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Requirements for Certification

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**Requirements for Certification and Use of Portable Measuring Apparatus for
Reverification and Dispute Meter Testing of Multiple Customer Metering Systems**

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Certification and Use of Portable Measuring Apparatus for Reverification and Dispute Meter Testing of Multiple Customer Metering Systems

1.0 Scope

These requirements are applicable to portable measuring apparatus which are used for the reverification and dispute meter testing of the watthour (Wh) energy function of Multiple Customer Metering Systems (MCMS).

2.0 Authority

This document has been produced under the authority of the Senior Engineer - Electricity Measurement.

3.0 Purpose

The purpose of this document is to establish requirements for the certification and use of portable measuring apparatus (calibration consoles) used for reverification and dispute meter testing of MCMS at their operational location.

4.0 References

- 4.1** *Electricity and Gas Inspection Act* (R.S. 1985, c. E-4), s. 5.
- 4.2** *Electricity and Gas Inspection Regulations* (SOR/86 -131), s. 7, s. 8.
- 4.3** Measurement Canada, S-E-01: Specifications for the Calibration, Certification and Use of Electricity Calibration Consoles
- 4.4** Measurement Canada, P-E-01: Procedures for Calibrating and Certifying Electricity Calibration Consoles Pursuant to the Requirements of S-E-01.
- 4.5** Measurement Canada, S-E-04: Specifications for the Installation Requirements for Multiple Customer Metering Systems.

5.0 Terminology

- 5.1** The terminology sections of S-E-01 and S-E-04 are applicable to this document.

Portable Measuring apparatus

A portable electricity measuring apparatus is a device (or a group of devices comprising the apparatus) which is used to establish errors when reverifying single phase and/or polyphase energy MCMS at their operational location.

6.0 Certification of Portable Measuring Apparatus

6.1 General

- 6.1.1** The certified portable measuring apparatus shall be calibrated at all applicable test points specified for the reverification of each type of MCMS.

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6.2 Administrative Requirements, Roles and Responsibilities (related to section 5.2 of S-E-01)

6.2.1 These requirements shall apply to all portable measuring apparatus which are used for the verification or reverification of MCMS.

6.3 Roles and Responsibilities

6.3.1 Prior to the calibration of the portable measuring apparatus, the person conducting the calibrations shall be responsible for ensuring that the following standards and measuring equipment to be used have been certified by Measurement Canada (MC) and/or the National Research Council of Canada.

(i) Energy standards

(ii) Voltage and current standards, as well as a current transformer if required

6.3.2 The distortion analyzer may be assessed by MC or any applicable ISO 17025-certified laboratory.

6.3.3 When an owner, other than MC, requests portable measuring apparatus certification to be performed by MC, the owner shall be responsible for providing all information required by these requirements.

6.3.4 For portable measuring apparatus that have never been certified or have not had a valid certificate for at least three years, the owner shall ensure that the portable measuring apparatus is fully compliant with all applicable specifications set out in these requirements prior to the calibration of the portable measuring apparatus.

6.3.5 The owner shall provide all information required to determine the manner in which the portable measuring apparatus will be used for reverifying meters. In addition, the owner shall provide the following information:

(i) the transformer-type MCMS with the highest and lowest voltage burden,

(ii) the self-contained type MCMS with the highest and lowest voltage burden,

(iii) the burden shall include each MCMS type to be reverified by the portable measuring apparatus.

6.3.6 The owner shall provide meters or burdens to perform all tests that require a burden.

6.3.7 The owner (other than MC) shall notify the MC Regional Office if a portable measuring apparatus is required to be used for reverifying meters outside the scope of certification. The owner shall also request the additional inspection required to expand the scope of the certification as needed to permit the use of the portable measuring apparatus to inspect those meters.

6.3.8 The user of a portable measuring apparatus shall be responsible for using it in a manner which is consistent with the way it was calibrated and certified.

6.3.9 The owner shall retain copies of the portable measuring apparatus worksheets and certificate until the expiration of the portable measuring apparatus certificate.

6.3.10 The owner shall ensure that the portable measuring apparatus is maintained in good repair and operating order.

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6.3.11 The owner shall forthwith notify the MC Regional Office (Electricity Specialist) of any modification, repair or adjustment of the portable measuring apparatus. The portable measuring apparatus (including MC-owned) shall not be used for reverification or dispute testing until the declared repairs or adjustments have been evaluated by the MC regional Electricity Specialist.

6.4 Marking and Documentation

6.4.1 Nameplate

Portable measuring apparatus shall be fitted with a legible, readily accessible nameplate indicating the following:

- (i) Name of manufacturer
- (ii) Model number
- (iii) Serial number
- (iv) Supply voltage and configuration

6.4.2 Log Book or File

6.4.2.1

A log book or file shall be maintained by the owner of the portable measuring apparatus and kept readily available.

6.4.2.2

The following items shall be recorded in the log book:

- (a) The dates and details, including the name of the person or persons who have performed any :
 - (i) accuracy checks,
 - (ii) adjustments,
 - (iii) maintenance,
 - (iv) repairs, and/or
 - (v) modifications to the portable measuring apparatus.
- (b) All final decisions communicated by MC regarding any:
 - (i) adjustments,
 - (ii) maintenance,
 - (iii) repairs, and/or
 - (iv) modifications.

6.4.3 Operating Manuals

The operating manuals for the portable measuring apparatus shall be readily available.

6.4.4 Portable Measuring Apparatus Marking

The portable measuring apparatus shall have all applicable connections, controls and switches indelibly identified.

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6.5 Technical Requirements

6.5.1 Use Requirements

Portable measuring apparatus shall be used in accordance with the terms and conditions of their certificates.

6.5.2 Accuracy Check

6.5.2.1

To maintain the certification of the portable measuring apparatus, an accuracy check shall be conducted each time the portable measuring apparatus is set up and used to reverify MCMS. The accuracy check shall be conducted at all test points used to evaluate the MCMS that are to be reverified.

6.5.2.2

The accuracy check shall consist of, as a minimum, connecting a certified standard or certified reference meter in a MCMS test position and comparing its registration error at each test point with the results determined during the initial calibration and certification of the portable measuring apparatus.

6.5.2.3

Where the error determined pursuant to the accuracy check differs from that appended to the certificate for the portable measuring apparatus, by more than ± 0.10 percent, or exceeds the allowable tolerance of ± 0.2 percent, the portable measuring apparatus shall not be used for reverification until the cause of the change in error has been determined and corrected.

6.5.2.4

The current distortion at 2.5 amperes and voltage distortion at the service voltage shall be measured at the output of the portable measuring apparatus prior to reverification of the MCMS. The measured distortion shall not exceed 5 percent.

6.5.2.5

The specification limit set by the manufacturer of the portable measuring apparatus for the nominal operating voltage shall be recorded on the certificate. The portable measuring apparatus shall be used within the nominal operating voltage prescribed by the manufacturer. The specified operating voltage of the apparatus shall be recorded on the certificate.

6.5.2.6

For automated consoles that indicate programmed target values of volts, amps and power factor or phase angle, rather than actual live values, the accuracy check shall also include a test to assess whether the actual values match the indicated target values within the tolerances specified in Table 1 of section 6.8.3.

6.5.2.7

All accuracy check results, including the difference between the registration error appended to the portable measuring apparatus certificate and the result of the accuracy check, shall be recorded in the log book or file.

6.5.3 Minimum Duration of Verification Tests

The minimum duration of any energy test on MCMS for the purpose of reverification shall be such that MCMS test results are provided to a resolution of 0.1 percent. In the case of portable measuring apparatuses equipped with energy reference meters that emit pulses, the minimum duration of tests shall be such that at least 1000 pulses are emitted by the energy reference meter.

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6.6 Environmental Requirements

6.6.1 The environmental conditions for the use of a portable measuring apparatus shall be as follows:

- (a) the portable measuring apparatus shall only be used when the temperature is within ± 7 degrees C of the certified temperature established for the portable measuring apparatus.
- (b) the temperature of the air surrounding the portable measuring apparatus shall be recorded and monitored every 30 minutes and shall not vary by more than ± 7 degrees C during reverification.
- (c) the portable measuring apparatus shall not be used for reverification of a MCMS if it is moved from a location where the ambient air temperature changes by more than 10 degrees C until the portable measuring apparatus has acclimatized for a minimum period of 2 hours.
- (d) the portable measuring apparatus shall not be used for reverification of a MCMS if 12 hours prior to the reverification it is exposed for more than 30 minutes to temperatures under 10 or over 40 degrees C.

6.7 Mechanical Requirements

6.7.1 Master Control Switch and Indication of Energization

Portable measuring apparatus shall have a master on/off control for switching off all power sources to the portable measuring apparatus. It shall be readily accessible and clearly marked.

6.7.2 Operating Mode

Portable measuring apparatus shall be capable of testing MCMS under single phase conditions with potential circuits connected in parallel and current circuits connected in series. A portable measuring apparatus that is capable of applying voltages and currents to the voltage and current circuits of a MCMS from independent sources shall be considered to meet this requirement if the applied voltages, currents, phase angles and loads from each source are within the tolerances set out in Table 1 of section 6.8.3.4. The spread of the applied voltages, currents, phase angles and loads, shall also be within the tolerances set out in Table 1 of section 6.8.3.4.

6.7.3 Individual Elements

Portable measuring apparatus shall be capable of testing individual elements of MCMS.

6.8 Electrical Requirements

6.8.1 No Load Testing Provision (Creep Test)

6.8.1.1

The portable measuring apparatus shall include means for removing current supplied by the apparatus to the MCMS under test. The no load testing provision shall be documented and be included with the operating manuals of the portable measuring apparatus.

6.8.1.2

The no load testing capability of the portable measuring apparatus shall be assessed with only the load voltage applied to each applicable MCMS to be tested. The energy recorded during a fifteen minute interval shall not be greater than 0.01 Wh.

6.8.2 Supply Voltage Requirements

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The portable measuring apparatus shall be calibrated and used within the manufacturers specified limits for supply voltage requirements. The owner of the portable measuring apparatus shall establish the supply voltage to be used for the device. Accuracy tests shall be run at +10 percent and -10 percent of the established supply voltage at a current test point used for reverification of the applicable MCMS. The difference between the errors shall not exceed ± 0.1 percent and any observed errors shall not exceed ± 0.2 percent.

6.8.3 Indicating Instruments

6.8.3.1

Portable measuring apparatus shall be capable of displaying the quantities listed below:

- (a) Voltage (volts)
- (b) Current (amps)
- (c) Phase angle (degrees) or power factor (Pf)

6.8.3.2

The provisions for displaying the quantities listed in section 6.8.3.1 shall be documented and meet the requirements of sections 6.8.3.3, 6.8.3.4 and 6.8.3.5 of this document, as applicable.

6.8.3.3

These instruments shall be capable of indicating their respective quantities to tolerances specified in Table 1, and shall be capable of indicating all values required for reverifying MCMS specified in the information provided, pursuant to section 6.3.5. When setting any of the quantities above, the respective indicating instrument shall be readily accessible with an unobstructed view.

6.8.3.4

Automated consoles that indicate the programmed target values rather than the actual live values of the quantities listed in 6.8.3.1 shall be deemed to meet the requirements of this section provided that the indicated target values match the actual values within the specified tolerances during testing. This shall be verified during the accuracy check of section 6.5.2.

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Table 1 - Required Indicator Accuracies

Quantity	Tolerances
Current	±2%
Voltage	±2%
Phase angle/power factor (at unity Pf)	±2.5°/±0.1%
Phase angle/power factor (at 0.5 Pf)	±1.0°/±3%
Power (active)	±2%

The tolerances expressed in percentage are in percent of true value.

6.8.3.5

For the purpose of determining compliance with the above tolerances, the currents, voltages, phase angles and loads shall be measured in the same circuit used to energize the meter under test, without any intervening transformers or components.

6.8.4 Accuracy and Repeatability of Portable Measuring Apparatus

Portable measuring apparatus shall be capable of setting all currents, voltages and phase angles within the tolerances set out in Table 1 of section 6.8.3.4, for all MCMS required to be reverified pursuant to section 6.3.5.

6.8.5 Portable Measuring Apparatus Reference Meters

6.8.5.1

The reference meters for portable measuring apparatus which automatically determine and display meter-under-test errors and which are not equipped with energy reference meters that emit at least one pulse for every 0.00300 watt-hours (or volt ampere hours, or var hours), shall display the errors to a resolution of at least two significant digits to the right of the decimal point when the console is undergoing calibration tests pursuant to these requirements. When the console is used for meter verification tests, the displayed error shall be shown with a resolution of at least one significant digit to the right of the decimal point.

6.8.5.2

Portable measuring apparatus which do not automatically determine and display meter-under-test errors shall be equipped with energy reference meters that emit at least one pulse for every 0.00300 watt-hours applied to the energy reference meter.

6.8.6 Control Circuits for Energy Meters

6.8.6.1

The control circuits for energy meters of portable measuring apparatus intended to reverify the energy function of MCMS and which do not automatically determine and display meter-under-test errors shall be equipped with a device to automatically count the test energy pulses provided by an electronic meter. Such portable measuring apparatus shall also be equipped with a device to predetermine the number of pulses of a MCMS under test and to count the pulses emitted by the energy reference meter during the predetermined number of pulses.

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6.8.6.2

Portable measuring apparatus equipped with devices that automatically detect the test energy pulses provided by an electronic meter, shall be capable of doing so without error.

6.9 Metrological Requirements

6.9.1 General - Manual Application of Correction Factors

All tolerances for portable measuring apparatus set out in this document shall be achieved without the manual application of correction factors.

6.9.2 General - Error Calculations

6.9.2.1

The error of the portable measuring apparatus at any test point is the difference between the results obtained for the standard (and transformer combination) when its apparent error is measured by the portable measuring apparatus, and the errors set out in the certificates for the standards used by the portable measuring apparatus.

At any test point

Portable measuring apparatus error is equal to [**Apparent error of standard** (and transformers)] minus [**Certified** (or calculated) **error of standard** (and transformers)]

6.9.2.2

The apparent error of the standard (and transformer combination) is either read directly off the portable measuring apparatus or calculated by the operator according to the operating principle of the portable measuring apparatus. The certified error of the standard is used if no instrument transformers are necessary. Where instrument transformers are necessary, the calculated error of the standard and transformer combination is determined according to the formula set out in section 7.1.2.2.5 of P-E-01: Procedures for Calibrating and Certifying Electricity Calibration Consoles Pursuant to the Requirements of S-E-01.

6.9.3 General - Minimum Duration of Accuracy Tests

The minimum duration of an accuracy test for a portable measuring apparatus shall meet the requirements of 7.1.3.1 of S-E-01 for calibration consoles.

6.9.4 Burden Effects

6.9.4.1

The portable measuring apparatus shall be tested for the effects of varying burden conditions. Each MCMS burden will be assessed at 25 percent of the nameplate current rating, connected in series and 0.5 power factor at the applicable voltage for the burden being assessed.

6.9.4.2

The change in portable measuring apparatus error resulting from the installation of different voltage burdens equivalent to those of MCMS types to be reverified using the portable measuring apparatus shall not exceed 0.1 percent.

6.9.4.3

The portable measuring apparatus error resulting from the installation of any voltage burden equivalent to that of a MCMS which will be reverified by the portable measuring apparatus shall not exhibit an error greater than ± 0.2 percent of the reading at any test point.

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6.9.5 Sensitivity to Number of MCMS Sensors under Test

6.9.5.1

The maximum permissible change in portable measuring apparatus errors resulting from varying the number of MCMS integral sensors installed in the test position shall not exceed ± 0.1 percent.

6.9.5.2

The portable measuring apparatus error resulting from the installation of the minimum number of MCMS integral sensors up to the maximum number of MCMS integral sensors installed in the test position shall not be greater than ± 0.2 percent of the reading at any test point.

6.9.5.3

The portable measuring apparatus shall be tested for sensitivity to the maximum and minimum number of integral sensors to be connected to each type of MCMS burden to be reverified using the portable measuring apparatus as follows:

- (a) The portable measuring apparatus shall be tested with one type of MCMS burden installed with the minimum number of integral sensors connected to the MCMS in the test position.
- (b) The portable measuring apparatus test shall be repeated with the maximum number of integral sensors connected to the MCMS in the test position. Testing shall be repeated for all MCMS burden types with the different combinations of the minimum to the maximum number of integral sensors connected to the MCMS in the test position.
- (c) The portable measuring apparatus shall not exceed the maximum permissible errors of 6.9.5.1 and 6.9.5.2.

6.9.5.4

The portable measuring apparatus shall be capable of maintaining the maximum test current used to reverify a MCMS when the maximum number of sensors is being used or connected to the MCMS within a tolerance of ± 2 percent.

6.9.6 Distortion

6.9.6.1

The maximum permissible errors for distortion in the voltage and current circuits in portable measuring apparatus shall not exceed 5 percent.

6.9.6.2

The distortion in the current and voltage circuits of portable measuring apparatus shall be measured with both circuits energized when conducting these tests.

6.9.6.3

The following distortion tests shall be conducted at unity and 0.5 power factor, using the load determined by the MCMS burden with the highest error from 6.9.4.1 above without any MCMS and integral sensors installed in the test position:

- (i) at a load of 2.5 amperes and the maximum reverification test current applicable to the burden with the highest error;
- (ii) at 120 volts and at the maximum reverification voltage applicable to the burden with the highest error to be used by the portable measuring apparatus.

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6.9.6.4

The distortion tests pursuant to 6.9.6.3 above shall be repeated with the MCMS burden with the highest error from 6.9.4.1 installed in the test position and with the maximum number integral sensors connected in the circuit to be reverified by the portable measuring apparatus.

6.9.6.5

For the purpose of calculating distortion, the formula in 7.5.5 of S-E-01 is applicable to portable measuring apparatus.

6.9.7 Current Switching Effects

6.9.7.1

The maximum permissible error for the current switching effects in semi-automatic and automatic portable measuring apparatus shall not introduce error changes greater than 0.2 percent.

6.9.7.2

Any error resulting from current switching shall not exceed ± 0.2 percent.

6.9.7.3

Semi-automatic and automatic portable measuring apparatus which have current and potential transformers connected between the reference meter and the meter-under-test position(s) shall be tested for current switching effects. Such portable measuring apparatus shall be calibrated at all applicable test loads required for the applicable test burdens determined pursuant to sections 6.9.4.1 having the highest error. Using the normal operating mode of the console, the current shall be switched to 10 percent of the test current determined pursuant to the test burden, and back to its original value.

6.9.7.4

The portable measuring apparatus shall then be recalibrated. This test shall be conducted five times. If the normal operating procedure for the portable measuring apparatus requires that the load be removed when switching from one setting to another, then this shall be done when conducting this test.

6.9.8 Portable Measuring Apparatus Calibration

6.9.8.1

The maximum permissible error for portable measuring apparatus shall be ± 0.2 percent of reading at any test point.

6.9.8.2

The errors of the portable measuring apparatus shall be determined by calibrating at all test loads required for reverification of each MCMS type to be reverified by the portable measuring apparatus.

6.9.8.3

The errors of the portable measuring apparatus determined in 6.9.8.2 shall be determined with all applicable current, and/or potential transformers, as well as any necessary test equipment connected between the reference meter(s) and the MCMS test position.

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6.9.9 Pulse Counters and Generators

6.9.9.1

The pulse counter and generators used for reverification of MCMS which are internal or external to the portable measuring apparatus shall not exhibit errors exceeding plus or minus one count.

6.9.9.2 Conditions for Metrological Characteristics

Internal or external pulse counters and pulse generators utilized with portable measuring apparatus, which are intended to be used for reverifying MCMS to be used for revenue metering, shall be tested by connecting them to an appropriate pulse generator or pulse counter, respectively. For testing pulse counters, the frequency setting of the pulse generator shall be the maximum pulse rate to be used for reverification of MCMS with pulse output(s). For testing pulse generators, the maximum frequency required to reverify MCMS pulse inputs shall be used. The duration of tests shall be such that at least 1000 pulses are generated.

7.0 Additional Information

For additional information regarding these requirements, please contact the Senior Program Officer for electricity measurement. For more information regarding Measurement Canada and its programs, visit our Web site located at <http://mc.ic.gc.ca>.

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