

*ENGINEERING SPECIFICATIONS FOR
POLYPHASE SOLID-STATE ELECTRICITY METERS
FOR USE ON THE ISO GRID*

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1. GENERAL INFORMATION

1.1. Description

1.1.1. This engineering specification shall apply to all solid-state polyphase electricity meters used in all load-connected revenue metering applications on the ISO Grid. These electricity meters are referred to as the Meter in the Specification.

1.1.2. ISO reserves the right to modify the Specification and to approve deviations from all or part of the Specification.

1.1.3. Any product exceptions must be approved in writing by ISO.

1.1.4. The Supplier is responsible and accountable for the detailed design and construction of the Meter.

1.2. Questions and Inquiries

Questions and inquiries about the Specification should be addressed to the ISO Energy Data Acquisition Specialists (EDAS) Team.

EDAS

EDAS@caiso.com

250 Outcropping way,

Folsom, CA 95630

(916) 608-5826

2. SCOPE

2.1. General

The Specification provides the minimum functional and performance requirements for the Meter. All requirements in the Specification are intended to assure the expected life cycles, security, accuracy, reliability and minimum maintenance requirement of the Meter. It is not intended to inhibit the design, construction and creativity of the Supplier. Some requirements, however, are specified to maintain the compatibility and interchangeability of the Meter.

2.2. Standards

The Meter shall comply with American National Standards Institute (ANSI) standards and other standards listed in Section 23, **Applicable Standards**, except those modified by the Specification. If conflicts exist, the requirements of the Specification will supersede those of ANSI and other standards.

2.3. Applicability

2.3.1. The Specification covers ISO's current and near future requirements for electricity meters used in load only revenue applications on the ISO System.

2.3.2. Meters approved for purchase under this Specification may not be required to have all of the specified features. ISO will specify the features for each application as necessary.

2.3.3. Each Meter supplied shall meet the specified minimum requirements and the requirements of Section 17, the Meter Approval Testing.

3. PERFORMANCE

3.1. Service Life

The Meter, excluding replaceable battery, shall have a minimum service life of 16 years from the manufacturer's shipping date, or 15 years from the installation date, whichever is longer. During the service life period, the Meter shall continue to operate in full compliance with the Specification.

3.2. Reliability

The annual failure rate, excluding user induced failures, shall not exceed 0.75% throughout the service life of the Meter. The failure rate is the ratio of the number of Failed Meters of a specific type, to the number of installed Meters of the same

type. A Failed Meter is defined in Section 17.2 and Section 24, Definitions. If the failure rate exceeds 0.75%, this may result in removal of the Meter from the ISO - approved list for load only revenue meters.

4. WARRANTIES

4.1. Standard Warranty

As a minimum, the Supplier shall provide a standard warranty of three years from the date of the Meter delivery.

4.2 Workmanship and Material

Supplier shall warrant that the Meter and all parts thereof furnished by Supplier, whether or not manufactured by Supplier, shall be of the kind and quality described by this Specification will be free of defects in workmanship, material, design, and quality, and shall be fit for its intended purpose.

4.3. Performance

Supplier shall warrant that when the Meter is placed in operation or used, it will perform in the manner set forth by this Specification.

The Supplier shall complete all cash refunds and replacements of the Failed Meters within 60 days of Purchaser’s delivery of the Failed Meters to the Supplier.

5. METER SHIPMENT ACCEPTANCE

5.1. Testing

Each Meter received by Purchaser will be tested for various physical and electronic attributes. A metering accuracy test shall be performed at the time of installation on the Purchaser’s premises.

5.2. Acceptable Quality Level (AQL)

The minimum Acceptable Quality Level (AQL) of each Meter as received at Purchaser’s facility shall meet or exceed that in Section 5.3.

5.3. Acceptance Criteria

The Purchaser shall accept the Meter if it meets all of the following criteria are met:

5.3.1. The Meter passes a combined inspection for physical and electronic attributes and metering accuracy as defined in Section 5.4.

5.4. Physical and Electronic Attributes and Metering Accuracy

5.4.1. The Meter will be inspected for physical and electronic attributes as shown in Attachment 1.

5.4.2. Installation accuracy tests will be performed on the Meter.

5.4.3. The tests will be performed at full and light loads. The test point loads are shown in Table 1.

Table 1
Test Point Loads

Meter Class	Test Points (amps)		
	Full Load @ 100%	Light Load @ 100%	Full Load @ 50% lag
20	5.00	0.50	5.00

5.4.4. For acceptance of a Meter, the metering accuracy at the test points shall be within:

5.4.4.1. ±0.25% at light load at power factor of 100%.

5.4.4.2. ±0.2% at full load at power factor of 100%.

5.4.4.3. ±0.25% at full load at power factor of 50% lag.

5.5. Defective Meters

Any Meter that fails any of the inspections or accuracy tests will be returned to the Supplier for replacement or full return credit in accordance with Section 4, Warranties. The Supplier shall pay for all shipping and handling costs for returning the Meter.

6. PRODUCT CHANGE

6.1. Notification

- 6.1.1. The Supplier shall submit to ISO, for ISO's evaluation and approval, a written request for any functional or design revision made to the Meter. Cosmetic changes, which do not affect the meter's functionality, will not require re-certification.
- 6.1.2. The Supplier shall submit to ISO a written request for any model substitution of the Meter for approval. Requests shall be made with sufficient lead-time so as not to affect the scheduled delivery of the Meter.
- 6.1.3. ISO reserves the right to reject any such substitutions or revisions at ISO's sole discretion.
- 6.1.4. A certified test report shall be required for all substitutions and revisions.
- 6.1.5. Written requests shall be addressed to EDAS at EDAS@caiso.com

6.2. Effective Date

ISO's approval of revisions per Section 6.1.3. becomes effective on the date of notification to the Supplier of such approval.

6.3. ISO Rights

ISO reserves the right to withdraw approval of the Meter if a change is made on any part or component of the Meter without ISO's prior written approval or if the meter is later found not to comply with this Specification. As a condition of being on the ISO approved meter list, supplier shall hold ISO harmless to supplier and others if ISO approval is canceled or withdrawn on said meter.

7. METERING FUNCTIONS

7.1. Measured Quantities

As used in this Specification, the term "delivered" applies to power and energy flowing out of the ISO Controlled Grid.

7.1.1. The following consumption quantities are required for all Load Meters approved for use on the ISO Grid:

- 7.1.1.1. Kilowatt-hours delivered
- 7.1.1.2. Kilovar-hours—delivered
- 7.1.1.3. Kilovoltamp-hours—delivered

7.1.2. The following demand quantities are required for all Load Meters approved for use on the ISO Grid:

- 7.1.2.1. Kilowatts--delivered
- 7.1.2.2. Kilovars—delivered
- 7.1.2.3. Kilovoltamps—delivered

7.1.3. The Meter shall be programmable to take one of the following actions for reverse consumption and demand quantities: 7.1.3.1. Ignore the reverse quantities.

- 7.1.3.2. Add the reverse quantities to the appropriate consumption and demand quantities.

7.2. Basic Default Metering Function

7.2.1. When power is applied to the Meter, it shall immediately begin recording total kilowatthours. This function shall be performed regardless of whether the Meter is programmed or not and shall not require a battery.

7.2.2. ISO may request the Supplier to program Meters with a specified program.

7.3. Demand Metering Function

7.3.1. As a minimum, the Meter shall be programmable for fixed and/or rolling interval demand calculations on kilowatts and kilovars.

7.3.2. A battery shall not be required to perform demand calculations, to save the results, or to communicate the results to a handheld meter reader connected to the optical port.

7.3.3. The Meter shall be programmable for one minute delivered kilowatt demand (as an approximation of “instantaneous” kilowatts delivered) in addition to the rolling interval demand calculation. The one-minute demand is not required to be synchronous with the other demand quantities.

7.3.4. The Meter shall be programmable for rolling interval demand calculations for any optional demand quantity (see Section 7.1.2.) that ISO specifies.

7.3.5. Demand intervals shall be programmable for duration of 1, 5, 10, 15, 30 or 60 minutes.

7.3.6. The demand interval shall be composed of an integral number of subintervals. Subinterval duration shall be a programmable duration of 1, 5, 10, 15 or 30 minutes.

7.3.7. Demand functions shall be capable of temporary suspension for a programmable time interval after power is restored following a power outage. The length of time shall be programmable from zero to 60 minutes in one-minute intervals.

7.3.8. After a demand reset, further manual demand resets shall be prevented with a programmable lockout time. A demand reset from a Meter Programmer connected to the optical port is not subject to this delay and can be initiated as frequently as required.

7.4. Load Profile Function

7.4.1. ISO requires that the Meter provide load profile recording of interval data for 1 to 4 channels of consumption quantities.

7.4.2. Date and time shall be stored with the load profile interval data.

7.4.3. Load profile data shall use a “wraparound” memory that stores new interval data by writing over the oldest interval data.

7.4.4. The load profile function shall be capable of storing and communicating a minimum of 30 days of 4 channel, 5 minute data, in addition to allowances for event recording (power outages, resets, time sets, etc.).

7.4.5. The load profile function shall have the capacity to count and store at least 16,000 counts in a 15-minute period of time.

7.4.6. Load profile data recording shall continue while the Meter is communicating with a Meter Programmer connected to the optical port.

7.5. Function during Power Disturbances

7.5.1. During power line disturbances such as brownout or outage conditions, and during transportation to the installation site, the Meter shall maintain all meter data as well as time keeping functions. Display and communication functions are not required during these conditions.

7.5.2. The Meter shall withstand all of the following outages during a continuous five year or longer service without the need to maintain its auxiliary power system, including replacing the battery:

7.5.2.1. 20 short outages per year at less than 30 seconds per outage.

7.5.2.2. 40 days of continuous/cumulative outage.

7.5.3. During a power outage critical program and billing data shall be written to nonvolatile memory. When power is restored, data shall be returned to active memory and data collection resumed.

7.5.4. Following a power outage, register “catch-up” time shall be a maximum of 30 seconds. During the “catch-up” time the Meter shall still calculate consumption and demand quantities. Optional outputs shall also function during this time.

7.5.5. During power outages, time shall be maintained with a cumulative error of no more than 2 minutes per week (0.02%).

7.5.6. The Meter shall record the date and time of any power outage. This data shall be available through remote interrogation of the meter.

7.6. Meter Test Mode Function

7.6.1. The Meter shall have the capability of a Test Mode that suspends normal metering operation during testing so that additional consumption and demand from the tests are not added to the Meter’s totals.

7.6.2. The Test Mode function shall be activated by a permanently mounted physical device that requires removal of the meter cover to access, or by a Meter Programmer connected to the optical port or RS-232 port.

7.6.3. Activation of the Test Mode shall cause all present critical billing data to be stored in nonvolatile memory and restored at the time of exit from the Test Mode.

7.6.4. Upon activation of the Test Mode, register displays shall accumulate beginning from zero.

7.6.5. Actuation of the billing period reset device during Test Mode shall reset the test mode registers.

7.6.6. After a programmable time-out period, the Meter will automatically exit from Test Mode and return to normal metering.

7.6.7. The default Test Mode registers for an unprogrammed meter shall include as a minimum:

7.6.7.1. Time remaining in the test interval.

7.6.7.2. Maximum kilowatt block demand

7.6.7.3. Total kilowatt-hours.

8. DISPLAY REQUIREMENTS

8.1. LCD Display

The Meter shall have an electronic display for displaying the consumption and demand quantities. A liquid crystal display (LCD) is preferred.

8.2. Viewing Characteristics

Digits for displaying the consumption and demand quantities shall be 0.3-inch minimum height, and be legible in normal daylight conditions from a distance of six feet by an observer. The viewing angle shall be a minimum of +/- 15 degrees from the front of the Meter face line of sight.

8.3. Display Components

The display shall provide the following:

8.3.1. Six digits for display of the consumption and demand quantities with decimal points for the three least significant digits.

8.3.2. Three digits for numeric display identifiers (ID numbers).

8.3.3. Alternate and Test Mode Displays

8.3.4. Continuous potential indication for each phase

8.3.5. End of interval indicator

8.3.6. Visual representation of the magnitude of the power flow.

8.3.7. Visual representation of the magnitude of the reactive power flow.

8.3.8. Annunciators for use with the consumption and demand quantities.

8.4. Digits

Consumption and demand quantities shall be programmable to display leading zeroes in four, five, or six digits with a decimal point at any of the least significant three digits.

8.5. Time Format

Time shall be displayed in the 24-hour military format.

8.6. Date Format

Date shall be displayed programmable in either Day/Month/Year or Month/Day/Year format.

8.7 Y2K Compliance

The meter shall be Y2K Compliant. The meter functionality will not be adversely affected as a result of the date change from 1999 to 2000, including leap year calculations.

8.8 Operating Modes

8.8.1 The display shall have at least three operating modes:

8.8.1.1. Normal Mode—In this mode the display shall scroll automatically through the programmed displays for normal meter reading.

8.8.1.2. Alternate Mode—In this mode the display shall scroll automatically, scroll manually, or freeze for up to one minute for alternate programmed displays.

8.8.1.3. Test Mode—In this mode the display shall scroll automatically, scroll manually, or freeze for up to one minute for test quantity displays.

8.8.2. Display ID numbers and display sequence shall be independently programmable for each of the three modes.

8.8.3. Display times shall be programmable.

8.9. Normal Mode

Upon power-up, the Meter display shall operate in the Normal Mode. The Meter display shall operate in Normal Mode until power is disconnected, the Alternate Mode is activated, or the Test Mode is activated.

8.10. Alternate Mode

The Alternate Mode shall be initiated with a display control device that does not require meter cover removal or with a Meter Programmer connected to the optical port.

8.11. Display Items

As a minimum the Meter shall provide the display quantities and items for each of the three modes as detailed in **Attachment 2**.

8.12. Identifiers

The Meter shall have programmable identifiers for the Meter ID, and the current program ID. The Meter ID shall be capable of eight alphanumeric characters.

9. METER DIAGNOSTICS

9.1. Self-test

The Meter register shall be capable of performing a self-test of the register software. As a minimum, the self-test shall be performed at the following times:

9.1.1. Whenever communications is established to the register.

9.1.2. After a power-up.

9.1.3. Once per day.

9.2. Diagnostic Checks

As a minimum, the following diagnostic checks shall be performed during a self-test:

- 9.2.1. Check the backup battery capacity.
- 9.2.2. Verify the program integrity.
- 9.2.3. Verify the memory integrity.

9.3. Pulse Overrun

The meter shall be capable of detecting and logging that the maximum number of pulses has been exceeded during a demand interval.

9.4. Error and Warning Displays

- 9.4.1. Any detected error or warning shall be stored in memory and an error or warning code displayed on the display.
- 9.4.2. Error code displays shall freeze the display.
- 9.4.3. Warning code displays shall be programmable to one of the following choices:
 - 9.4.3.1. Freeze the warning code on the display.
 - 9.4.3.2. Ignore the warning code (not displayed).
 - 9.4.3.3. Warning code display at the end of the Normal, Alternate, or Test Modes display sequences.

9.5. Error Reset

Error or warning conditions shall only be reset upon an explicit command invoked via the Meter Programmer or upon some other explicit action by the Meter Technician.

10. PROGRAMMING AND SOFTWARE

10.1. Optical Communications Interface.

The Meter shall be capable of communicating with a handheld reader (Itron DataCap or similar) and a laptop computer through an optical port.

10.2. Meter Programmers

PC DOS or Window based programs on a laptop or handheld computer with LCD displays will be used as meter reader/programming devices (Meter Programmers). Communications with the Meter shall be through the optical port.

10.3. Supplier Software

The Supplier shall provide all software for maintenance, programming, and operation of the Meter. The software shall include the following:

- 10.3.1. Field Program
- 10.3.4. Password protection to preclude 3rd party access for all levels of access EXCEPT READ-ONLY.

10.4. DOS and Windows

All software programs shall be PC DOS or Window based.

10.5. Meter Protocol

The protocol used for communication with the Meter through the optical port, RS-232 port or an optional modem shall be an asynchronous, byte oriented protocol.

11. COMMUNICATION

11.1. Optical Port

The primary communication port to the Meter for reading and programming of the internal data shall be an optically isolated communication port per ANSI C12.13, Type 2.

11.2. Baud Rate

The Optical Port shall communicate at a minimum of 9600 baud.

11.3. Optical Port Location

The Optical Port shall be located in the front of the Meter and be accessible without removing the Meter's cover. The Optical Port shall also be functional with the Meter cover removed.

11.4. Optical Port Cable

There shall be no cable connection between the optical port on the Meter cover and the register.

11.5. RS232 or RS 485

One RS-XXX port shall be provided at the meter for bi-directional communications (with security provisions included) to computers and/or data acquisition devices. The meter or meters must have the capability for being polled every 5 minutes for data by an external program running on the Meter Data Acquisition program located at the ISO on ISO computers. An optional RS-XXX port or ports with READ-ONLY access can be provided for others desiring the data. Most buyers will probably want the optional ports. All RS-XXX ports shall be optically isolated. ISO network protocol is TCP/IP.

The meter shall be capable of being polled simultaneously by more than one entity on one or more of its ports without loss of data, interference, lockup or other such problems. In all cases, priority servicing shall be given to the ISO-required RS-XXX port.

The meter shall be capable of being read and programmed through the RS-XXX port.

The meter shall support and be compatible with ISO "REMnet" communication chains.

Meter RS-XXX port to high speed digital (or lease line), ISDN, or Frame Relay to ATM Cloud POP to ISO located Meter Data Acquisition System.

11.6. Communication Requirements for Curtailable Loads

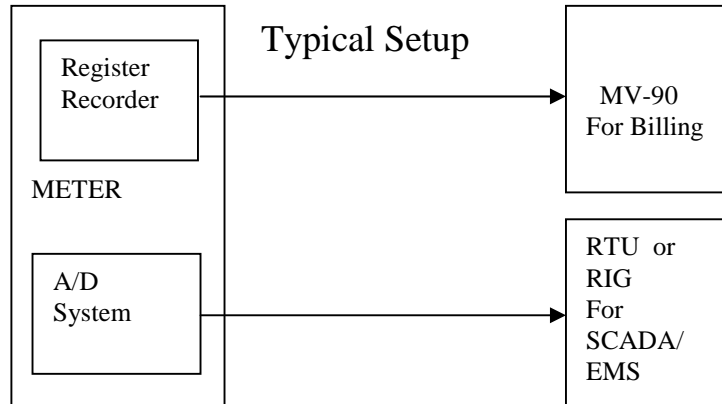
In addition to the other items in this specification, meters used for curtailable loads shall have the following features:

Additional RS232 or RS485 communication port for SCADA that functions simultaneously with the other ports.

The meter should be compatible with one or more of the following protocols for providing real-time SCADA information:

- Ethernet TCP/IP
- Modbus
- DNP 3.0
- Open Protocol compatible with major RTU and IED vendors such as Valmet, System Northwest, QEI, DAQ and Siemens

The SCADA Port will provide continuous output of real-time metering data, including Watts, Vars, and Power Factor.



12. OPTIONAL METER FUNCTIONS

12.1. Pulse Outputs

ISO may specify one to two channels of pulse outputs that are proportional to the consumption quantities. The pulse output values shall be programmable with pulse durations of at least 100 milliseconds. The outputs may be either 2-wire, Form A or 3-wire, Form C configuration.

12.2. End of Demand Interval (EOI)

ISO may specify a programmable auxiliary contact capable of being programmed to indicate End of Demand Interval (EOI).

12.3. Current Loop

ISO may specify an additional serial communication port consisting of a 2-wire, 20 milliamp current loop that is optically isolated from the rest of the Meter. The baud rate shall be selectable as 300/1200/2400/9600 baud as a minimum.

12.4. Internal Modem

ISO may specify an internal modem having telephone communication at auto-baud rates up to 28.8 kbaud. The modem shall include automatic baud select, configurable answer time window, and configurable answer ring-counter. The ring detect circuitry shall not be affected by spurious voltage rises in the telephone line.

12.5. Demand Threshold Alarm

ISO may specify a kilowatt threshold relay that closes at a programmable demand value and stays closed for the remainder of the interval and until at least one complete interval does not exceed the threshold value. Transformer loss Compensation

12.6. Transformer Loss Compensation

The meter should be equipped with algorithms that properly compensate for all watt/var losses in transformer. This compensation should register no load losses whenever the transformer is energized. The compensation should properly consider copper and stray watt losses and var losses when there is load on the transformer. The algorithm can consider that the transformer operated at a single temperature point.

12.7. Auxiliary Power

The meter can be ordered with an auxiliary power supply, supporting AC or DC voltages of 120/240V (ANSI). The auxiliary power input may be connected to a separate source or may be connected to any phase that is attached to the meter.

13. ACCURACY

13.1. ANSI C12.20

The Meter shall meet or exceed the accuracy specifications contained in ANSI C12.20-1997 over its entire service life without the need for adjustment.

13.2. Factory Calibration

The Meter shall be factory calibrated by the Supplier to provide the following level of accuracy:

13.2.1. $\pm 0.2\%$ at full load at power factor of 100%.

13.2.2. $\pm 0.25\%$ at full load at power factor of 50% lag.

13.2.3. $\pm 0.25\%$ at full load power factor at 50% lead.

13.2.4. $\pm 0.25\%$ at light load at power factor of 100%.

13.3. Test Equipment

Meter accuracy and calibration tests, both shop and field, shall require only standard test equipment. No special Laboratory-type test equipment or test procedures shall be required to assure accuracy of the Meter.

13.4. Creep

The Meter shall not creep. No pulse generation or registration shall occur for any consumption or demand quantity which depends on current while the current circuit is open except when Transformer Loss Compensation is being performed.

13.5. Starting Current

The Meter shall start to calculate consumption and demand quantities when the per phase current reaches the following limits:

13.5.1. Class 20 - 10 milliamps.

13.6. Start-up Delay

The Meter shall start to calculate consumption and demand quantities less than 3 seconds after power application.

13.7. Pulse Outputs

Pulse outputs shall have the same accuracy as the Meter displays.

14. ELECTRICAL REQUIREMENTS

14.1. Meter Forms, Voltages, and Classes.

The following Forms, Voltage Ratings and Classes of Meters are approved for installation on the ISO System:

A - Base Type, FORMS 5A and 9A, 120 Volts, Class 20.

Socket - Type, FORMS 5S and 9S, 120 Volts, Class 20.

Switchboard - Type, 2 Element and 3 Element, 120 Volts, Class 20.

Rack mounted meter assemblies - 2 element and 3 element, Class 20.

14.2. Circuit Boards

All circuit boards in the Meter shall be assembled per ANSI/IPC-610A, Class 2 Standards. They shall be designed to meet ISO's environmental and electrical testing requirements and the service life and performance expectations detailed in this Specification.

14.3. LCD Display Connectors

Gold pins encased in an elastomer or carbonized contacts or better construction shall be used to connect the LCD display to the register circuit board.

14.4. Metering Application

The Meter shall be used to meter electrical service on a continuous duty.

14.5. Connections

The Meter's internal electrical connections shall be in accordance with ANSI C12.10.

14.6 Meter Register Power Supply.

The Meter register shall be powered from the line side of the Meter and shall have provision for external backup power. Neither the Normal power supply nor the Backup Power Supply (when so equipped) shall be fused.

14.7 Clock

14.7.1. The clock internal to the Meter shall be accurate within 2 minutes per week (0.02%) when not synchronized to the line frequency and shall be resettable through the ISO communications interface. ISO will transmit a periodic master synchronizing signal to the meter.

14.7.2. The internal clock shall have two modes of operation as follows:

14.7.2.1. The clock shall synchronize with the line frequency until an outage occurs. During the outage, the clock will then synchronize with its own internal crystal. When power returns, the clock shall resynchronize with the ISO's master synchronizing signal and follow line frequency.

14.7.2.2. The clock shall always synchronize with its own internal crystal, as a default in the absence of line frequency.

14.7.3 The choice of clock mode shall be programmable.

14.8. Batteries

14.8.1. When the Meter design requires a battery as auxiliary power supply, the requirements of Section 7.5. shall apply.

14.8.2. The battery shall be secured with a holder securely attached to the Meter. The battery holder and electrical connections shall be designed to prevent the battery from being installed with reversed polarity.

14.8.3. Replaceable batteries shall be easily accessible by removing the Meter cover. Battery replacement while the Meter is in service shall not interfere with any of the specified functions.

14.8.4. No fuse external to the battery shall be installed in the battery circuit.

14.8.5. The meter battery shall provide a minimum carryover capability at 23° C for the functions listed in Section 7.5. and have a 15 year shelf life.

14.8.6. The following information shall be clearly identified on the battery:

14.8.6.1. Manufacturer

14.8.6.2. Date of Manufacture, including year and month (i.e. 9601) or year and week (i.e. 9644).

14.8.6.3. Polarity

14.8.6.4. Voltage Rating

14.8.6.5. Type

14.8.7. The Supplier shall provide battery handling instructions, safety precautions, and disposal instructions upon Purchaser's request.

14.8.8. The Supplier shall provide Material Safety Data Sheets upon Purchaser's request.

14.9. Electromagnetic Compatibility

The Meter shall be designed in such a way that conducted or radiated electromagnetic disturbances as well as electrostatic discharges do not damage nor substantially influence the Meter.

14.10. Radio Interference Suppression

14.10.1. The Meter shall not generate conducted or radiated radio frequency noise, which could interfere with other equipment.

14.10.2. The Meter shall meet FCC Part 15 Class A, Radio Frequency Interference Standard for computing devices.

15. MECHANICAL REQUIREMENTS

15.1. General

The Meter shall not pose any danger when operating under rated conditions in its normal working position. Particular attention shall be paid to the following:

- 15.1.1. Personnel protection against electric shock.
- 15.1.2. Personnel protection against effects of excessive temperature.
- 15.1.3. Protection against the spread of fire.
- 15.1.4. Protection against penetration of solid objects, dust or water.

15.2. Corrosion Protection

All parts shall be effectively protected against corrosion under normal operating conditions. Protective coatings shall not be damaged by ordinary handling nor damaged due to exposure to air. The meter shall be capable of operating in atmospheres of 95% relative humidity condensing.

15.3. Solar Radiation

The functions of the Meter shall not be impaired, the appearance of the Meter shall not be altered, and the legibility of the Meter nameplate and other labels shall not be reduced due to exposure to solar radiation throughout the service life of the Meter.

15.4. Corrosive Atmospheres

ISO may specify additional requirements for Meters used in corrosive atmospheres.

15.5. Meter Package

15.5.1. The Socket Meter's dimensions shall be in accordance with ANSI C12.10.

15.5.2. The Socket Meter shall be designed for mounting outdoors in a standard meter socket.

15.5.3. A twist-on self-locking cover shall be provided in accordance with ANSI C12.10 requirements. The cover shall have the following attributes:

15.5.3.1. It shall not contain a metal or conducting locking ring.

15.5.3.2. It shall be resistant to ultraviolet radiation.

15.5.3.3. It can be sealed in such a way that the internal parts of the meter are accessible only after breaking the seal(s).

15.5.3.4. Any non-permanent cover deformation shall not prevent the satisfactory operation of the meter.

15.5.3.5. The "sprue" hole (mold fill hole) shall not affect the ability to read the meter.

15.5.3.6. It shall have an optical port per ANSI C12.13, Type 2.

15.5.4. The method of securing the Socket Meter to the meter socket shall be with either a sealing ring or a high security-sealing device.

15.5.5. The billing period demand reset device shall accommodate a standard Utility-Type seal and shall remain in place with friction if not sealed.

15.5.6. Filtered ventilation shall be provided in the base of the Meter to prevent condensation inside the Meter.

15.6. Nameplate

15.6.1. The nameplate information shall comply with the minimum requirements of ANSI C12.10.

15.6.2. The nameplate of the Meter shall include the Meter's Serial Number and the Date of Manufacture.

15.6.2.1. The manufacturing date shall include the year and month (i.e. 9601) or the Year and Week (i.e. 9644).

15.6.3. The nameplate shall have the following attributes:

- 15.6.3.1. It shall be mounted on the front of the Meter.
- 15.6.3.2. It shall not be attached to the removable meter cover.
- 15.6.3.3. It shall be readable when the Meter is installed in the meter socket or Panel.
- 15.6.3.4. It shall not impair access for accuracy adjustment or field replacement of components (such as the battery).
- 15.6.4. The nameplate shall include ANSI standard bar coding.
- 15.6.5. The nameplate shall include an easily erasable strip with minimum dimensions of 3/8 inch by 1-1/2 inches for penciling in items such as meter multiplier or the Meter Tester's initials.

16. SECURITY

16.1. Billing Period Reset

Operation of the billing period demand reset mechanism shall require breaking of a mechanical sealing device. Use of common utility - Type sealing devices shall be accommodated.

16.2. Meter Password

The Meter shall be programmable by the Meter Programmer with up to four unique passwords to prevent unauthorized tampering by use of the optical port or the optional modem. Access rights and capabilities shall be individually programmable for each password. The Meter shall accept multiple requests from different sources without error, lockup or loss of data. The desirable password would consist of six Alpha-Numeric characters.

16.3. Test Mode

Removal of the Meter cover shall be required to activate the Test Mode. See section 7.6.

16.4. Program Security

At least four levels of security shall be available for the Rate Development Program and the Field Program. These levels include:

- 16.4.1. Read Register ---user can only READ billing and load profile data.
- 16.4.2. Read Register—user can only read billing and load profile data, and perform a billing period reset.
- 16.4.3. Read/Modify Register—user can perform functions listed in 16.4.1 and 16.4.2, plus download meter configuration files and operate other features of the Field Program.
- 16.4.4. Read/Modify/Program Register—user can perform functions listed in 16.4.1, 16.4.2 and 16.4.3, plus develop meter configuration files and operate additional features of the Rate Development Program.

17. METER APPROVAL TESTING

17.1. General Requirement

This Section outlines the testing required by ISO to assure the quality of meters purchased by others and installed at Their Facility to meter Electrical Power and Energy entering or leaving the ISO Grid.

ISO Testing using Independent Laboratory

In addition to the Required Manufacturer Testing specified in this Section, **ISO reserves the option** to engage an Independent Testing Laboratory to perform the tests as outlined in this Section. **When requested by ISO**, any Laboratory desiring eligibility to participate shall submit, in writing, to ISO the following:

Qualifications, including level of Certification for such work.

History of experience in this area.

A Proposed Test Plan and Schedule for Performing, Reporting and Documenting the tests outlined in Sections 17 (following).

- 17.1.1. In addition to the applicable testing requirements of the ANSI C12 standards, the qualification tests specified in this Section shall be conducted by the Supplier to confirm correct operation of the Meter.
- 17.1.2. The qualification testing is required for new Meter designs and for Meter product changes as defined in Section 6.
- 17.1.3. The Supplier shall provide a certified test report documenting the tests and their results. The test report will be signed by the Supplier's chief engineer and include all charts, graphs and data recorded during testing.
- 17.1.4. No equipment shall be shipped before all test and certification requirements are met.
- 17.1.5. Each test shall be conducted by the Supplier using a minimum of six Meters that are representative of production run meters.
- 17.1.6. All tests shall be conducted using the same six test Meters.
- 17.1.7. Meters which fail during the test shall not be repaired or tested further without the approval of the ISO.
- 17.1.8. ISO will approve the qualification of the facility and personnel who performs the testing.
- 17.1.9. ISO reserves the right to witness the tests.

17.2. Meter Failure Definition

A Meter shall be designated as failed if any of the following events occur:

- 17.2.1. Failure of the Meter to perform all of the specified functions.
- 17.2.2. Failure of the Meter to meet the technical performance specifications included in the Specification.
- 17.2.3. Signs of physical damage or performance degradation as a result of a test procedure, including effects, which could shorten the service life of the meter.
- 17.2.4. The occurrence of an unexpected change of state, loss of data or other unacceptable mode of operation for the Meter as a consequence of a test procedure.
- 17.2.5. Failures shall be classified as a hardware, firmware or software failure, or a combination according to the following definitions:
 - 17.2.5.1. Firmware failures are errors made during the fabrication of programmable read only memory (PROM) chips such that the required program or instruction set that the microprocessor is to perform is incorrect.
 - 17.2.5.2. Hardware failures are failures that are physical in nature and directly traceable to the component level. Visual observances such as discoloration, cracking, hardening of cables, poor solder joints, etc. are also included. Failures of DIP switches, jumpers, and links are also included.
 - 17.2.5.3. Software failures are failures such as the loss or unintended change of data, the inability to program the Meter, the loss of the Meter program, or the erroneous output or display of false information.

17.3. Meter Design Rejection Criteria

A Meter design will be rejected if any of the following events occur:

- 17.3.1. When one Meter fail while performing one test procedure and a second Meter fail performing another test procedure.
- 17.3.2. When two or more Meters fail while performing the same test procedure.

17.4. Test Setup

- 17.4.1. The Meter shall be connected to its normal operating supply voltage with a fully charged Power Failure Backup System. The Meter shall be energized throughout the duration of the test procedures, unless otherwise stated.
- 17.4.2. Before testing commences, the Meter shall be energized for a minimum of two hours at room temperature.
- 17.4.3. All tests shall be conducted at room temperature unless otherwise specified.

17.4.4. The Meter shall be loaded to the nameplate test amperes at 100% power factor for all tests unless otherwise indicated.

17.4.5. Full load test is 100% of the meter test amps, and light load test is 10% of the meter test amps.

17.5. Functional Test (No Load Test)

17.5.1. This test confirms the operation of the Meter functions in accordance with the Specification.

17.5.2. The Meter shall be energized with no load.

17.5.3. The Meter shall be programmed with ISO supplied parameters using a Meter Programmer.

17.5.4. Operation of the specified functions will be verified over 24 hours by observing the meter display and by interrogating the contents of meter registers via a Meter Programmer.

17.5.5. To pass this test the Meter shall operate as specified with no observed anomalies.

17.6. Accuracy Test

17.6.1. This test confirms the accuracy of the Meter.

17.6.2. The accuracy of the Meter shall be tested for all combinations of the following conditions:

17.6.2.1. At ambient temperature, 85° C, and -20° C.

17.6.2.2. At power factors of 100%, 50% lag, and 50% lead.

17.6.2.3. The meter should be tested at the following test points:

<u>Conditions</u>	<u>Current (amps)</u>
1	0.15
2	0.25
3	0.5
4	1.5
5	2.5
6	5.0
7	10.0
8	15.0
9	18.0
10	20.0

17.6.3. Accuracy curves shall be provided for all combinations of the conditions.

17.6.4. To pass this test the Meter shall have the indicated accuracy at ambient temperature for the following load conditions:

17.6.4.1. ± 0.2% at Full load at power factor of 100%.

17.6.4.2. ± 0.25 % at Full load at power factor of 50% lag.

17.6.4.3. ± 0.25 % at Full load at power factor of 50% lead.

17.6.4.4. ± 0.25 % at Light load at power factor of 100%.

17.7. Line Voltage Variation Test

- 17.7.1. This test confirms the Meter's correct operation under varying line voltage conditions.
- 17.7.2. The Meter shall be tested at line voltages ranging from 80% to 120% of rated voltage with 10% increment under the following load conditions:
 - 17.7.2.1. Full load at power factor of 100%.
 - 17.7.2.2. Light load at power factor of 100%.
- 17.7.3. To pass this test the Meter shall meet the following criteria:
 - 17.7.3.1. Operate as specified.
 - 17.7.3.2. Have an accuracy as specified in Section 17.6.4. Throughout the 90% to 110% voltage range.
 - 17.7.3.3. The Power Failure Backup System shall not take over when the voltage is above 90% and below 110% of rated.

17.8. Momentary Power Loss

- 17.8.1. This test confirms the Meter's ability to withstand momentary power outages.
- 17.8.2. The test will be performed by opening the AC power supply input for the specified duration.
- 17.8.3. Twelve tests shall be conducted using the following sequence:
 - 17.8.3.1. Energize the Meter.
 - 17.8.3.2. Simulate a power loss of 0.5 cycles at 60 hertz.
 - 17.8.3.3. Lengthen each succeeding simulated power outage by 0.5 cycles until a duration of 6.0 cycles is attained.
 - 17.8.3.4. The start of each successive test shall be delayed by one minute.
- 17.8.4. To pass this test the Meter shall operate as specified with no observed anomalies.

17.9. Power Failure Backup System Test

- 17.9.1. This test confirms the carryover capability of the Power Failure Backup System.
- 17.9.2. This test shall be conducted at ambient temperature using a new or fully charged battery.
- 17.9.3. The test shall be conducted using the following sequence:
 - 17.9.3.1. Energize the Meter at full load for two hours.
 - 17.9.3.2. De-energize the Meter for 24 hours.
 - 17.9.3.3. Verify the integrity of programs and metering data stored in memory.
- 17.9.4. To pass this test the Meter shall operate as specified with no observed anomalies.

17.10. Brownout and Extended Low Voltage Test

- 17.10.1. This test confirms the Meter's ability to withstand brownouts and extended low voltage conditions.
- 17.10.2. The test shall be conducted using the following sequence:
 - 17.10.2.1. Energize the Meter and verify correct operation.
 - 17.10.2.2. Slowly lower the line voltage at a rate of 1 volt per second to 80% of nominal voltage.
 - 17.10.2.3. Operate the Meter at this voltage level for 6 hours.
 - 17.10.2.4. Verify correct Meter operation. If the meter comes up with the power outage detection flag, this should be recorded.
 - 17.10.2.5. Lower the line voltage at a rate of 1 volt per second from 80% to 50% of nominal voltage.
 - 17.10.2.6. Operate the Meter at this voltage level for 6 hours.

- 17.10.2.7. Verify correct operation of the Meter and the Power Failure Backup System.
- 17.10.3. To pass this test the Meter shall operate as specified with no observed anomalies.
- 17.11. Effect of Power Failure Backup System Voltage Variation on Clock Accuracy
 - 17.11.1. This test confirms the effects of the battery voltage on the Meter's clock accuracy.
 - 17.11.2. The Meter shall be tested with the battery disconnected and an auxiliary dc power supply connected to the battery carryover circuit. The dc power shall be applied at 105%, 100% and 95% of nominal battery voltage. Each voltage level shall be maintained for at least 6 hours prior to recording time variation.
 - 17.11.3. To pass this test the accuracy of the Meter clock shall be within $\pm 0.02\%$ (2 minutes per week) with a voltage variation of $\pm 5\%$ of nominal battery voltage at ambient temperature.
- 17.12. Effect of Temperature Variation on Clock Accuracy
 - 17.12.1. This test confirms the effects of temperature on the Meter clock accuracy.
 - 17.12.2. This test shall be conducted with the register in the battery carryover mode.
 - 17.12.3. The temperature shall be varied from 85° C to -20° C.
 - 17.12.4. The Meter shall be exposed to each temperature for a least 2 hours prior to testing.
 - 17.12.5. To pass this test the accuracy of the Meter clock shall be within $\pm 0.02\%$ (2 minutes per week) at ambient temperature, 85° C, and -20° C
- 17.13. Temperature Cycle Test
 - 17.13.1. This test confirms the effects of an accelerated temperature cycle on the Meter.
 - 17.13.2. The Meter cover shall be removed during this test.
 - 17.13.3. The test duration shall be 7 days (168 hours).
 - 17.13.4. The temperature shall be cycled once per 24 hour period.
 - 17.13.5. Temperature shall be varied linearly during the tests at a constant rate not to exceed 20° C per hour.
 - 17.13.6. Humidity shall not be controlled during the test.
 - 17.13.7. The Meter shall be de-energized during the fourth and fifth cycles of the test to verify the performance of the Power Failure Backup System during temperature fluctuations.
 - 17.13.8. Each 24 hour cycle shall consist of the following:
 - 17.13.8.1. Begin test at +20° C (or room temperature if within 5° C).
 - 17.13.8.2. Ramp up to +85° C in approximately 3.25 hours.
 - 17.13.8.3. Hold at +85° C for approximately 10.75 hours.
 - 17.13.8.4. Ramp down to -20° C in approximately 5.25 hours.
 - 17.13.8.5. Hold at -20° C for approximately 2.75 hours.
 - 17.13.8.6. Ramp up to +20° C in approximately 2.00 hours.
 - 17.13.9. Begin next 24 hour cycle or end test after 7 cycles.
 - 17.13.10. To pass this test the Meter shall operate as specified with no observed anomalies for the entire test period.
- 17.14. Humidity Cycle Test
 - 17.14.1. This test confirms the effects of an accelerated humidity cycle on the Meter.
 - 17.14.2. The Meter cover shall be removed during this test, or a meter cover with a large hole at the bottom may be substituted.
 - 17.14.3. The duration of the test shall be 24 hours.

- 17.14.4. Condensation may form on the Meter during the test.
- 17.14.5. Temperature shall be varied linearly during the tests at a constant rate not to exceed 20° C per hour.
- 17.14.6. Humidity shall not be controlled during temperature changes.
- 17.14.7. The test shall consist of the following sequence:
 - 17.14.7.1. Begin at +20° C (or room temperature if within 5°C).
 - 17.14.7.2. Ramp up to +85° C in approximately 3.25 hours.
 - 17.14.7.3. Ramp up to a relative humidity of 95% in approximately 1 hour.
 - 17.14.7.4. Hold at +85° C at a relative humidity of 95% ±1% for approximately 14.5 hours.
 - 17.14.7.5. Ramp down to +20° C in approximately 3.25 hours.
 - 17.14.7.6. Concurrently with 17.14.7.5. ramp down to a relative humidity of 75% in approximately 15 minutes.
 - 17.14.7.7. Hold relative humidity at 75% for remainder of temperature ramp down.
 - 17.14.7.8. Hold at 20° C at a relative humidity of 75% ±1% for approximately 2 hours.
- 17.14.8. To pass this test the Meter shall operate as specified with no observed anomalies for the entire test period.
- 17.15. Insulation Withstand Test
 - 17.15.1. This test confirms the insulation levels of the Meter.
 - 17.15.2. The Meter shall not be energized for this test.
 - 17.15.3. The insulation between power line voltage and current carrying parts and any other metallic or conductive part shall be tested by applying 2500 volts rms, 60 Hz for a period of one minute.
 - 17.15.4. To pass this test the leakage current shall not exceed five milliamp for the duration of the test and the Meter shall operate after completion of the test.
- 17.16. Standard Waveform Surge Withstand Test
 - 17.16.1. This test confirms the ability of the Meter to withstand voltage transients.
 - 17.16.2. The Meter shall be energized but not loaded during the test.
 - 17.16.3. The test shall be conducted in accordance with the latest revision of ANSI C37.90.1.
 - 17.16.4. The oscillatory test wave shall be applied at a repetition rate of 100 tests per second for 25 seconds.
 - 17.16.5. The test signal shall be applied in both the common and transverse modes.
 - 17.16.6. The test shall be conducted on all voltage, current, and optional equipment inputs and outputs.
 - 17.16.7. This test will be performed two times with a maximum period of 1 minute between tests.
 - 17.16.8. To pass this test the Meter shall operate as specified with no observed anomalies.
- 17.17. Fast Transient Waveform Surge Withstand Test
 - 17.17.1. This test confirms the ability of the Meter to withstand fast voltage transients.
 - 17.17.2. The Meter shall be energized but not loaded during the test.
 - 17.17.3. This test shall be conducted in accordance with the latest revision of ANSI C37.90.1.
 - 17.17.4. The uni-polar test wave shall be applied at a repetition rate of 100 tests per second for 25 seconds.
 - 17.17.5. The test signal shall be applied in both the common and transverse modes.
 - 17.17.6. The test shall be conducted on all voltage, current, and optional equipment inputs and outputs.
 - 17.17.7. This test will be performed two times with a maximum period of 1 minute between tests.

- 17.17.8. To pass this test the Meter shall operate as specified with no observed anomalies.
- 17.18. Powerline Surge Voltage and Current Test
- 17.18.1. This test confirms the ability of the Meter to withstand power line voltage and current surges.
- 17.18.2. The meter shall be energized but not loaded during the test.
- 17.18.3. The test shall be performed using the uni-polar and the ring waveform specified in the latest revision of ANSI C62.41.
- 17.18.4. The test surges shall be applied to the power line in both the normal and common modes.
- 17.18.5. The following number of surges shall be applied at the indicated voltages:
- 17.18.5.1. 12 surges at 6 kV.
- 17.18.5.2. 12 surges at 5 kV.
- 17.18.5.3. 36 surges at 4 kV.
- 17.18.6. The first test surges at 5 kV and 6 kV shall be injected at 0 degrees on the positive half cycle of the waveform. Each successive test surge shall be shifted 15 degrees on the positive half-cycle of the waveform up to 180°.
- 17.18.7. The first test surge at 4 kV shall be injected at 0 degrees on the positive half-cycle of the waveform. Each successive test surge shall be shifted 15 degrees on both the positive and negative half-cycles of the waveform up to 360°.
- 17.18.8. Sufficient time shall be allowed in between test surges for the electronic components to return to normal operating temperatures. A minimum of 5 minutes shall be allowed between each surge test.
- 17.18.9. The applied test signals shall be monitored and recorded. The Meter under test shall be monitored to confirm that correct operation is maintained.
- 17.18.10. After the tests each meter shall be inspected for visible damage, such as signs of arcing, etc.
- 17.18.11. To pass this test the Meter shall operate as specified with no visible damage observed.
- 17.19. Electrostatic Susceptibility Test
- 17.19.1. This test verifies the ability of the Meter to withstand electrostatic discharges.
- 17.19.2. This test shall be tested in accordance with the latest revision of Military Handbook DODHDBK-263.
- 17.19.3. The test generator shall simulate a human body with a capacitance of 100 pico-farads and a series resistance of 1500 ohms.
- 17.19.4. The test probe shall be a 3/8 inch rod with a rounded tip.
- 17.19.5. The following procedures shall be followed:
- 17.19.5.1. Test all surfaces, including switches, buttons and other components, which could be contacted by personnel handling and installing the Meter under normal circumstances. This shall include any safety grounded or neutral terminals on the exterior of the meter enclosure.
- 17.19.5.2. With the test probe voltage set at 10 kV, contact each of the above surfaces with the probe.
- 17.19.5.3. With the test probe voltage set to 15 kV, locate the probe to within approximately 0.5-inch (avoiding contact) with each of the above surfaces.
- 17.19.5.4. The functions of the Meter shall be periodically verified for correct operation.
- 17.19.6. To pass this test the Meter shall operate as specified with no observed anomalies.
- 17.20. Visual Inspection
- 17.20.1. This test shall be performed after all of the other tests except the Shipping Test have been performed.
- 17.20.2. Visual inspection shall be performed for all electronic circuit boards in the Meter.

17.20.3. To pass this test the Meter shall have no defect that is rejectable per IPC-610A, Class 2 Standards on any electronic circuit board.

17.21. Shipping Test

17.21.1. This test confirms the ability of the Meter and its packaging to withstand the rigors of shipping and handling.

17.21.2. The Meter shall not be energized during this test, but shall be programmed and operating in the power Backup mode.

17.21.3. The packaged Meter shall be subjected to the following tests:

17.21.3.1. The National/International Safe Transit Association Pre-shipment Test Procedures, Project 1A.

17.21.3.2. American Society for Testing and Materials (ASTM) Standard D-999 latest revision, Method B, Single Container Resonance Test. Test intensities, frequency ranges and test duration's shall meet or exceed the recommended values of ASTM D-999.

17.21.4. To pass this test the Meter shall be inspected and tested to verify that no damage had occurred and that the time and all stored data are correct.

18. SAFETY

18.1. Hazardous Voltage

Hazardous voltages shall not be easily accessible with the meter cover removed.

18.2. Grounding

All accessible conductive parts on the exterior of the meter and conductive parts that are accessible upon removal of the meter cover shall be electrically connected to the Meter grounding tabs. All connections in the grounding circuit shall be made with an effective bonding technique.

18.3. Toxic Materials

No materials that are toxic to life or harmful to the environment shall be exposed in the Meter during normal use.

18.4. Fire Hazard

Materials used in the construction of the Meter shall not create a fire hazard.

19. DATA SECURITY AND PERFORMANCE

19.1. Manual access for changing data or reprogramming shall, require the physical removal or breaking of an ISO seal by ISO-Authorized personnel. This applies to **all** Metering Equipment, including recorders, Data Servers and other Associated Devices.

19.2. Each Meter must be capable of being polled simultaneously by more than one user, without loss of data, interference or lockup.

19.3. No loss of data shall occur as a result of the following events within design specifications:

Power outages, frequency changes, transients, harmonics, reprogramming, and reading.

Environmental factors - - Dampness, heat, cold, vibration, dust.

19.4. Five-minute interval data for the most recent 60 day period shall always be available and accessible via the communications interface or the optical interface.

20. INSPECTION

The Manufacturer and its sub-suppliers shall provide for in-plant inspections of material, inspections of the testing facility and audits of the Supplier's quality control by ISO as required

21. DELIVERY AND PACKAGING

21.1. Delivery Schedule

Delivery will be according to an agreed delivery schedule. The Supplier and the Purchaser will negotiate a delivery schedule at the time of purchase.

21.2. Packaging

21.2.1 The Meters shall be delivered as complete assembled units, including cover and battery, ready for programming.

22. DOCUMENTATION

22.1. Hardware

22.1.1. An instruction booklet detailing the necessary procedures and precautions for installation of the Meter shall be provided for each Meter purchased. This booklet is intended for use by field personnel during initial installation and shall be written in the style of a step by step outline.

22.1.2. A technical/maintenance manual and repair manual shall be provided for each Meter. These manuals shall be sufficiently detailed so that circuit operation can be understood and equipment repair facilitated.

22.2. Software

The Manufacturer shall provide a complete set of manuals detailing the operation of the Field Program to ISO. These manuals shall explain to a person with only basic computer knowledge how to generate and download Meter configuration files.

23. APPLICABLE STANDARDS

This specification shall be used in conjunction with the following publications. The revisions in effect when bids are awarded shall apply.

ANSI C12.1, *American National Standard Code for Electricity Metering*

ANSI C12.10, *American National Standard for Electromechanical Watthour Meters*

ANSI C12.13, *American National Standard for Electronic Time-of-Use Registers for Electricity Meters*

ANSI C12.16, *American National Standard for Solid-State Electricity Meters*

ANSI C18.1, *American National Standard for Dry Cells and Batteries*

ANSI C18.2, *American National Standard for Sealed Rechargeable Nickel-Cadmium Cylindrical Bare Cells*

ANSI C37.90.1, *IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems*

ANSI C62.41, *IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits*

ANSI/IPC -610A, *Acceptability of Electronic Assemblies*

ASTM D-999, *Standard Methods for Vibration Testing of Shipping Containers*

California Weights and Measures for Electric Metering

9880-263, *Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)*

FCC Regulations, Part 15, *Technical Standards for Computing Equipment*

National/International Safe Transit Association, *Pre-Shipment Test Procedures, Project 1A, Procedure for Testing Packaged-Products, Weighing Under 100 Pounds or 45.36 kgs*

UL 1642, *Underwriters Laboratories Standard for Safety of Lithium Batteries*

24. DEFINITIONS

Ambient Temperature – Temperature of $23^{\circ} \pm 2^{\circ}$ Celsius.

Average Power Factor – Power factor calculated using the average active and reactive power flows over the latest demand interval.

Delivered – Energy (active, reactive, or apparent) that flows from ISO to the Consumer.

Failed Meter – A Meter in which any part or component, except the removable battery, has failed through no fault of Purchaser.

Failure – Any hardware, firmware or software failure, or any combination.

Field Program – A software package that allows the user to download Meter configuration files into the Meter and perform other testing and maintenance activities. Hazardous Voltage – Any voltage exceeding 30 volts rms.

Meter – All single phase and three phase electricity meters with electronic registers, including hybrid and solid state meters, but excluding solid state recorders, and including any optional devices included under the Meter cover.

Meter Programmers – PC DOS or windows based laptop computers used for meter reading/programming.

MSDS – Material Safety Data Sheet

Power Failure Backup System – A sub-system in the Meter that provides power to the electronic circuitry when the normal power line voltage is below operating limits. The sub-system usually consists of a battery and may or may not include a super capacitor.

RFI – Radio Frequency Interference

Specification – This engineering specification.

Supplier –The manufacturers and suppliers, and their sub-suppliers.

Temperature tolerance – $\pm 2^{\circ}$ Celsius.

25. ATTACHMENTS

25.1. Physical and Electronic Attribute Criterion for Electricity Meters

25.2. Meter Display Items

Attachment 1
Physical and Electronic Attribute Criterion for Electricity Meters

Test / Inspection Description	Pass	Fail
1. Bayonets A. Missing or loose parts, i.e., cotter pin, arc gap, etc.		
2. Meter Base A. Any cracked and/or missing/damaged gasket B. Any broken leg C. Missing or loose voltage link or screw D. Any missing or loose arc gaps E. Missing or damaged ventilation screen or filter on applicable meter F. Sealing hole unusable for sealing G. Any chips on upper half of meter (gasket ring area) H. Any chips which may jeopardize meter integrity I. Any sign of water damage in meter such as corrosion, oxidation, stain J. Missing or loose rivets holding frame to base		
3. Meter Frame A. Nameplate data incorrect or flawed B. Missing or loose hardware on frame		
4. Module A. Loose or defective power connectors B. Improper routing of voltage leads C. Improper fit (loose or crooked) D. Crimped or pinched voltage leads E. Incorrect module F. Calibration screw access should not be significantly affected (or covered)		
5. Meter Cover A. Wiring to communication port is correct & solid B. Proper meter cover is used for meter type and class C. Mechanical reset mechanism works properly D. Proper alignment, positioning, and operation of all cover mechanisms		
6. Electronic Register A. Program register to verify acceptance of rate schedule B. Check display that all segments are operational C. Check battery carryover function, if appropriate D. Check register tracking by inputting disk revolutions E. Check for any visual defects in the register assembly		

Only scratches and/or chips that are cosmetically or functionally objectionable will be classified as defective and failing.

Attachment 2
Meter Display Items

Display Item	Normal Mode	Alternate Mode	Test Mode
Minimum Requirements for Delivered kWh			
Complete Display (Segment) Test	x	x	
Demand Reset Count		x	
Demand Reset Date		x	
Instantaneous kW	x	x	
Interval length		x	
Minutes of Battery Use		x	
Present time	x	x	
Program ID		x	

Meter Display Items (cont.)

Total kWh	x	x	x
Wh per disk revolution (Kh)		x	
Wh per pulse (Ke)		x	
Minimum Requirements for Test Mode			
Present Interval Demand—kW			x
Pulse count			x
Time left in subinterval			x
Total kWh			x
Additional requirements for kVARh (if specified)			
Maximum Delivered kVAR		x	
Additional requirements for kVAh (if specified)			
Maximum Delivered kVA		x	