circuit-breakers-inductive load switching.	IEC 62271-308 (2002) IEC 61233 (1994)
4	High-voltage alternating current circuit-breakers-guide for short-circuit and switching test procedures for metal-enclosed and dead tank circuit breakers.	IEC 62271-308 (2002) IEC 61633 (1995)
5	Additional requirements for enclosed switchgear and controlgear from 1 kV to 72.5 kV to be used in severe climatic conditions.	IEC 62271-308 (2002) IEC 60932 (1988)
6	LV Switchgear and controlgear: Part 1 General rules	IS 13947 Part 1 (2001) IEC 60947-1 (2001)
7	Gas Insulated Substance (GIS)	IS 14657 (1998) IEC 62271-102 (2001)
8	Gas Insulated Metal enclosed Switchgear for rated voltage of 72.5 kV & above	IEC 60517 (1990)

17. EMI / EMC TEST FACILITY

Table 3

Sl.	Test	Standard/ Specification
1	Radio interference measurement	IS 6842 (1987) CISPR 16-2 (1999) CISPR 16-1 (1999) CISPR 14-1 (2000) CISPR 14-2 (1997) CISPR 22 (1997)
2	Fast transient burst test	IEC 61000-4-4 (2001)
3	Test for Immunity to electrostatic Discharge (ESD)	IEC 61000-4-2 (2000)
4	Immunity to electromagnetic HF fields	IEC 61000-4-3 (2000)
5	Test of immunity to conducted disturbances, induced by radio frequency fields.	IEC 61000-4-6 (2001)
6	Testing & measurement techniques Surge immunity test.	IEC 61000-4-5 (2000)

18. ENVIRONMENTAL TEST FACILITY

Table 3

Sl.	Test	Standard/ Specification
1	Cold Test	IS 9000 Part 2 (1977)
2	Dry Heat Test	IS 9000 Part 3 (1977)
3	Damp Heat (Cyclic) Test	IS 9000 Part 5 (1981)
4	Damp Heat (Steady State) Test	IS 9000 Part 4 (1979)
5	Salt mist Test	IS 9000 Part 11 (1983)
6	Dust Test	IS 9000 Part 12 (1981)
7	Vibration Test	IS 9000 Part 8 (1981)
8	Test for Robustness of termination and integral mounting device	IS 9000 Part 19/ Sec 1 to 5 (1986)
9	Resistance to soldering heat and solderability	JSS 50101 (1972) Test No.15 & 19
10	Bump Test	IS 9000 Part 7/ Sec 2 (1979)
11	Free fall repeated	IS 9000 Part 7/ Sec 3 (1979)
12	Driving Rain	IS 9000 Part 16 (1983)
13	Ingress protection test	IS 4691 (1985) IS 12063 (1987) IS 13947 Part 1 (1993) IEC 947-1 (1989) IEC 529 (1989)
14	Seismic testing	IEC 60068
15	Glow wire	IS 11000 Part 2/ Sec 1 (1984) IEC 60695

Annexure II

SAMPLE

SCOPE OF ACCREDITATION

Sl.	Contents	Page
1	Rotating electrical machines	105
2	Environmental	106

Sample 1

Scope of Accreditation – Rotating electrical machines

GROUP	TEST	RANGE OF TESTING/ LIMIT OF DETECTION	PUBLISHED SPECIFICATION AGAINST WHICH TESTING
MOTORS & PUMPS	1. Marking	Visual Examination	IS 325-1996 IS 8418-1999 IS 996-1979 IS 8472-1998 IS 1520-1980 IS 9079-1979 IS 2148-1981 IS 9283-1995 IS 6381-1972 IS 10805-1986 IS 6595-1980 IS 11501-1986 IS 7538-1975 IS 12225-1997 IS 8034-1989 IS 14220-1994
	2. Terminal Marking	Visual Examination	IS 325-1996 IS 7538-1975 IS 996-1979
	3. Earthing	Visual Examination	do
	4. Measure-ment of Stator Resistance	0 to 2000 Ohms Class 0.5	IS 325-1996 IS 9079-1979 IS 9283-1995 IS 7538-1975 IS 12225-1997 IS 8034-1989 IS 14220-1994
	5. No Load Test at Rated Voltage	All motors 0 to 45 kW Class 0.5	do
	6. Reduced voltage Running up test	All motors 0 to 45 kW Class 0.5	do
	7. Full load test	a) Submersible motors 0 to 45kW Class 0.5 b) All motors 0 to 22 kW Class 0.5	IS 325-1996 IS 996-1979 IS 9079-1979 IS 9283-1995 IS 7538-1975 IS 8034-1989 IS 14220-1994
	8. Temperature Rise Test at Rated Voltage	a) Submersible motors 0 to 45kW Class 0.5 b) All motors 0 to 22 kW Class 0.5	IS 325-1996 IS 996-1979 IS 8472-1998 IS 9079-1979 IS 9283-1995 IS 6381-1972 IS 7538-1975 IS 12225-1997 IS 8034-1989 IS 14220-1994

Sample 2

Scope of Accreditation – Environmental

GROUP	TEST	RANGE OF TESTING/ LIMIT OF DETECTION	PUBLISHED SPECIFICATION AGAINST WHICH TESTING
Environ-metal	1. Ingress of protection test	Upto IP 68 tests Max. size of object for IP 5X/6X test: 2.5 m(L) X 1.8 m (W) X 2.5 m (H), 4 ton weight	IS 2086-1993 IS 8623 (Pt I,II,III) 1993 IS 3231-1965 IS 8187-1976 IS 8828-1996 IS 9920-1985 IS 9921-1985 IS 12640-1988 IS 13703 (Part I,II)1993 IS 10027-1981 IS 13947 (Part I)-1993 IS 13947 (Part 2)-1993 IS 13947 (Part 3) 1993 IS 13947 (Part 4) 1993 IS 13947(Part 5)1993 IS 12063-1987 IEC 947-7 (1989) IEC 529 (1989)
	2. Dry heat test	Ambient to 100 deg C Accuracy ±1 deg C	IS:13779-1993 IEC:687, 1992 IS:9000 (Pt. 3) IEC:1036, 1996 CBIP Report 88
	3. Cold test	upto -40 deg C Accuracy ±1 deg C	IS:13779-1993 IEC:687, 1992 IS:9000 (Pt. 2) IEC:1036, 1996 CBIP Report 88
	4. Damp heat	60- 95% RH, 20-50 deg C temp Class 1.0	IS:13779-1993 IEC:687, 1992 IS:9000 (Pt. 5) IEC:1036, 1996 CBIP Report 88

Annexure III

INSTRUMENT ACCURACY LIMITS

INSTRUMENT ACCURACY LIMITS

Sl	Parameter	Range	Instrument Accuracy
1	**Voltage**		
	Upto 1000 V	Dc upto 1 KHz	± 1.5%
		1 KHz upto 5 KHz	± 2%
		5 KHz upto 20 KHz	± 3%
		20 KHz and above	± 5%
	1000 V and above	Dc upto 20 KHz	± 3%
		20 KHz and above	± 5%
2	**Current**		
	Upto 5 A	Dc upto 60 Hz	± 1.5%
		60 Hz upto 5 KHz	± 2.5%
		5 KHz upto 20 KHz	± 3.5%
		20 KHz and above	± 5%
	5A and above	Dc upto 5 KHz	± 2.5%
		5 KHz upto 20 KHz	± 3.5%
		20 KHz and above	± 5%
3	**Leakage Current**		
	Upto 30mA	50/ 60 Hz	± 3.5%
	30mA and above	50Hz – 5 KHz	± 5%
4	**Power** (50/ 60 Hz)	Upto 1 W	± 20mW
		Above 1 W and upto 3 KW	± 3%
		Above 3 KW	± 5%

5	**Power factor** (50/ 60 Hz)		± 0.05
6	**Frequency**	Upto 10 KHz	± 0.2%
7	**Resistance**	1 mohms upto 100 mohms and above 1 Mohms Above 1 Tohms For all other cases	± 5% ± 10% ± 3%
8	**Temperature**[1, 2]	Below 100^0C 100^0C upto 500^0C	± 2^0C ± 3%
9	**Time**	10 ms upto 200 ms 200 ms upto 1 s 1s and above	± 5% ± 10 ms ± 1%
10	**Linear dimensions**	Upto 1mm 1mm upto 25 mm 25 mm and above	± 0.05mm ± 0.1mm ± 0.5%
11	**Mass**	Above 10g and upto 100g 100g upto 5 kg 5kg and above	± 1% ± 2% ± 5%
12	**Force**	For all values	± 6%
13	**Mechanical energy**	For all values	± 10%
14	**Torque**		± 10%
15	**Angles**		± 1 degree

16	**Relative humidity**	30% to 95% RH	± 6% RH
17	**Barometric air pressure**		± 0.01 Mpa
18	**Gas and fluid pressure**	For static measurements	± 5%

1 Thermocouple not included. Thermocouples type K, premium grade, are recommended

2 Not for measurements related to relative humidity

Source: IEC EE – CBCTL (WGI) 07/96

Annexure IV

IMPORTANT TESTS FOR
PROFICIENCY TESTING IN ELECTRICAL TESTING

PROFICIENCY TESTING PROGRAM

1. Switchgear Equipment

Sl.	Test
1.	Measurement of the resistance of the main contact
2.	Test for tripping limits and characteristics
3.	Temperature rise

2. Rotating Machines

Sl.	Test
1.	Resistance measurement
2.	No load test
3.	Full load test
4.	Flow measurement

3. Transformers & Reactors

Sl.	Test
1.	Resistance measurement
2.	No load test
3.	Full load test

4. Transmission line Equipment and Accessories

Sl.	Test
1.	Resistance measurement
2.	Ratio & Phase Angle Error measurement test
3.	Tensile strength
4.	Electro-Mechanical failing load test
5.	Porosity test on ceramic insulators

5. Cables and Accessories

Sl.	Test
1.	Conductor Resistance
2.	Thickness of Insulation
3.	Tensile Strength
4.	Insulation Resistance
5.	Mechanical strength
6.	Mutual capacitance & inductance test

6. Power Capacitors

Sl.	Test
1.	Capacitance Measurement (Motor Capacitor)
2.	KVAR Output of LT Capacitor

7. Lamps, Luminaries and Accessories

Sl.	Test
1	Dimensions & Cap Temperature rise
2	Electrical and luminous characteristics
3	Operating conditions
4	Circuit PF, Supply current
5	Current waveform

8. Wiring Accessories

Sl.	Test
1	Tensile test, Elongation test
2	Conductor Resistance test
3	Dimensional checks

9. Domestic Electrical Appliances

Sl.	Test
1	Room heater & electric steam iron
2	Input & Earth Resistance
3	Power Input
4	Heating test
5	Leakage current test
6	Electric strength test & abnormal operation test
7	Crepage distance & clearance test

10. Power Stablisers and UPS

Sl.	Test
1	Load effect
2	Ripple on DC Current
3	UPS efficiency Test
4	Harmonic components measurements

11. Batteries

Sl.	Test
1	Capacity test
2	High Rate discharge test at normal temperature & low temperature
3	Resistance to over charge
4	Loss of capacity on storage

12. Power System Protection Relays

Sl.	Test
1	Test of power consumption
2	Pick up test
3	Drop out test
4	Rated burden test

13. Measuring Instruments

Sl.	Test
1	Voltage, Current, Resistance
2	Frequency
3	Temperature Measurements

14.1 Solid Insulating Materials

Sl.	Test
1.	Volume/ Surface Resistivity of Moulded/ Ceramic Insulation
2.	Moisture Absorption
3.	Dielectric Constant at 1 MHz
4.	Dissipation Factor at 1 MHz

14.2 Liquid Dielectrics Materials

Sl.	Test
1.	Flash Point
2.	Neutralisation Value

14.3 Magnetic Materials

Sl.	Test
1	Surface Insulators Resistivity
2	Specific core loss

14.4 Conductors

Sl.	Test
1	Electrical Resistance test
2	Breaking load

15. High Voltage testing

Sl.	Test
1.	Impulse Flashover test Dry
2.	Switching Impulse Flashover test Dry & Wet
3.	Power frequency Flashover test Dry & Wet
4.	Voltage Distribution test
5.	RIV test
6.	Corona Inception & Extinction test

16. Short Circuit test

Sl.	Test
1.	CT accuracy test
2.	Temperature Rise test
3.	Tripping Time Characteristic (C.B)
4.	Power loss (Transformers)
5.	Contact Resistance Measurement (C.B)
6.	Short Circuit Reactance Measurement by Inductance Bridge
7.	Measurement of HV Fuse Resistance

17. EMI / EMC testing

Sl.	Test
1.	EMHF test

18. Environmental testing

Sl.	Test
1.	Ingress of protection
2.	Salt mist
3.	Vibration
4.	Leakage current measurement
5.	Temperature & Humidity

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