

# Inspection And Testing Manual For Electric Motors



## About EESL



**ENERGY EFFICIENCY SERVICES LIMITED**  
A JV of PSUs under the Ministry of Power

Efficiency Services Limited (EESL), a Joint Venture of Company of Public Sector Undertaking (PSU) of Ministry of Power to facilitate implementation of energy efficiency projects. It is registered under the companies Act, 1956 on 10 December 2009 and the commencement of business certificate was obtained on 11 February 2010. EESL functions as an Energy Service Company (ESCO), as Consultancy Organization and as a Resource Centre.

## About CLASP



CLASP is an international 501© 3 non-profit organization headquartered in Washington DC, USA, with the mission to improve the energy and environmental performance of the appliances & equipment we use every day, accelerating our transition to a more sustainable world. CLASP has been supporting the development and implementation of appliance standards and labeling programs in India since its inception in 1999.

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**Inspection and Testing  
Manual For  
Electric Motors**





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(भारत सरकार, विद्युत मंत्रालय के सार्वजनिक क्षेत्र के उपक्रमों का संयुक्त उद्यम)  
**ENERGY EFFICIENCY SERVICES LIMITED**  
(A Joint Venture of PSUs of Ministry of Power, Govt. of India)



### Foreword

Energy Efficiency Services Limited (EESL) is a publicly owned energy services company with the mission of delivering energy efficiency across India. Established in 2009, EESL is promoted by Ministry of Power, Government of India as a Joint Venture company of four Central Power Sector undertakings viz NTPC Ltd. PFC, REC and Power Grid.

EESL is set up to create and sustain markets for energy efficiency in the country. EESL works closely with Bureau of Energy Efficiency (BEE) and is leading the market related activities of the National Mission for Enhanced Energy Efficiency (NMEEE), one of the eight national missions under the Prime Minister's National Action Plan on Climate Change

Based on the success of *Unnat Jyoti by Affordable LEDs for All (UJALA)*, the world's largest LED programme for domestic consumers, EESL has established itself as a super Energy Service Company (ESCO). EESL and UJALA have paved the way for large-scale energy efficiency implementation in India. It has shown government stakeholders that energy efficiency can deliver multiple benefits within a short time period to all sectors, and importantly, with limited or no costs to the government. Recognising the potential for replication with other high efficient appliances and equipment to trigger investment, innovation and best-in class manufacturing, EESL is expanding its programs to scale up deployment of energy efficient appliances such as energy efficient fans, air conditioners, induction motors and agricultural pumps for which demand is projected to grow significantly.

The success of bulk procurement & distribution program is based on a robust quality assurance framework and build credibility of the program amongst consumers such that it provides a level playing field for the participants, and deliver the projected energy savings.

Quality assurance is a key element to all aspects of energy efficiency programs: program design, implementation and evaluation. It provides a framework to ensure program standards are met and closes the feedback loop in order to assess and improve program processes. To ensure that the products procured through EESL's program meet the quality standards, EESL, in partnership with CLASP, has developed 'Inspection and Quality Assurance Manuals' for its bulk procurement programs. This manual provides stepwise guidelines, and defines the quality assurance criteria and inspection process that include the relevant test methods, sampling criteria, schedule of tests and levels of control at the manufacturers' end. This is to ensure compliance of the procured products with the requirements prescribed by EESL, thereby building credibility of the program and ensuring the quality of the product.

EESL is making every effort toward this, and the inspection and testing manual is a key milestone in that direction. It reflects our commitment and sincerity in ensuring that only quality products are procured and delivered to the consumers.

I would like to commend & congratulate CLASP and EESL teams for their efforts in the development of this manual. I am convinced that this manual will be integral to EESL's quality assurance program and demonstrate our commitment and sincerity in ensuring the procurement of quality products.

(Saurabh Kumar)

Date: 23.07.19

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# MANUAL FOR TESTING AND INSPECTION OF ELECTRIC MOTORS

## 1. SCOPE

**1.1** This manual highlights the key elements essential for the field inspection officers to ensure the quality for three phase squirrel cage totally enclosed air-over induction motors in 2, 4, 6 or 8 poles having output ratings from 0.12 kW to 1000 kW at rated voltage upto and including 1000 V and rated frequency 50 Hz procured by EESL. This complies with the requirements laid out in the tender/bid document, thereby building credibility of the program and ensuring the quality of the product.

This manual specifies guidelines for the bid evaluation, pre-delivery, and post-delivery/verification inspection including the sampling methodology in carrying out the type, acceptance and routine tests of three phase induction motors covered under the scope of IS 12615. This manual also prescribes the levels of control at the manufacturers end for specifies the performance requirements for electric motor.

This frame sizes and duty ratings covered under this inspection manual are as given below:

### *Frame Size*

- a) Frame size from 56 up to and including 315 M having frame to output co-relation as specified in Table 3 of IS 1231;
- b) Frame size 315 L with dimensions as per IS 1231 and having output rating as declared by motor manufacturer; and
- c) Frame size 355 and above, with dimensions and output ratings as declared by motor manufacturer but conforming to IS 8223.

### *Duty Ratings*

This manual cover motor for type S1 (continuous duty). Motors rated for duty cycles S2 and above with an equivalent S1 duty output are also covered.

**NOTE:** For other details regarding the scope of this manual, please refer IS 12615:2018.

Stepwise guidelines for the inspection of electric motors are given in Annex A of this manual.

## 2. REFERENCE

**2.1** The following standard shall be referred while using this manual

IS No/IEC/ISO	Title
1231 : 1974	Dimensions of three phase foot mounted induction motors
1885 (Part 35) : 1993	Electrotechnical vocabulary: Part 35 Rotating machines
2223 : 1983	Dimensions of flange mounted A.C. induction machines
2254 : 1985	Dimensions of vertical shaft motors for pumps

<b>IS No/IEC/ISO</b>	<b>Title</b>
3043 : 1987	Code of practice for earthing
4691	Degrees of protection provided by enclosure for rotating electrical machinery
4728	Terminal markings and direction of rotation for rotating electrical machinery
4905	Methods for random sampling
7816 : 1975	Guide for testing insulation resistance of rotating machines
8223 : 1999	Dimensions and output series for rotating electrical machines
12065 : 1987	Permissible limits of noise level for rotating electrical machines
12075 : 2008	Mechanical vibration of rotating electrical machines with shaft heights 56 mm and higher – measurement, evaluation and limits of vibration severity
12615:2011	Three phase squirrel cage energy efficient induction motors
13508:1992	Test procedure for measurement of loss tangent angle of coils and bars for machine winding
14222:1995/IEC 60034-15	Impulse voltage withstand level
15999 (Part I): 2016	Rotating electrical machines: Part 1 Rating and performance
15999 (Part 2/ Sec 1) : 2011	Rotating electrical machines: Part 2 Method of tests, Section 1 Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)
IS/IEC 60034 (Part 5): 2000	Rotating electrical machines: Part 5 Degrees of protection provided by the integral design of rotating electrical machines (IP CODE) – Classification
IS/ISO 9001	Quality Management System

### **3. DEFINITIONS**

All definitions given in IS 12615, IS/IEC 60034-1 and IS 1885 (Part 35) shall apply. Some of the important definitions relevant to this manual are given below.

#### **3.1 Rated Value**

A quantity value assigned, generally by a manufacturer, for a specified operating condition of a machine.

#### **3.2 Rating**

The set of rated values and operating conditions.

### **3.3 Rated Output**

The value of the output included in the rating.

### **3.4 Load**

All the values of the electrical and mechanical quantities that signify the demand made on a rotating machine by an electrical circuit or a mechanism at a given instant.

### **3.5 No-load (operation)**

The state of a machine rotating with zero output power (but under otherwise normal operating conditions).

### **3.6 Full Load**

The load, which causes a machine to operate at its rating.

### **3.7 Full Load Value**

A quantity value for a machine operating at full load.

NOTE: This concept applies to power, torque, current, speed, etc.

### **3.8 Duty**

The statement of the load(s) to which the machine is subjected, including, if applicable, starting, electric braking, no-load and rest and de-energized periods, and including their durations and sequence in time.

### **3.9 Duty Type**

A continuous, short-time or periodic duty, comprising one or more loads remaining constant for the duration specified, or a non-periodic duty in which generally load and speed vary with the permissible operating range.

### **3.10 Locked Rotor Torque**

The smallest measured torque the motor develops at its shaft and with the rotor locked, over all its angular positions at rated voltage and frequency.

### **3.11 Locked Rotor Current**

The greatest steady-state r.m.s. current taken from the line with the motor held at rest, over all angular positions of its rotor, at rated voltage and frequency.

### **3.12 Pull-up Torque (of A.C. motor)**

The smallest steady-state asynchronous torque, which the motor develops between zero speed, and the speed, which corresponds, to the breakdown torque, when the motor is supplied at the rated voltage and frequency.

### **3.13 Breakdown Torque (of A.C. motor)**

The maximum steady-state asynchronous torque, which the motor develops without an abrupt drop in speed, when the motor is supplied at the rated voltage and frequency.

### **3.14 Cooling**

A procedure by means of which heat resulting from losses occurring in a machine is given up to a primary coolant, which may be continuously replaced or may itself be cooled by a secondary coolant in a heat exchanger.

### **3.15 Coolant**

A medium, liquid or gas, by means of which heat is transferred.

### **3.16 Thermal Equilibrium**

The state reached when the temperature rises of the several parts of the machine do not vary by more than a gradient of 2 K per hour.

### **3.17 Tolerance**

The permitted deviation between the declared value of a quantity and the measured value.

### **3.18 Efficiency**

Ratio of output power to input power expressed in the same units and usually given as a percentage.

### **3.19 No-load Test**

Test in which a machine run as a motor provides no useful mechanical output from the shaft, or when run as a generator with its terminals open-circuited.

### **3.20 Locked Rotor Test**

Test in which the rotor is locked to prevent rotation.

### **3.21 Total Losses**

Difference between the input power and the output power, equivalent to the sum of the constant losses, load losses, additional load losses and the excitation circuit losses.

### **3.22 Constant Losses**

Sum of the iron losses and the friction and windage losses.

### **3.23 Iron Losses**

Losses in active iron and additional no-load losses in other metal parts.

### **3.24 Friction Losses**

Losses due to friction (bearings and brushes, if not lifted at rated conditions) not including any losses in a separate lubricating system. Losses in common bearings should be stated separately, whether or not such bearings are supplied with the machine. The bearing losses are based on the operating temperatures of the bearings, the type of oil and oil temperature.

### **3.25 Windage Losses**

Total losses due to aerodynamic friction in all parts of the machine, including power absorbed in shaft mounted fans, and in auxiliary machines forming an integral part of the machine.

### **3.26 Load Losses**

The sum of the winding ( $I^2R$ ) losses and the electrical brush losses, if any.

### **3.27 Terminal Voltage**

For polyphase A.C. machines the arithmetic average of line voltages.

### **3.28 Type test**

Tests that are necessary to check the performance and characteristics of the units and components and shall be carried out by a recognized testing authority who may be the manufacturer if approved by the purchaser.

### **3.29 Acceptance test**

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

### **3.30 Routine test**

Routine tests are intended to check the quality of the individual test unit. These tests are done to ensure the reliability of test objects and consistency of the material used in their manufacture that are likely to vary during production. These tests are conducted on each unit after completion at the manufacturer's work.

### **3.31 Verification test**

Verification tests are the evaluation of whether or not a product, service, or system complies with a regulation, requirement, or imposed conditions.

## **4 QUALITY CONTROL MEASURES BY THE MANUFACTURER**

The manufacturer shall exercise suitable levels of control as described in 4.1 to 4.6 below:

### **4.1 In House Test Laboratory**

The manufacturer shall have the requisite test facilities in house, which shall be suitably equipped and staffed where various tests, specified in the relevant standard, shall be carried out in accordance with the test methods prescribed in the relevant standard.

### **4.2 Maintenance of Test Records**

The manufacturer shall maintain all records of tests, inspection and calibration. All testing equipment and measuring instruments shall be periodically checked and calibrated and records of such checks/calibration shall be maintained. Copies of any records and other connected papers that may be required by the EESL representatives shall be made available during the visit at the manufacturing premises.

### **4.3 Quality System in the Organization**

The manufacturer should implement proper Quality Management System in their organization in accordance with IS/ISO 9001 as applicable to various day-to-day activities of the organization.

### **4.4 Marking on the Product**

The marking on the motors shall be furnished in a permanent and legible manner on either the product where it is accessible and visible and/or packaging or product data sheet/leaf-let. The information on the motors shall be in accordance with clause 18 of IS 12615.

Each electric motor shall be provided with a rating plate(s). The plates shall be made of durable material and be securely mounted.

The rating plate(s) shall preferable be mounted on the frame of the machine and be located so as to be easily legible in the position of use determined by the type of construction and mounting arrangement of the machine. If the electrical machine is so enclosed or incorporated in the equipment that its rating plate is not easily legible, the manufacturer shall, on request, supply a second plate to be mounted on the equipment.

Electric motors with rated outputs up to and including 750 W (or VA) and dimensions not covered by IS 8223 shall be marked with the information given in items 1, 2, 11, 12 and 26 below as a minimum.

For special-purpose and built-in machines with rated outputs up to and including 3 kW (or kVA) items 1, 2, 11 and 12 shall be marked as a minimum and item 26 may be provided in another form.

In all other cases, rating plate(s) shall be durably marked with the items in the following list given in 1 to 26, as far as they apply. The items need not all be on the same plate.

If the manufacturer gives more information, this need not necessarily be marked on the rating plate(s). The items are numbered for convenient reference, but the order in which they appear on the rating plate(s) is not standardized. Items may be suitably combined-

- 1) The manufacturer's name or mark;
- 2) The manufacturer's serial number, or identification mark;  
NOTE: A single identification mark may be used to identify each member of a group of machines, which are made to the same electrical and mechanical design and are produced in one batch using the same technology.
- 3) Information to identify the year of manufacture. This shall be marked on the rating plate or be given on a separate data sheet to be provided with the machine;  
NOTE: If this information can be obtained from the manufacturer by quoting the data specified in item 2, it may be omitted from both the rating plate and the separate data sheet.
- 4) The manufacturer's machine code;
- 5) For A.C. machines, the number of phases;
- 6) The number(s) of the rating and performance standard(s) which are applicable as per IS/IEC 60034-1 and IS 12615. If IS 12615 is marked, this implies compliance with IS 12615;
- 7) The degree of protection provided by the integral design of the rotating electrical machine enclosures (IP code) in accordance with IS 4691;
- 8) The thermal class and the limit of temperature or of temperature rise (when lower than that of the thermal class) and, if necessary, the method of measurement, followed in the case of a machine with a water-cooled heat exchanger by 'P' or 'S', depending on whether the temperature rise is measured above the primary or secondary coolant respectively (see 8.2). This information shall be given for both stator and rotor (separated by a slash) when their thermal class differ;
- 9) The class (es) of rating of the machine if designed for other than rating for continuous running duty S1;
- 10) The rated output(s) range of rated output;
- 11) The rated voltage(s) or range of rated voltage;
- 12) For A.C. machines the rated frequency or range of rated frequency. For universal motors the rated frequency shall be followed by the appropriate symbol: for example, ~ 50 Hz/or A.C. 50 Hz/D.C.;
- 13) The rated current(s) or range of rated current;
- 14) The rated speed(s) or range of rated speed;
- 15) The permissible over speed or the maximum safe operating speed;
- 16) For D.C. machines with separate excitation or with shunt excitation and for synchronous machines, the rated field voltage and the rated field current;
- 17) For A.C. machines, the rated power factor(s);

- 18) For wound-rotor induction machines, the rated open-circuit voltage between slip-rings and the rated slip-ring current;
- 19) For D.C. motors with armatures intended to be supplied by static power converters, the identification code of the static power converter. Alternatively, for motors not exceeding 5 kW, the rated form factor and the rated alternating voltage at the input terminals of the static power converter, when this exceeds the rated direct voltage of the motor armature circuit;
- 20) The maximum ambient air temperature, if other than 40°C;  
The maximum water coolant temperature, if other than 25°C;
- 21) The minimum ambient air temperature;
- 22) The altitude for which the machine is designed (if exceeding 1000 m above sea-level);
- 23) For hydrogen-cooled machines, the hydrogen pressure at rated output;
- 24) When specified, the approximate total mass of the machine, if exceeding 30 kg;
- 25) For machines suitable for operation in only one direction of rotation, the direction of rotation, indicated by an arrow need not be on the rating plate, but it shall be easily visible;
- 26) The connecting instructions in accordance with IS 4728 by means of a diagram or text located near the terminals. Two different rated values shall be indicated by X/Y and a range of rated values shall be indicated by X-Y; and
- 27) BEE star label and/or BIS standard mark and BIS License number.

Any other additional information may be provided on the rating plate subject to agreement between the manufacturer and EESL.

#### **4.5 Raw Materials and Components**

As far as possible, each consignment of the raw material and components should be accompanied by a test certificate certifying its conformity to the relevant Indian Standard wherever exists or else each lot of raw material shall be checked for its conformity as per the relevant standard, if any.

#### **4.6 Sampling and Frequency of Testing**

The tests, as specified in Table 1 and the levels of control specified therein, shall be carried out on the entire production of the factory. Table 1 specifies the levels of control for electric motor as per IS 12615.

**Table 1**  
**Sampling and Frequency of Testing**

S. No.	Test Requirement	Test Methods		No. of samples	Frequency of testing
		Clause	Reference Standards		
1	Dimensions	-	IS 1231, IS 2223 and IS 2254	One	Every 200 motors or less of same type and design
2	Earthing	-	IS 3043	Each Motor	-
3	Momentary excess torque		IS 15999 (Part 2/Sec1)	One motor	Every 50 motors of same type and design
4	Pull up Torque	11.2	-do-	-do-	-do-
5	Sustained Overloads	11.3	-do-	-do-	-do-
6	Temperature rise	8	IS/IEC 60034-1	-do-	Every 200 motors of same type and design
7	Test for vibration severity (if required as per the contract specification)	-	IS 12075	-do-	-do-
8	Noise level (if required as per the contract specification)	-	IS 12065	-do-	-do-
9	Terminal marking	-	IS/IEC 60034-1	-do-	-do-
10	Marking	10	-do-	Each motor	-
11	Measurement of resistance of stator winding	8.6	IS/IEC 60034-1	-do-	-
		5.7	IS 15999 (Part 2/Sec 1)		
12	No load test at rated voltage	9.1	IS/IEC 60034-1	-do-	-
		-	IS 15999 (Part 2/Sec1)		
13	Reduced voltage running test at no load (applicable for squirrel cage motors upto 37 kW)	-	IS 15999 (Part 2/Sec 1)	-do-	-
14	Locked rotor test	-	-do-	-do-	-

S. No.	Test Requirement	Test Methods		No. of samples	Frequency of testing
		Clause	Reference Standards		
15	Full load test	-	-do-		-
16	Momentary overload test	-	-do-	One motor	Every 200 motors of same type and design
17	Insulation Resistance test	-	IS 7816	Each motor	-
18	High Voltage Test	9.2	IS/IEC 60034-1	-do-	-
19	Test for degree of protection (if required as per the contract specification)	-	-do-	One motor	Every 200 motors of same type and design
20	Temperature Rise test at limiting values of voltage and frequency variation (if required as per the contract specification)	8	-do-	-do-	-do-
21	Over speed test (if required as per the contract specification)	9.7	-do-	-do-	-do-
22	Test on insulation system (if required as per the contract specification): a) Tangent Delta and Delta Tangent Delta test b) Impulse voltage withstands test	- - -	IS 13508  IS 14222	-do-	-do--

Tests at S. No 7, 8 and 18 to 21 are optional tests and shall be carried out as per the mutual agreement between the manufacturer and EESL.

In case the manufacture does not have requisite test facilities for any of the tests shown in Table 1 above, the same may be tested from any independent NABL accredited test labs except for the tests, which are to be carried out on each electric motor.

In case of failure of any motor in respect of tests carried out on each electric motor, cause of failure shall be identified and corrective action shall be taken to remove the non-conformity.

In the case of failure of any sample, in respect of the tests conducted on each lot manufactured, double the number of samples shall be taken for testing and no failure in those samples shall be permitted. Otherwise, the lot shall be rejected. After corrective actions two consecutive lots shall be tested as per the sample size and frequency indicated in the Table 1 and then original frequency shall be restored if both the samples pass.

## **5 INFORMATION TO BE FURNISHED BY THE PURCHASER/BUYER**

**5.1** When enquiring or ordering electric motors to the prescribed standard as specified in the contract, the following information in addition to those given in clause 10 of IS/IEC 60034-1 may be furnished by EESL to the suppliers/manufacturers:

*General information:*

- a) Name of the purchaser;
- b) Address of the purchaser;
- c) Name of the contact person and the contact details;
- d) BIS certification Mark on the product and the copy of licence document;
- e) In case of BEE star labeled product, relevant documents relating to approval of model registration;
- f) Total number of electric motor required; and
- g) Location where the meters required to be supplied.

*Technical information:*

- 1) The manufacturer's name or mark;
- 2) The manufacturer's serial number, or identification mark;
- 3) The manufacturer's machine code/model number;
- 4) For A.C. machines, the number of phases;
- 5) Degree of protection provided by the integral design of the rotating electrical machine enclosures (IP code);
- 6) The thermal class and the limit of temperature or of temperature;
- 7) The class(es) of rating of the machine if designed for other than rating for continuous running duty S1;
- 8) The rated output(s) range of rated output;
- 9) The rated voltage(s) or range of rated voltage;
- 10) For A.C. machines the rated frequency or range of rated frequency;
- 11) The rated current(s) or range of rated current;
- 12) The rated speed(s) or range of rated speed;
- 13) The permissible over speed or the maximum safe operating speed;
- 14) For A.C. machines, the rated power factor(s);
- 15) The maximum ambient air temperature;
- 16) The altitude for which the machine is designed;
- 17) Approximate total mass of the machine, if exceeding 30 kg;
- 18) Direction of rotation; and
- 19) The connection diagram.

## **6 INFORMATION TO BE FURNISHED BY THE MANUFACTURER OR THE SUPPLIER**

**6.1** EESL may ask the manufacturer/supplier to furnish the following information while supplying the electric motors complying with the relevant standard specified in the contract.

- 1) The manufacturer's machine code/model number;
- 2) For A.C. machines, the number of phases;
- 3) The number(s) of the rating and performance standard(s) which are applicable as per IS/IEC 60034-1 and IS 12615;
- 4) The degree of protection provided by the integral design of the rotating electrical machine enclosures (IP code) in accordance with IS 4691;
- 5) The thermal class and the limit of temperature or of temperature rise (when lower than that of the thermal class) and, if necessary, the method of measurement, followed in the case of a machine with a water-cooled heat exchanger by 'P' or 'S', depending on whether the temperature rise is measured above the primary or secondary coolant respectively (see 8.2). This information shall be given for both stator and rotor (separated by a slash) when their thermal class differ;
- 6) The class(es) of rating of the machine if designed for other than rating for continuous running duty S1;
- 7) The rated output(s) range of rated output;
- 8) The rated voltage(s) or range of rated voltage;
- 9) For A.C. machines the rated frequency or range of rated frequency. For universal motors the rated frequency shall be followed by the appropriate symbol: for example, ~ 50 Hz/or A.C. 50 Hz/D.C.;
- 10) The rated current(s) or range of rated current;
- 11) The rated speed(s) or range of rated speed;
- 12) The permissible over speed or the maximum safe operating speed;
- 13) For D.C. machines with separate excitation or with shunt excitation and for synchronous machines, the rated field voltage and the rated field current;
- 14) For A.C. machines, the rated power factor(s);
- 15) For wound-rotor induction machines, the rated open-circuit voltage between slip-rings and the rated slip-ring current;
- 16) For D.C. motors with armatures intended to be supplied by static power converters, the identification code of the static power converter. Alternatively, for motors not exceeding 5 kW, the rated form factor and the rated alternating voltage at the input terminals of the static power converter, when this exceeds the rated direct voltage of the motor armature circuit;
- 17) The maximum ambient air temperature, if other than 40 °C. The maximum water coolant temperature, if other than 25 °C;
- 18) The minimum ambient air temperature;
- 19) The altitude for which the machine is designed (if exceeding 1000 m above sea-level);
- 20) For hydrogen-cooled machines, the hydrogen pressure at rated output;
- 21) When specified, the approximate total mass of the machine, if exceeding 30 kg;

- 22) For machines suitable for operation in only one direction of rotation, the direction of rotation, indicated by an arrow need not be on the rating plate, but it shall be easily visible;
- 23) The connecting instructions in accordance with IS 4728 by means of a diagram or text located near the terminals. Two different rated values shall be indicated by X/Y and a range of rated values shall be indicated by X-Y;
- 24) BIS standard mark and BIS License number; and
- 25) BEE star label.

## **6.2 Additional information**

- a) Name of the manufacturer;
- b) Address of the manufacturer;
- c) Organization structure;
- d) Location of different manufacturing units, if manufacturing is done at more than one locations;
- e) Name and contact details of the responsible person in each units;
- f) Details of the testing personnel;
- g) Availability of complete test facilities at the manufacturing premises;
- h) List of test equipment, measuring instruments and their accuracy class;
- i) Details of calibration of each equipment/measuring instruments including their validity period;
- j) Whether any arrangements made with any outside test labs where test facilities for any particular test (s) are not available with the manufacturer;
- k) Whether the manufacturers lab is accredited by NABL and if yes what is the scope of accreditation and its validity;
- l) Accreditation of outsourced lab and the validity period;
- m) Declaration in uncertainty in measurement; and
- n) Whether the product (s) covered are BIS certified. If BIS certified what is the validity of the licence and the varieties/types covered in the licence.

## **7 STAGES OF INSPECTION AND CONTROL**

The inspection activities shall be undertaken in three different stages as follows:

Stage 1 – Bid Evaluation through document verification and Type Testing

Stage 2 – Production/Pre-Delivery

Stage 3 – Post-Delivery/Verification Testing

The detail procedure in respect of all the above three stages are described in 7.1 to 7.3.

### **7.1 Bid Evaluation**

Bid evaluation shall comprise of type test certificate and the verification of relevant documents. Manufacturers or bidders shall submit a declaration about the product details supported by type test certificate from an independent third party NABL accredited laboratory against the specified test standard. During the bidding phase, the pre-qualification of any manufacturer or bidder shall be based on verification of the documents and test certificates submitted. In case

of any change in any design parameter, the complete type test shall be repeated. The manufacturer shall submit the type test report along with other necessary supporting documents while submitting their bid, which are subject to evaluation and scrutiny by EESL.

All the necessary information submitted by the bidder, as confirmation and declaration of quality should comply with the prescribed guidelines of EESL and the stipulation of the prescribed test standard. In case of non-compliance in any of the parameter, the bid shall be rejected.

### 7.1.1 Type Test

Manufacturer and/or the bidder shall get their product tested on two samples in an independent accredited laboratory or in the manufacturers own lab which shall be duly accredited by NABL.

The electric motors shall be subjected to the following type test as given in Table 2 below:

**Table 2  
Type Test for Bid Evaluation**

S. No.	Test Requirement	Clause Reference as per IS 12615	Test Methods	
			Clause	Reference Standards
1	Dimensions	9	-	IS 1231, IS 2223 and IS 2254
2	Earthing	10	-	IS 3043
3	Momentary excess torque	11.1		IS 15999 (Part 2/Sec1)
4	Pull up Torque	11.2	11.2	-do-
5	Sustained Overloads	11.3	11.3	-do-
6	Temperature rise	12 and 19.7	8	IS/IEC 60034-1
7	Test for vibration severity (if required as per the contract specification)	13 and 19.11	-	IS 12075
8	Noise level (if required as per the contract specification)	15 and 19.12	-	IS 12065
9	Terminal marking	16	-	IS/IEC 60034-1
10	Marking	18	10	-do-
11	Measurement of resistance of stator winding	19.2	8.6 5.7	IS/IEC 60034-1 IS 15999 (Part 2/Sec 1)
12	No load test at rated voltage	19.3	9.1 -	IS/IEC 60034-1 IS 15999 (Part 2/Sec1)

S. No.	Test Requirement	Clause Reference as per IS 12615	Test Methods	
			Clause	Reference Standards
13	Reduced voltage running test at no load (applicable for squirrel cage motors upto 37 kW)	19.4	-	IS 15999 (Part 2/Sec 1)
14	Locked rotor test	19.5	-	-do-
15	Full load test	19.6	-	-do-
	Momentary overload test	19.8	-	
16	Insulation Resistance test	19.9	-	IS 7816
17	High Voltage Test	19.10	9.2	IS/IEC 60034-1
18	Test for degree of protection (if required as per the contract specification)	19.13	-	IS/IEC 60034-5
19	Temperature Rise test at limiting values of voltage and frequency variation (if required as per the contract specification)	19.14	8	-do-
20	Over speed test (if required as per the contract specification)	19.15	9.7	-do-
21	Test on insulation system (if required as per the contract specification): a) Tangent Delta and Delta Tangent Delta test b) Impulse voltage withstands test	19.16	- -	IS 13508  IS 14222

### 7.1.2 Document Verification

The following documents shall be submitted by the manufacturers/bidders for verification and scrutiny by EESL. A detail scrutiny of the documents listed below is essential to verify the authenticity and validity of each documents submitted.

- a) Copy of valid BIS certification marks Licence, if the product carries BIS certification mark;
- b) Copy of test certificates of important raw materials and components for electric motors.

- c) Warranty certificate for guarantee of performance of minimum period as prescribed by EESL;
- d) Document relating to BEE approval for star rating label;
- e) Type test report in original from a NABL accredited testing laboratory as per IS 12615; and
- f) Copy of valid NABL certificate of accreditation of manufacturers' lab and independent lab.

## **7.2 Production/ Pre-Delivery Inspection**

The production/pre-delivery inspection shall be carried out by EESL or their authorized representatives. The sample shall be supplied free of cost by the manufacturer. The testing charges for all the type tests shall be borne by EESL. The schedule of test for pre-delivery inspection prior to shipment from the manufacturer's premises or their warehouse shall comprise of the following:

- a) Type test
- b) Acceptance test
- c) Routine Test

The production/pre-delivery inspection shall be carried out at the manufacturer's premises on samples selected at random from their finished stock or their warehouse.

To ensure the production of quality products in a continuous manner, verify the proper levels of control in the manufacturing process by the manufacturer. These include presence of an in house accredited test facility, trained and competent testing personnel, maintenance of test records, inspection and calibration, proper Quality Management System measures in accordance with IS/ISO 9001.

### *7.2.1 Type Test*

For the purpose of type tests, two samples of induction motors for each type and design shall be selected from the lot offered. Sample drawn for type tests shall be tested at a NABL approved manufactures or third party test lab.

The tests given in the Table 2 shall constitute the type tests and shall be carried out on the selected samples for type tests. The sample shall be representative of a manufacturer's production selected from the finished stock at the manufacturers end or in their warehouse.

Before commencement of the type tests, the induction motors shall be visually examined including the components, parts and their assembly, constructions, mechanical hazards, marking provision of suitable terminals for supply connections including the provisions for earthing. The external surface finish shall be even and free from surface defects.

The samples shall successfully pass all the type tests for proving conformity with the requirements of the standard. If the sample fails in any of the type tests, EESL at its discretion, may call for fresh samples not exceeding twice the original number and subject them again to all tests or to the test (s) in which failure (s) had occurred. No failure is permitted in the repeat test.

The type test report shall also contain the nameplate or rating plate particulars of the electric motors for purposes of identification.

Type test may be waived off in case tender document originally lays out the requirement of BIS certification mark, if any.

### *7.2.2 Acceptance Test*

To ensure the quality of products supplied by the manufacturer, acceptance test shall be carried out by EESL on each lot offered for inspection.

Samples shall be selected at random to ensure proper representation of a lot from the factory or their warehouse/stockyard for necessary testing in the manufacturers own lab duly accredited by NABL in the presence of EESL representatives. The method employed for random selection should be in accordance with IS 4905 to ensure proper representation of a lot. The sample size and acceptance quality level (AQL) shall be as laid down in IS 2500 (Part 1).

The samples selected from the lot shall be checked for any visual defects including the components, parts and their assembly, constructions, mechanical hazards, marking provision of suitable terminals for supply connections including the provisions for earthing as well as the external surface finish for any surface defects.

In case of failure of sample in any of the tests specified in the standard/inspection manual, reject the lot and send a written communication to the manufacturer. The manufacturer may after rectifying the necessary corrective measures can reoffer the lot for inspection.

Three inspection levels, I, II and III, are given in Table 1 of IS 2500 (Part 1) for general use. Unless otherwise specified, level II shall be used. Level I may be used when less discrimination is needed level III when greater discrimination is required.

Table 1 of IS 2500 (Part 1) provides the information about the lot size and corresponding inspection level. For the purpose of lot inspection by EESL, single sampling plan with normal or tightened or reduced inspection as given in Table 2A, 2 B and 2 C of IS 2500 (Part 1) may be followed. The different level of AQL specifying the acceptance and rejection number of the lot as given in Tables 2 A to 2 C shall be at the discretion of EESL.

Special levels, S-1, S-2, S-3 and S-4 given in Table 1 of IS 2500 (Part 1) may also be used where relatively small sample sizes are necessary and larger sampling risks can be tolerated.

**NOTE:** A third party inspecting agency can be employed for inspection of the lot offered by the manufacturers and submit test reports in the prescribed format as given in Annex B and duly approved by EESL for scrutiny and approval.

The nature of tests and the relevant test standard for the acceptance tests are given in Table 3 below:

**Table 3**  
**Acceptance Test for Pre-Delivery Inspection**

Sr. No.	Test Requirement	Clause Reference as per IS 12615	Test Methods	
			Clause	Reference Standards
1	Dimensions	9	-	IS 1231, IS 2223 and IS 2254
2	Earthing	10	-	IS 3043
3	Momentary excess torque	11.1		IS 15999 (Part 2/Sec1)
4	Pull up Torque	11.2	11.2	-do-
5	Sustained Overloads	11.3	11.3	-do-
6	Temperature rise	12 and 19.7	8	IS/IEC 60034-1
7	Test for vibration severity (if required as per the contract specification)	13 and 19.11	-	IS 12075
9	Terminal marking	16	-	IS/IEC 60034-1
10	Marking	18	10	-do-
11	Measurement of resistance of stator winding	19.2	8.6 5.7	IS/IEC 60034-1 IS 15999 (Part 2/Sec 1)
12	No load test at rated voltage	19.3	9.1 -	IS/IEC 60034-1 IS 15999 (Part 2/Sec1)
13	Reduced voltage running test at no load (applicable for squirrel cage motors upto 37 kW)	19.4	-	IS 15999 (Part 2/Sec 1)
14	Locked rotor test	19.5	-	-do-
15	Full load test	19.6	-	-do-
	Momentary overload test	19.8	-	
16	Insulation Resistance test	19.9	-	IS 7816
17	High Voltage Test	19.10	9.2	IS/IEC 60034-1

### 7.2.3 Routine Test

In case production routine tests are to be repeated at the time of procurement, then where agreed to between EESL and the manufacturer, the tests may be carried out at the manufacturer's

works; alternatively, the tests may be repeated at the place specified by EESL provided that all the arrangements for tests are made by EESL at the specified place.

Routine tests are the tests that would be conducted on each unit after completion at the manufacturer's work.

The following shall constitute the routine tests:

<b>S. No.</b>	<b>Nature of Test</b>	<b>Clause Reference of IS 12615</b>	<b>Referred Indian Standard (IS &amp; IS/IEC)</b>
1	Insulation Resistance Test	16.1.1	7816
2	Measurement of Resistance of Winding of Stator	16.1.2	15999 (Part 1) & 15999 (Part 2/Sec1)
3	No load test	16.1.3	-do-
4	Locked rotor readings voltage, current, power and torque at a suitable reduce voltage	16.1.4	-do-
5	Reduced voltage running up test at no load (for squirrel cage motors up to 37 kW only)	16.1.5	-do-
6	High Voltage Test	16.1.6	-do-

### **7.3 Post Delivery Inspection/Verification Testing**

For verification testing, the sample shall be drawn from open market or manufacturer's warehouse/stockyard. EESL shall bear the cost of the sample as well as the cost of testing.

Verification tests shall cover all the type tests for electric motors as mentioned in Table 3 of this manual. The type testing shall be carried out in an independent test laboratory.

## **8 COMPLAINT REDRESSAL**

Whenever a complaint is received after the induction motors have been delivered/used and the complaint is proved to be genuine and the warranty period (where applicable) has not expired, the defective goods or their components shall be replaced or repaired free of cost by the manufacturer. The final authority to judge the conformity of the product to the relevant standard specified in the contract shall be with EESL. In the event of any damages caused by the electric motor or claim filed by the user against the supply made by the manufacturer as per the contract and also non-compliance of the product to the relevant standard specified in the contract, entire liability arising out of such non-compliant product shall be with the manufacturer and EESL shall not in any way be responsible in such eventualities.

The manufacturer shall give a guarantee for the soundness of construction and performance of the induction meters, and shall be responsible for putting right any manufacturing defects free

of charge for a period of 12 months right from the date of sale or date of installation whichever is later. Such repairs or replacements of defective parts shall be carried out at manufacturer's works, or his authorized agent at site or at service shop.

## **9 PRODUCTION PLAN**

The manufacturer shall provide advance information about their production plan and readiness of the lot to be offered for inspection to EESL.

## **10 TEST METHOD AND ITS REQUIREMENTS**

The method of tests and its requirements shall be in accordance with IS 9283 for motors and IS 8034 for pump-sets.

## **11 TEST REPORT PROFORMA FOR ELECTRIC MOTORS**

The test report format give in Annex B shall be used by the testing laboratory or the manufacturers while submitting their test reports.

## **12 TEST CERTIFICATE**

- 12.1** Unless otherwise specified, the purchaser shall accept manufacturer's certificate as evidence of compliance of the motor with the requirements of this standard together with a type test certificate on a motor identical in essential details with the one purchased, together with routine tests on each individual motor.
- 12.2** Certificate of routine tests shall show that the motor purchased has been run and has been found to be electrically and mechanically sound

# **Annexures**



## ANNEX A

### STEPWISE GUIDELINES FOR THE INSPECTION OF ELECTRIC MOTORS

#### 1. Introduction

This inspection manual elaborates the quality assurance process for electric motors procured by EESL. This will ensure compliance of the procured products with the requirements laid out in the tender document, thereby building credibility of the program and ensuring the quality of the product.

To ensure procurement of quality products, proper inspection should be carried out by EESL. The inspection activities are divided in three different stages:

Step 1 – Bid Evaluation before finalization of the bid

Step 2 – Production/Pre-Delivery

Step 3 – Post-Delivery/Verification Testing

#### 2. Bid Evaluation

For bid evaluation, manufacturer shall submit the test report from an NABL accredited lab against the relevant standard along with other necessary supporting documents (show the list in red below) while submitting their bid. The test report should include type tests on safety and performance.

All the necessary information submitted by the bidder should comply with the prescribed guidelines of EESL and relevant test standard. In case of non-compliance in any of the parameter, the bid shall be rejected.

- a) Copy of valid BIS certification marks License, if the product carries BIS certification mark;
- b) Type test report in original from a NABL accredited testing laboratory as per the relevant standard;
- c) Copy of test certificates of important raw materials and components;
- d) Copy of valid NABL certificate of accreditation of the test lab issuing the test certificate/report; and
- e) Warranty certificate for guarantee of performance of minimum number of years prescribed by EESL.

#### 2. Prerequisite for Inspection at the manufacturers premises

Before undertaking the inspection, the EESL inspecting officers should ensure the following:

- a) Opening meeting with the concerned officials and the testing and quality control personal to discuss and planning to undertake the required task;
- b) Visit to the test laboratory to check the following;
  - Availability of requisite test facilities as per the prescribed standard and its workability;
  - Calibration detail and the validity of each instruments and test equipment;

- Verification of test records and other relevant records related to in process quality control including the manual and procedure for ISO 9001 certification; and
- Verification of testing facilities at the production line if applicable.

After ensuring the compliance of all the requirements mentioned above, the inspecting officers shall draw samples for acceptance and type tests from the lot offered for inspection by the manufacturers. For acceptance tests the sampling plan and AQL shall be as per IS 2500 (Part 1). Routine tests shall be carried out on the entire lot.

After the completion of all the tests as per the specified standard, the test report shall be prepared on the prescribed format as given in Annex B of this manual. The test reports shall be signed by the inspecting officer from EESL and the authorized person from the manufacture.

### **3. Production/ Pre-Delivery Inspection**

The field-inspecting officer shall draw samples at random from the finished stock of the lot offers. The number of samples for acceptance tests shall be as laid down in IS 2500 (Part 1) using a suitable AQL.

The production/pre-delivery inspection shall be carried out by field inspecting personnel from EESL or their authorized representatives at the manufacturer's premises on samples selected at random from their finished stock or their warehouse for testing. The sample shall be supplied free of cost by the manufacturer. The manufacturer shall provide advance information about their production plan and readiness of the lot to be offered for inspection to EESL. Pre dispatch inspection tests include type, acceptance and routine tests.

Before commencement of the type tests, the samples shall be visually examined including the components, parts and their assembly, constructions, mechanical hazards, marking provision of suitable terminals for supply connections including the provisions for earthing. The external surface finish shall be even and free from surface defects.

#### **4.1 Type Tests**

The sample selection for type testing shall be based on random sampling. The number of samples for type testing shall be two drawn from the finished stock of the lot offered by the manufacturer/supplier. Sample drawn for type tests shall be sent to an NABL approved test labs. The testing charges for all the type tests shall be borne by EESL.

The samples shall successfully pass all the type tests for proving conformity with the requirements of the standard. If the sample fails in any of the type tests, EESL at its discretion may call for fresh samples not exceeding twice the original number and subject them again to all tests or to the test in which failure had occurred. No failures are permitted in the repeat test.

EESL may waive off the type test on the lot offered by the supplier/manufacturers in case the electric motors covered under the scope of this manual carries BIS certification mark and/or BEE energy efficiency level.

The list of type tests shall be as given in Table 2 of this manual.

### **3.2 Acceptance Tests**

To ensure the quality of products supplied by the manufacturer, acceptance test shall be carried out by EESL on each lot offered for inspection. The manufacturer shall supply, free of charge, the samples from the factory or their warehouse/stockyard for necessary testing in the manufacturers' accredited lab in presence of EESL representatives.

Samples shall be selected at random from the lot offered by the manufacturers/supplier from the finished stock using IS 4905 to ensure proper representation of a lot. The sample size and acceptance quality level (AQL) shall be as per IS 2500 (Part 1).

In the absence of test facilities for any particular test, the testing personnel deputed by EESL shall draw the samples from the manufacturing premises or from manufacturers warehouse/stockyard and send the same to an NABL approved test labs for the required tests.

In case of failure of sample in any of the tests specified in the standard/inspection manual, the lot shall be rejected and a written communication to this effect shall be made to the manufacturer. The manufacturer may after rectifying the necessary corrective measures can reoffer the lot for inspection. A third party inspecting agency can be employed by EESL for inspection of the lot offered by the manufacturers and submit test reports in the prescribed format given in the inspection manual. The list of acceptance tests shall be as given in Table 4 of this manual.

### **4.3 Routine Test**

In case production routine tests are to be repeated at the time of procurement, then where agreed to between EESL and the manufacturer, the tests may be carried out at the manufacturer's works; alternatively, the tests may be repeated at the place specified by EESL provided that all the arrangements for tests are made by EESL. The routine tests shall be carried out on each motors from the lot offered for inspection. In case of failure in any of the tests, the sample under tests shall be either rejected or reworked/rectified and retested. The list of routine tests is given in section 12.2.3 of this manual.

## **4. Post Delivery Inspection/Verification Testing**

Verification testing is a vital crosscheck mechanism to ensure quality products reach the end users/consumers post-delivery. For verification testing, the sample shall be drawn from open market or manufacturer's warehouse/stockyard. EESL shall bear the cost of the sample as well as the cost of testing in an independent NABL accredited lab. The verification testing shall include all the type tests specified in IS 12615 for submersible motor and the inspection manual and shall be sent to independent test lab approved by NABL.

The samples shall successfully pass all the type tests for proving conformity with the requirements of the standard. If the sample fails in any of the type tests, EESL at its discretion, shall draw the sample may call for fresh samples not exceeding twice the original number and subject them again to all tests or to the test in which failure had occurred. No failures are permitted in the repeat test. In case of failure of samples in repeat testing, EESL shall take appropriate action against the manufacturers.

## ANNEX B

### TEST REPORT FORMAT FOR THREE PHASE ELECTRIC MOTORS AS PER IS 12615

#### 1. SITE CONDITIONS

a) Altitude in meters:

b) Ambient Temperature:

#### 2. ELECTRICAL OPERATING CONDITIONS (SUPPLY VOLTAGE AND FREQUENCY)

Test Report No.:		Date:	
Name of the equipment		Brand	
Name of the Motor Manufacturer:		Model No. / Name	

#### 3. DETAILS OF THE SAMPLE

Rated Output	kW	Rated Voltage	V	Current	A
EFF. Class		Frequency	Hz	Speed	rpm
Efficiency (%)		No. of Phases		No of Pole	
Class of insulation		Type of Duty		Type of Encl.	
Connection		Power factor		Degree of protection	
Type of motor		Frame size		Method of Cooling	
Ref. Indian Standard		BIS Cert. Mark (Licence Number (if any))		Mounting	
BEE Star Label (if any) and the validity period		Motor Srl. Number		Year of Manufacturing	

#### 4. Measuring Equipment/Instruments Details

S. No.	Instrument/ Equipment Name	Make	Accuracy Class	Range and least count	Cal. Valid Date

#### TESTS

**1 Dimensions as per IS 1231/2223/2254/8223 (Clause 7 and 16.2.1)**

**2 Earthing Provisions (Clause 8)**

**3 Terminal Marking (Clause 9)**

**4 Measurement of Resistance of Winding of Stator (Clause 16.1.2)**

Stator Winding Resistance per phase

**5 Insulation Resistance Test (Clause 16.1.1)**

Specified Value: 30 M $\Omega$

Observed Value in M $\Omega$ :

**6 High Voltage Test (Clause 16.1.6): Pass/Fail**

**7 No Load Tests (Clause 16.1.3):**

Readings of voltage, current and power input

**8 Reduced Voltage Running Up Test upto 37 kW (Clause 16.1.5): Pass/Fail**

**9 Momentary Overload Test (Clause 16.2.5): Pass/Fail**

**10 Momentary Excess Torque (Clause 12.1): Pass/Fail**

**11 Pull-up Torque (Clause 12.2): Pass/Fail**

**12 Sustained Overloads (Clause 12.3): Pass/Fail**

**13 Locked Rotor Readings at Reduced Voltage (Clause 16.1.4)**

Readings of voltage, current and Power Input

**14 Locked Rotor Test (for motors having output rating upto 37 kW) (Clause 16.2.2)**

Parameter	Starting Torque		Power Factor	Starting Current		Impedance	Frequency	Input Power
Unit	Kg.m	(% of FLT)	-	Amps	(% of FLT)	$\Omega$		Watts
Observed Values								

NOTE: Specify the test arrangement as per clause 16.2.2.2

**15 Determination of Starting Characteristics – Locked Rotor Current (Clause 16.2.2.3)**

Specify the method used for the tests

**16 Temperature Rise Test (Clause 13 and 16.2.4)**

Requirements	Ambient temperature ° C	
	Specified Limit (° C)	Observed Values (° C)
AC Windings of Motor by Resistance Method (max)		

**17 Full Load Test (Clause 16.2.3)**

S. No.	Load (%)	Voltage	Current	Power Input	Speed	Freq.	Power Output	Slip	Eff.	Power Factor	Torque
		Volts	Amps	Watts	rpm	Hz	Watts	%	%		kgm
1.	No Load										
2.	25 %										
3.	50 %										
4.	75 %										
5.	100% (Rated Load)										
6.	125 %										

## **OPTIONAL TEST**

- 1. Vibration Severity (Clause 16.3.2)**
- 2. Noise level (Clause 16.3.2)**
- 3. Degree of Protection by Enclosure (Clause 16.3.3)**

<b>S. No.</b>	<b>Name of the Test</b>	<b>Remarks</b>
1.	Marking	Pass/Fail
2.	Test for first characteristic number	-do-
3.	Test for second characteristic number	-do-

- 4. Over Speed Test (Clause 16.3.4): Pass/Fail**
- 5. Temperature Rise at Limiting Value Voltage and Frequency Variation  
Clause 16.3.5)**

Tested by	Approved by
Name	Name
Designation	Designation
Date	Date
Seal of the Organization	







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