

# Inspection and Testing Manual For Smart Meter



## 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.

**Supported by:**

**MacArthur**  
**Foundation**

CLASP acknowledges the funding support from MacArthur Foundation for preparation of this manual.

**Inspection And Testing  
Manual For  
Smart Meter**







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**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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## ACKNOWLEDGEMENT

EESL would like to acknowledge the contribution by CLASP team for their technical leadership and support towards the development of this manual. We would especially like to thank P. K. Mukherjee, Senior Advisor for his technical expertise and Dr. Archana Walia, Director, India Program for her leadership in this endeavour. The technical and program teams at EESL and CLASP worked collaboratively and diligently to put together and shape the manual.

We would also like to recognise the sincere efforts of the following individuals, whose contributions have been pivotal to the development of the manual:

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# MANUAL FOR TESTING AND INSPECTION OF AC STATIC DIRECT CONNECTED AND TRANSFORMER OPERATED SMART WATTHOUR METER

## 1. SCOPE

**1.1** This manual highlights the key elements essential for the field inspection officers to ensure the quality for ac static direct connected watt-hour and transformer operated watt-hour and var-hour smart meters procured by EESL in compliance 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 smart meters covered under the scope of IS 16444 (Part 1 and Part 2). This manual also prescribes the levels of control at the manufacturers end for specifies the performance requirements for smart meters.

Stepwise guidelines for the inspection of ac static direct connected watt-hour and transformer operated watt-hour and var-hour smart meters are given in Annex A of this manual.

## 2. REFERRED STANDARD

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

IS No/IEC/ISO	Title
2500 (Part 1)	Sampling procedure for inspection by attributes Part 1 sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
4905	Method of random sampling
IS/ISO 9001	Quality management system- Requirements
13779 : 1999	a.c. Static watthour meters, Class 1 and 2 – Specification
14697:1999	a.c. Static transformer operated watthour and var-hour meters, Class 0.2S, 0.5S and 1.0S
15884 : 2010	Alternating current direct connected static prepayment meters for active energy (Class 1 and 2) – Specification
15959 (Part 1) : 2011	Data exchange for electricity meter reading, tariff and load control : Companion specification
15959 (Part 2) : 2011	Data exchange for electricity meter reading, tariff and load control: Part 2 Companion specification for smart meter
16444 (Part 1)	ac static direct connected watt hour meter, class 1 and 2: Part 1 direct connected smart meters
16444 (Part 2)	ac static transformer operated watt hour meter, class 0.2s, 0.5s and 1.0s: Part 2 Transformer operated smart meters

### **3. DEFINITIONS**

All definitions given in IS 13779, IS 14697, IS 15884 and IS 15959 (Part 1 and Part 2) shall apply. Some of the important definitions relevant to this manual are given below:

#### **3.1 Smart Meter**

Static watt-hour meter with time of use registers, internal connect and disconnect switches with two-way communication capability designed to measure flow of forward (import) or both forward (import) and reverse (export), store and communicate the same along with other parameters defined in this standard. It is remotely accessed for collecting data/events, programming for select parameters.

#### **3.2 Lot**

The number of pumps of the same size, type and duty point offered for inspection at one time shall constitute a lot.

#### **3.3 Sampling**

The selection of a portion of a lot with a view to taking a decision about the quality of the lot on the basis of results obtained by inspecting the selected portion.

#### **3.4 Sample Size**

The number of pumps selected for inspection and/or testing from a lot.

#### **3.5 Routine test**

Tests carried out on each meter to check conformity with the requirements of standard in aspects, which are likely to vary during production

#### **3.6 Type Test**

Series of tests carried out on meters of the same type having identical characteristics, to prove conformity with all the requirements of the relevant standard for the relevant class of meter. These are intended to prove the general qualities & design of a given type of meter.

#### **3.7 Acceptance Test**

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

#### **3.8 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 smart meters 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 meters shall be in accordance with clause 6.8 of IS 16444 (Part 1) for direct connected smart meters and clause 6.8 of IS 16444 (Part 2) for transformer operated smart meters.

In addition, the meters shall carry BIS certification mark licence.

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 manufacturer shall carryout all the tests specified in IS 16444 (Part 1 and 2). The number of samples to be subjected to various tests and the frequency of testing including the action that are required to be taken by the manufacturer in case of failure of sample in any of the test or

tests are given in Table 1 for ac static directed connected smart meters and Table 2 for ac static transformer operated smart meters.

**Table 1**  
**Sampling and Frequency of Testing for ac static direct connected**  
**Watt-hour smart meter**

S. No	Test Requirements	Test Method		No. of Samples	Frequency of Testing
		Clause	Reference Standard		
1	General constructional requirements	6.1 to 6.4	IS 13779	Each smart meter	-
2	Terminals	6.4	-do-	Three	Every lot received from the supplier
3	Terminal cover	6.5,6.5.1,6.5.2 and 6.7	-do-	-do-	Each lot produced
4	Clearance and Creepage distance	6.6	-do-	-do-	-do-
5	Resistance to heat and fire	6.8	-do-	-do-	-do-
6	Mechanical requirements: a) Vibration test b) Shock test c) Spring hammer test d) Protection against penetration of dust and water e) Tet for resistance to heat and fire	6.9,12.3 and 12.5	-do-	-do-	-do-
7	Display of values	6.10	IS 13779	Three	-do-
8	Output device	6.11	IS 13779	Three	-do-
9	Marking	7	-do-	Each smart meter	-
10	Climatic condition: a) Dry heat test b) Cold test c) Damp heat cycling test	8 and 12.6	-do-  IS 13779	Three  Three	Each lot produced  Each lot produced
11	Power consumption (voltage circuits)	6.10.1.1	16144 (Part 1)	-do-	-do-

S. No	Test Requirements	Test Method		No. of Samples	Frequency of Testing
		Clause	Reference Standard		
12	Power consumption (current circuits)	6.10.1.2	-do-	-do-	-do-
13	Influence of supply voltage	4.4.2	IS 15884	-do-	-do-
14	Influence of short –time overcurrent	4.4.3	-do-	-do-	-do-
15	Influence of self-heating	4.4.4	-do-	-do-	-do-
16	Influence of heating	4.4.5	-do-	-do-	-do-
17	Insulation requirements: a) Impulse voltage test b) ac high voltage test c) insulation resistance test	9.5	IS 13779	-do-	-do-
18	Immunity to earth fault	9.6	-do-	-do-	-do-
19	Electromagnetic compatibility: a) Radio interference measurement b) Fast transient burst test c) Test of immunity to electrostatic discharges d) Test for immunity to electromagnetic HF field e) Surge immunity test	4.5 and 5.5	IS 15884	-do-	-do-
20	Accuracy requirement: a) Test on limits of error b) Test on meter constant c) Test on starting condition d) Test on no-load condition e) Test on ambient influence f) Test on repeatability of error g) Test of influence quantities	11.1 11.2 11.3 11.4 11.5 11.6 11.7	IS 13779      IS 13779	-do-      Three	-do-      Each lot produced
21	Test for load switch: a) Load switch capability b) Performance requirement for load switching	7.1 4.6.6.2	IS 16444 (Part 1) IS 15884	-do-	-do-

S. No	Test Requirements	Test Method		No. of Samples	Frequency of Testing
		Clause	Reference Standard		
22	Data exchange and communication protocol	8	IS 16144 (Part 1)  IS 15959 (Part 1 and Part 2)	-do-	-do-
23	Communication requirement: a) Connectivity technologies b) RF technology requirements c) Communication layer protocol	9 9.1 9.2 9.3	IS 16444 (Part 1)	-do-	-do-
24	Display	10.3	-do-	Each smart meter	-
25	Test for load switch	10.4	-do-	Three	Each lot produced
26	Test for data exchange protocol	-	IS 15959 (Part 1 and Part 2)	-do-	-do-
27	Test for smart meter communicability	10.6	IS 16444 (Part 1)	-do-	-do-
28	Functional requirements: a) Disconnection mechanism b) Reconnection mechanism c) Reconnection mechanism for prepayment meter (Optional)	11.1 11.2 11.3	-do-	Each meter	-
29	Status of load switch	11.4	-do-	-do-	-

**Table 2**  
**Sampling and Frequency of Testing for ac static transformer operated Watt-hour and**  
**Var-hour smart meter**

S. No	Test Requirements	Test Method		No. of Samples	Frequency of Testing
		Clause	Reference Standard		
1	General constructional requirements	6.1 to 6.4	IS 14697	Each smart meter	-
2	Terminals	6.4	-do-	Three	Every lot received from the supplier
3	Terminal cover	6.5,6.5.1, 6.5.2 and 6.7	IS 13779	-do-	-do-
4	Clearance and Creepage distance	6.6	IS 14697	-do-	Each lot produced
5	Resistance to heat and fire	6.8	-do-	-do-	-do-
6	Mechanical requirements: a) Vibration test b) Shock test c) Spring hammer test d) Protection against penetration of dust and water e) Tet for resistance to heat and fire	6.9,12.3 and 12.5	-do-	-do-	-do-
7	Display of values	6.10	-do-	-do-	-do-
8	Output device	6.11	-do-	-do-	-do-
9	Marking	7	-do-	Each smart meter	-
10	Climatic condition: a) Dry heat test b) Cold test c) Damp heat cycling test	8 and 12.6	-do-	Three	Each lot produced
11	Power consumption (voltage circuits)	6.10.1.1	16144 (Part 2)	-do-	-do-
12	Power consumption (current circuits)	6.10.1.2	-do	-do	-do-



S. No	Test Requirements	Test Method		No. of Samples	Frequency of Testing
		Clause	Reference Standard		
13	Influence of supply voltage	9.2.1 and 9.2.2	IS 14697	-do-	-do-
14	Influence of short – time overcurrent	9.2.3	-do-	-do-	-do-
15	Influence of self-heating	9.3	-do-	-do-	-do-
16	Influence of heating	9.4	-do-	-do-	-do-
17	Insulation requirements: a) Impulse voltage test b) ac high voltage test c) insulation resistance test	9.5	-do-	-do-	-do-
18	Immunity to earth fault	9.6	-do-	-do-	-do-
19	Electromagnetic compatibility: a) Radio interference measurement b) Fast transient burst test c) Test of immunity to electrostatic discharges d) Test for immunity to electromagnetic HF field e) Surge immunity test	10	IS 14697	Three	Each lot produced

S. No	Test Requirements	Test Method		No. of Samples	Frequency of Testing
		Clause	Reference Standard		
20	Accuracy requirement: a) Test on limits of error b) Test on meter constant c) Test on starting condition d) Test on no-load condition e) Test on ambient influence f) Test on repeatability of error g) Test of influence quantities	11.1 11.2 11.3 11.4 11.5 11.6 11.7	-do-	-do-	-do-
21	Data exchange and communication protocol	7	IS 16144 (Part 1)  IS 15959 (Part 1 and Part 3)	-do-	-do-
22	Communication requirement: a) Connectivity technologies b) RF technology requirements c) Communication layer protocol	8 8.1 8.2 8.3	IS 16444 (Part 2)  -	-do-	-do-
23	Display	9.3	-do-	Each smart meter	-
24	Test for data exchange protocol	9.4	-do-	Three	Each lot produced
25	Test for smart meter communicability	28	IS 15959 (Part 3)	-do-	-do-
26	Functional requirements:	10	IS 16444 (Part 2)	Each meter	-

In case the manufacture does not have requisite test facilities for any of the tests shown in Table 1 and 2 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 smart meter.

In case of failure of any smart meter in respect of tests carried out on each smart meter, 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 Table 2 for direct connected and transformer operated smart meters and then original frequency shall be restored if both the samples pass.

## **5 INFORMATION TO BE FURNISHED BY EESL**

**5.1** When enquiring or ordering smart meters to the prescribed standard as specified in the contract, the following information in addition to those given in clause 7 of IS 13779 for direct connected and Clause 7 of IS 14697 for transformer operated smart meters 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) Total number of smart meter required; and
- f) Location where the meters required to be supplied.

*Technical information for both ac static direct connected meter ac static transformer operated smart meters*

- a) Type of smart meter (directed/transformer connected);
- b) Type of meter according to basic and maximum current;
- c) Principle unit in which meter can read (e.g. Watt-hour or kWh for directed connected meters and Var-hour, Watt-hour or kWh for transformer operated meters);
- d) Meter constant;
- e) Class index of the meter;
- f) The reference ambient temperature if different from 27 °C;
- g) Rated voltage, frequency and number of phase and number of wires (e.g. 2 wire/3 wire/4 wire);
- h) Transformation ratio in case of transformer operated smart meter; and
- i) BIS certification and product covered BIS certification marks licence.

## **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 smart meter complying with the relevant standard specified in the contract.

- 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 6.1 to 6.3.

### **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 accredited by NABL.

Before commencement of the tests, the smart meters shall be visually examined including the components, parts and their assembly, constructions, mechanical hazards, marking provision of suitable terminals for supply connections, earthing and the effectiveness of screws and connection. The external surface finish shall be even and free from finishing defects. The smart meters shall be subjected to the following type test as given in Table 3 for direct connected smart meters and Table 4 for transformer operated smart meters.

**Table 3**  
**List of Type Tests for Bid Evaluation (ac static direct connected smart meters)**

S. No	Test Requirements	Clause reference as per IS 16444 (Part 1)	Test Method	
			Clause	Reference Standard
1	General constructional requirements	6.2	6.1 to 6.4	IS 13779
2	Terminals	6.2.1	6.4	-do-
3	Terminal cover	6.2.2	6.5,6.5.1,6.5.2 and 6.7	-do-
4	Clearance and Creepage distance	6.3	6.6	-do-
5	Resistance to heat and fire	6.4	6.8	-do-
6	Mechanical requirements: a) Vibration test b) Shock test c) Spring hammer test d) Protection against penetration of dust and water e) Tet for resistance to heat and fire	6.5	6.9,12.3 and 12.5	-do-
7	Display of values	6.6	6.10	-do-
8	Output device	6.7	6.11	-do-
9	Marking	6.8	7	-do-

S. No	Test Requirements	Clause reference as per IS 16444 (Part 1)	Test Method	
			Clause	Reference Standard
10	Climatic condition: a) Dry heat test b) Cold test c) Damp heat cycling test	6.9	8 and 12.6	-do-
11	Power consumption (voltage circuits)	6.10.1.1	6.10.1.1	16144 (Part 1)-
12	Power consumption (current circuits)	6.10.1.2	6.10.1.2	-do-
13	Influence of supply voltage	6.10.2	4.4.2	IS 15884
14	Influence of short –time overcurrent	6.10.3	4.4.3	-do-
15	Influence of self-heating	6.10.4	4.4.4	-do-
16	Influence of heating	6.10.5	4.4.5	-do-
17	Insulation requirements: a) Impulse voltage test b) ac high voltage test c) insulation resistance test	6.10.6	9.5	IS 13779
18	Immunity to earth fault	6.10.7	9.6	-do-
19	Electromagnetic compatibility: a) Radio interference measurement b) Fast transient burst test c) Test of immunity to electrostatic discharges d) Test for immunity to electromagnetic HF field e) Surge immunity test	6.11	4.5 and 5.5	IS 15884
20	Accuracy requirement: a) Test on limits of error b) Test on meter constant c) Test on starting condition d) Test on no-load condition e) Test on ambient influence f) Test on repeatability of error g) Test of influence quantities	6.12	11.1 11.2 11.3 11.4 11.5 11.6 11.7	IS 13779

S. No	Test Requirements	Clause reference as per IS 16444 (Part 1)	Test Method	
			Clause	Reference Standard
21	Test for load switch: a) Load switch capability b) Performance requirement for load switching	7 7.1 7.2	7.1 4.6.6.2	IS 16444 (Part 1)  IS 15884
22	Data exchange and communication protocol	8	8	IS 16144 (Part 1)  IS 15959 (Part 1 and Part 2)
23	Communication requirement: a) Connectivity technologies b) RF technology requirements c) Communication layer protocol	9 9.1 9.2 9.3	9 9.1 9.2 9.3	IS 16444 (Part 1)
24	Display	10.3	10.3	-do-
25	Test for load switch	10.4	10.4	-do-
26	Test for data exchange protocol	10.5	10.5	-do-
27	Test for smart meter communicability	10.6	10.6	-do-
28	Functional requirements: a) Disconnection mechanism b) Reconnection mechanism c) Reconnection mechanism for prepayment meter (Optional)	11 11.1 11.2 11.3	11.1 11.2 11.3	-do-
29	Status of load switch	11.4	11.4	-do-

NOTES:

1. For test of load switch, one sample in case of utilization category UC1 and two samples in case of utilization category UC2/UC3. For data exchange protocol and smart meter communicability test, one sample shall be tested.
2. Following test shall be carried out to assess for smart meter functional condition after the type test for metrology is carried out but before test of resistance to heat and fire {see IS 15959 (Part 2) for functional test procedure}.
  - a) Accuracy of the meter at pre-defined points [5 percent  $I_b$ ,  $I_b$  and  $I_{max}$ ] UPF
  - b) Access and data read test.
  - c) Remote disconnect/connect



**Table 4**  
**List of Type Tests for Bid Evaluation (ac static transformer operated Watt-hour and**  
**Var-hour smart meter)**

S. No	Test Requirements	Clause reference as per IS 16444 (Part 2)	Test Method	
			Clause	Reference Standard
1	General constructional requirements	6.2	6.1 to 6.4	IS 14697
2	Terminals	6.2.1	6.4	-do-
3	Terminal cover	6.2.2	6.5,6.5.1,6.5.2 and 6.7	IS 13779
4	Clearance and Creepage distance	6.3	6.6	IS 14697
5	Resistance to heat and fire	6.4	6.8	-do-
6	Mechanical requirements: a) Vibration test b) Shock test c) Spring hammer test d) Protection against penetration of dust and water e) Tet for resistance to heat and fire	6.5	6.9,12.3 and 12.5	-do-
7	Display of values	6.6	6.10	-do-
8	Output device	6.7	6.11	-do-
9	Marking	6.8	7	-do-
10	Climatic condition: a) Dry heat test b) Cold test c) Damp heat cycling test	6.9	8 and 12.6	-do-
11	Power consumption (voltage circuits)	6.10.1.1	6.10.1.1	16144 (Part 2)
12	Power consumption (current circuits)	6.10.1.2	6.10.1.2	-do
13	Influence of supply voltage	6.10.2	9.2.1 and 9.2.2	IS 14697
14	Influence of short –time overcurrent	6.10.3	9.2.3	-do-
15	Influence of self-heating	6.10.4	9.3	-do-
16	Influence of heating	6.10.5	9.4	-do-
17	Insulation requirements: a) Impulse voltage test b) ac high voltage test c) insulation resistance test	6.10.6	9.5	-do-

S. No	Test Requirements	Clause reference as per IS 16444 (Part 2)	Test Method	
			Clause	Reference Standard
18	Immunity to earth fault	6.10.7	9.6	-do-
19	Electromagnetic compatibility a) Radio interference measurement b) Fast transient burst test c) Test of immunity to electrostatic discharges d) Test for immunity to electromagnetic HF field e) Surge immunity test	6.11	10	-do-
20	Accuracy requirement: a) Test on limits of error b) Test on meter constant c) Test on starting condition d) Test on no-load condition e) Test on ambient influence f) Test on repeatability of error g) Test of influence quantities	6.12	11.1 11.2 11.3 11.4 11.5 11.6 11.7	IS 14697
21	Data exchange and communication protocol	7	7	IS 16144 (Part 1)  IS 15959 (Part 1 and Part 3)
22	Communication requirement: a) Connectivity technologies b) RF technology requirements c) Communication layer protocol	8 8.1 8.2 8.3	8 8.1 8.2 8.3	IS 16444 (Part 2)  -
23	Display	9.3	9.3	-do-
24	Test for data exchange protocol	9.4	9.4	-do-
25	Test for smart meter communicability	9.5	9.5	-do-
26	Functional requirements:	10	10	-do-

NOTES: 1. Following test shall be carried out to assess for smart meter functional condition and functionality of communication module after the type test for metrology is carried out but before test of resistance to heat and fire'.

- a) Accuracy of the meter at pre-defined points [5 percent  $I_b$ ,  $I_b$  and  $I_{max}$ ] UPF
- b) Manufacturer shall demonstrate the functionality of communication module by data read test that is reading kWh energy register through the communication module.

### 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) Document relating to BEE approval for star rating label;
- c) Type test report in original from a NABL accredited testing laboratory as per IS 16444 (Part 1) for ac static direct connected smart meters and IS 16444 (Part 2) for ac static transformer operated smart meters;
- d) Copy of test certificates of important raw materials and components for smart meters, namely terminal block and terminal covers;
- e) Copy of valid NABL certificate of accreditation of manufacturers lab and independent lab; and
- f) Warranty certificate for guarantee of performance of minimum as prescribed by EESL.

## 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.

### 6.2.1 Type Test

For the purpose of type tests, three samples of ac static directed connected and/or ac static transformer operated smart meters of 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 3 and Table 4 for direct connected and transformer operated respectively as given below 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 smart meters 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 smart meters 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.

#### *6.2.2 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 for direct connected and transformer operated meters are given in the Table 5 and Table 6 respectively.

**Table 5**  
**List of Acceptance Test for Pre-Delivery Inspection**  
**(AC static direct connected smart meter)**

S. No.	Test Requirements	Clause reference as per IS 16444 (Part 1)	Test Method	
			Clause	Reference Standard
1	General constructional requirements	6.2	6.1 to 6.4	IS 13779
2	Terminals	6.2.1	6.4	-do-
3	Terminal cover	6.2.2	6.5,6.5.1,6.5.2 and 6.7	-do-
4	Resistance to heat and fire	6.4	6.8	-do-
5	Display of values	6.6	6.10	-do-
6	Output device	6.7	6.11	IS 13779
7	Marking	6.8	7	-do-
8	Power consumption (voltage circuits)	6.10.1.1	6.10.1.1	16144 (Part 1)
9	Power consumption (current circuits)	6.10.1.2	6.10.1.2	-do-
10	Influence of supply voltage	6.10.2	4.4.2	IS 15884
11	Influence of short –time overcurrent	6.10.3	4.4.3	-do-
12	Influence of self-heating	6.10.4	4.4.4	-do-
13	Influence of heating	6.10.5	4.4.5	-do-
14	Insulation requirements: a) AC high voltage test b) insulation resistance test	6.10.6	9.5	IS 13779
15	Accuracy requirement: a) Test on limits of error b) Test on meter constant c) Test on starting condition d) Test on no-load condition e) Test on repeatability of error	6.12	11.1 11.2 11.3 11.4 11.7	IS 13779

S. No.	Test Requirements	Clause reference as per IS 16444 (Part 1)	Test Method	
			Clause	Reference Standard
16	Test for load switch: a) Load switch capability b) Performance requirement for load switching	7 7.1 7.2	7.1 4.6.6.2	IS 16444 (Part 1) IS 15884
17	Data exchange and communication protocol	8	8	IS 16144 (Part 1) IS 15959 (Part 1 and Part 2)
18	Communication requirement: a) Connectivity technologies b) RF technology requirements c) Communication layer protocol	9 9.1 9.2 9.3	9 9.1 9.2 9.3	IS 16444 (Part 1)
19	Display	10.3	10.3	-do-
20	Test for load switch	10.4	10.4	IS 16444 (Part 1)
21	Test for data exchange protocol	10.5	10.5	-do-
22	Test for smart meter communicability	10.6	10.6	IS 16444 (Part 1)
23	Functional requirements: a) Disconnection mechanism b) Reconnection mechanism c) Reconnection mechanism for prepayment meter (Optional)	11 11.1 11.2 11.3	11.1 11.2 11.3	-do-
24	Status of load switch	11.4	11.4	-do-

NOTES:

1. For test of load switch, one sample in case of utilization category UC1 and two samples in case of utilization category UC2/UC3. For data exchange protocol and smart meter communicability test, one sample shall be tested.
2. Following test shall be carried out to assess for smart meter functional condition after the acceptance test for metrology is carried out but before test of resistance to heat and fire {see IS 15959 (Part 2) for functional test procedure}.
  - a. Accuracy of the meter at pre-defined points [5 percent  $I_b$ ,  $I_b$  and  $I_{max}$ ] UPF
  - b. Data read test by reading cumulative kWh energy register through the communication module. Manufacturer shall demonstrate functionality of communication module. Minimum parameters to be demonstrated shall be kWh and Remote disconnect/connect'.
  - c. Remote disconnect/connect

**Table 6**  
**List of Acceptance Tests for Pre delivery Inspection (AC static transformer operated Watt-hour and Var-hour smart meter)**

S. No.	Test Requirements	Clause reference as per IS 16444 (Part 2)	Test Method	
			Clause	Reference Standard
1	General constructional requirements	6.2	6.1 to 6.4	IS 14697
2	Terminals	6.2.1	6.4	-do-
3	Terminal cover	6.2.2	6.5,6.5.1,6.5.2 and 6.7	-do-
	Resistance to heat and fire	6.4	6.8	IS 14697
4	Display of values	6.6	6.10	-do-
5	Output device	6.7	6.11	-do-
6	Marking	6.8	7	-do-
7	Power consumption (voltage circuits)	6.10.1.1	6.10.1.1	16144 (Part 2)
8	Power consumption (current circuits)	6.10.1.2	6.10.1.2	-do-
9	Influence of supply voltage	6.10.2	9.2.1 and 9.2.2	IS 14697
10	Influence of short –time overcurrent	6.10.3	9.2.3	-do-
11	Influence of self-heating	6.10.4	9.3	-do-
12	Influence of heating	6.10.5	9.4	IS 14697
13	Insulation requirements: a) AC high voltage test b) insulation resistance test	6.10.6	9.5	-do-
14	Immunity to earth fault	6.10.7	9.6	-do-
15	Accuracy requirement: a) Test on limits of error b) Test on meter constant c) Test on starting condition d) Test on no-load condition e) Test on repeatability of error	6.12	11.1 11.2 11.3  11.4  11.7	-do-
16	Data exchange and communication protocol	7	7	IS 16144 (Part 1) IS 15959 (Part 1 and Part 3)



S. No.	Test Requirements	Clause reference as per IS 16444 (Part 2)	Test Method	
			Clause	Reference Standard
17	Communication requirement: a) Connectivity technologies b) RF technology requirements c) Communication layer protocol	8 8.1 8.2 8.3	8 8.1 8.2 8.3	IS 16444 (Part 2) - -
18	Display	9.3	9.3	-do-
19	Test for data exchange protocol	9.4	9.4	-do-
20	Test for smart meter communicability	9.5	9.5	-do-
21	Functional requirements:	10	10	-do-

NOTES:

1. Following test shall be carried out to assess for smart meter functional condition and functionality of communication module after the acceptance test for metrology is carried out but before test of resistance to heat and fire'.
  - a) Accuracy of the meter at pre-defined points [5 percent  $I_b$ ,  $I_b$  and  $I_{max}$ ] UPF and
  - b) Manufacturer shall demonstrate the functionality of communication module by data read test that is reading kWh energy register through the communication module.

**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.

S. No.	Test Requirements	Test Method	
		Clause	Reference Standard
<b><i>Direct connected smart meter</i></b>			
1	General constructional requirements	6.1 to 6.4	IS 13779
2	Display of values	6.10	-do-
3	Marking	7	-do-
4	Functional requirement: a) Disconnection mechanism b) Reconnection mechanism	11 11.1 11.2	IS 16444 (Part 1)

S. No.	Test Requirements	Test Method	
		Clause	Reference Standard
	c) Reconnection mechanism for prepayment meter	11.3	
5	Status of load switch	11.4	-do-
<b><i>Transformer operated smart meter</i></b>			
1	General constructional requirements	6.1 to 6.4	IS 14697
2	Display of values	6.10	-do-
3	Marking	7	-do-
4	Functional requirement:	11	IS 16444 (Part 1)

### 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 smart meters as mentioned in Table 3 and Table 4 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 smart meters 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 smart meter 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 smart 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 in IS 16444 (Part 1) for direct connected smart meters and IS 16444 (Part 2) for transformer operated smart meters.

## **11 TEST REPORT PROFORMA FOR SMART METER**

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

# **Annexures**



## ANNEX A

### STEPWISE GUIDELINES FOR THE INSPECTION OF SMART METERS

#### 1. Introduction

This inspection manual elaborates the quality assurance process for ac static direct connected watt-hour and transformer operated watt-hour and var-hour smart meters 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;
  - 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 LED street light luminaire 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 smart meters 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 3 and Table 4 of this manual

#### **4.2 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 7 and Table 8 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 smart meters 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 8.2.3 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 16444 (Part 1) for ac static direct connected watt-hour and IS 16444 (Part 2) for transformer operated watt-hour and var-hour smart meters 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 MANUFACTURERS LAB AND INDEPENDENT LAB FOR SMART METERS

#### 1. General Information

Manufacturer/ Laboratory Name			
Address			
Date of Receipt of samples (for Independent Labs)			
Test Standard			
Test Report No.		Date of testing	
Tested by		Reviewed By	

#### 2. Details of the Sample Tested

Brand Name	
Model Name, if any	
Year of Manufacturer	
Model Number (if any)	
Serial No.	
Type of Meter (direct connected/transformer operated)	
Basic current ( $I_b$ ) and Maximum current ( $I_{max}$ )	
Meter Constant	
Class Index of the Meter	
Rated voltage, frequency and number of phase and number of wires (e.g. 2 wire/3 wire/4 wire)	
Principle unit in which meter can read (e.g. Watt-hour or kWh for directed connected meters and Var-hour, Watt-hour or kWh)	

for transformer operated meters)	
BIS Certification Marks with licence number, if any	

### 3. Measuring Equipment/Instruments Details

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

### 4. Test Results

#### a) AC Static Direct Connected Smart Meter

S. No.	Nature of Tests	Test Method		Specified Value	Observed Value	Pass/Fail
		Clause	Reference Standard			
1	General constructional requirements	6.1 to 6.4	IS 13779			
2	Terminals	6.4	-do-			
3	Terminal cover	6.5,6.5.1,6.5.2 and 6.7	-do-			
4	Clearance and Creepage distance	6.6	-do-			
5	Resistance to heat and fire	6.8	-do-			
6	Mechanical requirements: 1) Vibration test 2) Shock test 3) Spring hammer test 4) Protection against penetration of dust and water 5) Tet for resistance to heat and fire	6.9,12.3 and 12.5	-do-			
7	Display of values	6.10	-do-			
8	Output device	6.11	IS 13779			

S. No.	Nature of Tests	Test Method		Specified Value	Observed Value	Pass/ Fail
		Clause	Reference Standard			
9	Marking	7	-do-			
10	Climatic condition: 1) Dry heat test 2) Cold test 3) Damp heat cycling test	8 and 12.6	-do-			
11	Power consumption (voltage circuits)	6.10.1.1	16144 (Part 1)-			
12	Power consumption (current circuits)	6.10.1.2	-do			
13	Influence of supply voltage	4.4.2	IS 15884			
14	Influence of short –time overcurrent	4.4.3	-do-			
15	Influence of self-heating	4.4.4	-do-			
16	Influence of heating	4.4.5	-do-			
17	Insulation requirements: 1) Impulse voltage test 2) ac high voltage test 3) insulation resistance test	9.5	IS 13779			
18	Immunity to earth fault	9.6	-do-			
19	Electromagnetic compatibility: 1) Radio interference measurement 2) Fast transient burst test 3) Test of immunity to electrostatic discharges 4) Test for immunity to electromagnetic HF field 5) Surge immunity test	4.5 and 5.5	IS 15884			

S. No.	Nature of Tests	Test Method		Specified Value	Observed Value	Pass/Fail
		Clause	Reference Standard			
20	Accuracy requirement: 1) Test on limits of error 2) Test on meter constant 3) Test on starting condition 4) Test on no-load condition 5) Test on ambient influence 6) Test on repeatability of error 7) Test of influence quantities	11.1 11.2 11.3 11.4 11.5 11.6 11.7	IS 13779			
21	Test for load switch: 1) Load switch capability 2) Performance requirement for load switching	7.1 4.6.6.2	IS 16444 (Part 1) IS 15884			
22	Data exchange and communication protocol	8	IS 16144 (Part 1) IS 15959 (Part 1 and Part 2)			
23	Communication requirement: 1) Connectivity technologies 2) RF technology requirements 3) Communication layer protocol	9 9.1 9.2 9.3	IS 16444 (Part 1)			
24	Display	10.3	-do-			
25	Test for load switch	10.4				
26	Test for data exchange protocol	10.5	-do-			

S. No.	Nature of Tests	Test Method		Specified Value	Observed Value	Pass/ Fail
		Clause	Reference Standard			
27	Test for smart meter communicability	10.6	-do-			
28	Functional requirements: 1) Disconnection mechanism 2) Reconnection mechanism 3) Reconnection mechanism for prepayment meter (Optional)	11.1 11.2 11.3	-do-			
29	Status of load switch	11.4	-do-			

b) *AC Static Transformer Operated Smart Meter*

S. No.	Test Requirements	Test Method		Specified Value	Observed Value	Pass/ Fail
		Clause	Reference Standard			
1	General constructional requirements	6.1 to 6.4	IS 14697			
2	Terminals	6.4	-do-			
3	Terminal cover	6.5,6.5.1,6.5.2 and 6.7	IS 13779			
4	Clearance and Creepage distance	6.6	IS 14697			
5	Resistance to heat and fire	6.8	-do-			

S. No.	Test Requirements	Test Method		Specified Value	Observed Value	Pass/Fail
		Clause	Reference Standard			
6	Mechanical requirements: 1) Vibration test 2) Shock test 3) Spring hammer test 4) Protection against penetration of dust and water 5) Tet for resistance to heat and fire	6.9,12.3 and 12.5	-do-			
7	Display of values	6.10	-do-			
8	Output device	6.11	-do-			
9	Marking	7	-do-			
10	Climatic condition: 1) Dry heat test 2) Cold test 3) Damp heat cycling test	8 and 12.6	-do-			
11	Power consumption (voltage circuits)	6.10.1.1	16144 (Part 2)			
12	Power consumption (current circuits)	6.10.1.2	-do-			
13	Influence of supply voltage	9.2.1 and 9.2.2	IS 14697			
14	Influence of short –time overcurrent	9.2.3	-do-			
15	Influence of self-heating	9.3	IS 14697			
16	Influence of heating	9.4	-do-			
17	Insulation requirements: 1) Impulse voltage test 2) ac high voltage test 3) insulation resistance test	9.5	-do-			
18	Immunity to earth fault	9.6	-do-			

S. No.	Test Requirements	Test Method		Specified Value	Observed Value	Pass/Fail
		Clause	Reference Standard			
19	Electromagnetic compatibility 1) Radio interference measurement 2) Fast transient burst test 3) Test of immunity to electrostatic discharges 4) Test for immunity to electromagnetic HF field 5) Surge immunity test	10	-do-			
20	Accuracy requirement: 1) Test on limits of error 2) Test on meter constant 3) Test on starting condition 4) Test on no-load condition 5) Test on ambient influence 6) Test on repeatability of error 7) Test of influence quantities	11.1 11.2 11.3 11.4 11.5 11.6 11.7	-do-			
21	Data exchange and communication protocol	7	IS 16144 (Part 1)  IS 15959 (Part 1 and Part 3)			
22	Communication requirement: 1) Connectivity technologies 2) RF technology requirements 3) Communication layer protocol	8 8.1 8.2 8.3	IS 16444 (Part 2)			
24	Display	9.3	-do-			



S. No.	Test Requirements	Test Method		Specified Value	Observed Value	Pass/ Fail
		Clause	Reference Standard			
25	Test for data exchange protocol	9.4	-do-			
26	Test for smart meter communicability	9.5	-do-			
27	Functional requirements:	10	-do-			





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