Procedures

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Document(s):	Distribution Date: **2006-08-15**	Effective Date: **2006-08-15**
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PROCEDURES FOR THE VERIFICATION AND REVERIFICATION OF ELECTRICITY METERS PURSUANT TO THE REQUIREMENTS OF S-E-02

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Procedures for the Verification and Revification of Electricity Meters Pursuant to the Requirements of S-E-02

1.0 Scope

This document applies to electricity meters submitted for verification and reverification pursuant to the requirements of S-E-02, *Specification for the Verification and Reverification of Electricity Meters* .

2.0 Purpose

This document is intended to provide support for the verification and reverification of electricity meters performed pursuant to the requirements of S-E-02. Detailed descriptions and explanations, as well as test procedures related to specific requirements are provided. The procedures provided in the following sections describe the processes necessary to evaluate electricity meters for the purposes verification and reverification.

3.0 References

1) *Electricity and Gas Inspection Act*.

2) *Electricity and Gas Inspection Regulations*.

3) Provisional Specifications for the Verification and Reverification of Electricity Meters (S-E-02)

4) Specifications for the Certification, Calibration and Use of Electricity Calibration Consoles (S-E-01)

5) Measurement Canada Bulletins

6) Measurement Canada Notices of Approval

4.0 Definitions

For the purpose of this document reference can be made to the definitions of S-E-02.

5.0 Procedures for Assessing Administrative Requirements

5.1 General

The application of the specification and procedures allow for the verification and reverificaiton of electricity meters however, the owner of the meter ultimately remains legally responsible for ensuring meters are compliant with the statute Measurement Canada's (MC) policies and programs. Through market place monitoring programs established by MC, meter owners shall also be required to subject meters to testing that ensure these specifications continue to be valid for the purpose of verification and reverification.

5.2 Conditions for Testing

5.2.1 Scope

This procedure relates to section 5.2.1 of the Specifications. It is intended to ensure that the meter is tested under the specified conditions for meter evaluation.

5.2.2 General

The meter verifier is responsible to ensure that they have knowledge of, and access to, the Specifications as well as these procedures. They shall understand the content and its application to the meter(s) under test. Where the Specifications stipulate any conditions that testing shall be performed under, those conditions shall be satisfied prior to the meter being evaluated for verification or re-verification.

5.2.3 Procedure

No specific procedure required.

5.3 Range of Accuracy Test

5.3.1 Scope

This procedure relates to section 5.2.2.1 of the Specifications. It is intended to ensure that a meter verifier has knowledge of specific conditions and requirements for the verification of an approved meter.

5.3.2 General

All meters which are intended to be verified for use in obtaining the basis of a charge, shall be approved by MC. Each measurement quantity and function has been evaluated to an extent determined by the Engineering and Laboratory Services Directorate (ELSD) in accordance with existing Specifications, and Procedures. The ELSD generates a Notice of Approval (NOA) for each meter type. The NOA may approve certain functions or quantities, some of which may not be required or desired by the meter owner for the intended use of that particular meter. Any such functions or quantities shall be disabled by the owner prior to meter testing.

The test points and tolerances established in the Specifications are expected to apply to most meters evaluated for the purposes of verification. In exceptional cases the NOA may stipulate additional tests to supplement those specified, or may waive specified tests as necessary for the purposes of verification.

Interpretations or clarifications of Specifications or Procedures may be established through Policy Bulletins or Technical Circulars.

5.3.3 Procedure

1) The meter verifier shall have knowledge of and, access to the MC NOA related to the specific meter under test.

2) The meter verifier shall have knowledge of and access to all MC Bulletins, Technical Circulars for the specific meter under test.

3) Ensure that all conditions necessary for proper evaluation of the meter (as specified in the Specifications, Procedures, NOA, applicable Bulletins, and Technical circulars), are satisfied prior to commencing evaluation of the meter for the purposes of verification.

4) Ensure that only those approved functions or quantities intended to be evaluated for verification are accessible. Any other approved functions or quantities shall be disabled and rendered inaccessible prior to verification and sealing.

5.4 Implicit Accuracy of Each Measurement Function

5.4.1 Scope

This procedure relates to section 5.2.2.2 of the Specifications. It is intended to clarify that meter owners are responsible to ensure that any verified meter is in fact accurate throughout its operating range.

5.4.2 General

Any meter that is verified and sealed pursuant to section 9 (1) of the *Electricity and Gas Inspection Act* (Act) shall be accurate over the full operating range of the meter.

5.4.3 Procedure

No specific procedure required

5.4.4 Remarks

1) A meter shall meet all specified requirements and verification criteria prior to being verified and sealed to be used to obtain the basis of a charge.

2) The meter does not meet the specified requirements, if during any testing performed it is found to exhibit errors exceeding the specified tolerance at any point within its operating range. This applies regardless of whether such testing is performed pursuant to the Specifications or otherwise.

5.5 Error Determination

5.5.1 Scope

This procedure describes how to determine the error of a meter. It is intended to ensure that any errors attributed to meters are determined correctly and consistently.

5.5.2 General

While there are several expressions of accuracy in measurement, MC specifies that meter errors are expressed as percentage true error. This is consistent with section 46 of the *Electricity and Gas Inspection Regulations* (Regulations).

5.5.3 Procedure

1) Determine the value of the quantity being measured as indicated by the meter under test to a minimum of four digits of resolution.

2) Determine the value of the quantity being measured as indicated by the certified reference meter, (standard) to a minimum of four digits of resolution.

3) Perform any conversions that are necessary to ensure that the values determined in steps 1) and 2) are expressed in the same units, (eg. Watt-hours, Vars, pulses, etc.).

4) Divide the value obtained in step 1) by the value obtained in step 2), then subtract one (1) from the result.

5) The resultant value determined through step 4) is defined as “relative (true) error”. Multiply that value by 100 to obtain the error expressed as a percentage. This is also referred to as “percentage (true) error”.

5.5.4 Formula

E = ((R/T)-1)×100%

Where:
E - is the relative (true) error of the meter, expressed in precent (precent error)
R - is the quantity indicated by the meter under test
T- is the true value of the quantity indicated by the reference meter, and expressed in the same units as R.

5.6 Correction for Known Errors

5.6.1 Scope

This procedure relates to section 5.2.3 of the Specifications. It is intended to ensure that any errors attributed to meters are unbiased due to inherent errors of the calibration console or reference standard.

5.6.2 General

Effective September 1, 2006 the results of all meter tests performed for the purpose of verification and reverification shall be corrected for the known errors of the calibration console.

Prior to September 1, 2006 the following is applicable:

Calibration consoles and reference standards usually have some certified error(s) at various test points. For meters tested pursuant to compliance sampling plans, this procedure will establish the true error of a meter by correcting the observed error of the meter, using the certified error of the calibration console.

For all other meter testing until September 1, 2006, observed errors are corrected only when they are close to, (within the limits specified in section 5.2.3 of the Specifications), the allowable tolerance for that meter test point. This will ensure that the effect of the console certified errors does not cause meters with error exceeding the tolerance to be verified, or meters with error less than the tolerance to be rejected.

5.6.3 Procedure

5.6.3.1 For Compliance Sample Testing until Sept.1, 2006 and applicable to all testing after that date.

1) Observe the errors displayed or provided by the calibration console for a meter at specified test points.

2) Obtain the certified error of the calibration console at those test points. These are available on the calibration console certificate.

3) Where the meter test point is such that there is no certified error available, then in Step 2) interpolate from the errors available on the calibration console certificate as specified in S-E-01.

4) Subtract the error obtained in Step 2) from the error observed in Step 1). The resultant is the relative (true) error, expressed in percent, of the meter at that test point.

5) Record the error as calculated.

5.6.3.2 Other Verification Testing until Sept. 1, 2006

1) Observe the errors displayed or provided by the calibration console for a meter at specified test points.

2) For energy meters and electronic or hybrid demand meters, calculate if any observed errors, are within the specified percentage point range from the allowable tolerance for that meter type.

3) For electromechanical demand meters, calculate if any observed errors are within the specified percentage point range from the allowable tolerance for that meter type.

4) If the observed errors are within the specified range of the allowable tolerance then no correction is necessary. Record the errors as observed in Step 1).

5) If the observed errors are not within the specified range of the allowable tolerance then a correction is necessary. To determine the adjustment follow the process outlined in subsection 5.6.3.1.

6) Record the relative (true) error as calculated.

5.6.4 Formula

$$\mathbf{E = E_{MM} - E_{CC}}$$

Where:
E - is the relative (true) error of the meter expressed in percent
E_{MM} - is the error displayed or provided by the calibration console expressed in percent
E_{CC} - is the certified error of the calibration console expressed in percent

5.6.5 Remarks

Correction for known errors of a calibration console may be performed manually, or automatically where a calibration console is equipped with tables in which known errors for specific test points are stored and software is used to automatically correct for the known error at those test points. Where such tables are used to establish the corrected error of a meter, the correction shall be performed in a manner equivalent to that established in the procedure of subsection 5.6.3.1 above.

5.7 Documentation of Errors

5.7.1 Scope

This procedure relates to section 5.2.4 of the Specifications. It is intended to establish the required level of resolution to which errors shall be recorded.

5.7.2 General

Errors shall be recorded to at least one significant digit to the right of the decimal place. Meter verifiers are allowed to record errors to a greater resolution if so desired. Errors determined and corrected pursuant to sections 5.5.4 of this procedure and 5.2.4 of the Specification may be rounded to the nearest first digit to the right of the decimal place.

5.7.3 Procedure

Where the value of the second digit to the right of the decimal place is “five (5)”or greater, then the first digit to the right of the decimal shall only be rounded up if rounding is performed.

5.7.4 Remarks

Excessive additional digits to the right of the decimal place should be avoided where possible. The values of those digits are metrologically invalid if the calibration console has not been certified to that level of precision.

5.8 Limits of Calibration

5.8.1 Scope

This procedure relates to section 5.2.5 of the Specifications. It is intended to ensure that newly manufactured and/or reworked meters are calibrated to register with minimum error.

5.8.2 General

Allowable limits of error are specified for certain meter types and/or certain test points. The range of allowable error is intended to account for conditions where the meter calibration is not completely controllable.

5.8.3 Procedure

1) Where adjustments are possible, including mechanical, electronic or software, a newly manufactured or reworked meter shall be adjusted to register errors as close to zero (0) as practically possible prior to being submitted for verification or reverification.

2) Step 1) applies to each specified test point for that meter.

5.9 Testing Facilities

5.9.1 Scope

This procedure relates to section 5.3 of the Specifications. It is intended to ensure that all facilities and equipment that are necessary for verification testing of meters is available and certified as required.

5.9.2 General

Section 19 of the Act stipulates that a contractor shall provide, free of charge, electricity, equipment, and facilities to MC for the purposes of testing meters. Section 5 of the Act stipulates that only calibrated and certified measuring apparatus may be used for the purpose of verifying meters.

5.9.3 Procedure

1) Ensure test facilities are available

2) Determine what test equipment is required in order to perform all specified meter verification testing, ensure it is available.

3) Ensure that the test location meets all Specified environmental requirements and all applicable meter test conditions such as temperature, humidity, illumination, accessibility.

4) Ensure that any measuring apparatus and/or standards used for the verification of meters are available and calibrated and certified in accordance with the Act, Regulations and related Specifications, (such as S-E-01).

5.10 Verification and Reverification Methods

5.10.1 Scope

This procedure relates to section 5.4 of the Specifications. It is intended explain the methods by which meters may be verified.

5.10.2 General

Meters may be verified or reverified individually or through approved MC sampling plans. The procedures provided in this document are applicable only to the verification and or reverification of individual meters. For verification and reverification of meters by sampling methods, refer to the series of sampling documents as applicable to statistical methods.

5.10.3 Procedure

No procedure required.

5.11 Verification Seal and Marking Requirements

5.11.1 Scope

This procedure relates to section 5.5 of the Specifications. It is intended to ensure that verified meters are sealed and marked as required by the Act.

5.11.2 General

Section 9 (1) of the Act states that a verified meter may not be placed in service until it has been sealed. MC establishes specific requirements for the sealing and marking of verified meters. The seal or marking shall identify the meter verifier and the year in which the meter was verified. Seals are used to prevent undetected access to metrological components or adjustments of a meter.

5.11.3 Procedure

5.11.3.1
1) Review any Specifications and Bulletins established by MC regarding the sealing and marking of verified meters.

2) Review the Notice of Approval for the meter being verified.

3) Ensure that verified meters are sealed and marked in accordance with the Specifications, Bulletins and Notice of Approval, with a seal or identifier accepted by MC.

4) Meters verified by compliance sampling shall be sealed with the original seal applied upon initial verification. The seal shall be intact, legible and in good condition. For meters which require their seals to be broken in order to perform the inspections, MC shall be advised by the AMV in writing prior to the inspection of the precautions that will be taken to ensure the integrity of the results. If the lot is acceptable, such individual meters which are also acceptable shall be resealed with an identifier indicating the original seal year in the sealing assembly.

5) Individual meters with broken, deteriorated or illegible seals, or with errors that exceed the allowable tolerance, are removed from the lot of meters and shall be resubmitted for verification by another method.

5.12 Disposition of Meter with Questionable Accuracy

5.12.1 Scope

This procedure relates to section 5.6 of the Specifications. It is intended to ensure that meters which may be suspected of not conforming to the Specifications are not placed into service.

5.12.2 General

The fact that a meter is verified and sealed does not guarantee that the meter currently conforms to the requirements of the Specifications. A verified meter shall always conform to the requirements of the Specifications at any time that it may be used to obtain the basis for a charge.

5.12.3 Procedure

1) A meter may be suspected of being in a state that does not conform to the Specifications, and therefore should be reverified where potential damage has occurred.

Potential damage can result from, but is not limited to, the following examples:

a) Dropped meter
b) Damaged packaging where a meter is packed and transported
c) Exposure to extreme environmental conditions such as fire or flood
d) Exposure to chemicals which may react with the meter material

5.13 Documentation

5.13.1 Scope

This procedure relates to section 5.7 of the Specifications. It is intended to ensure that the documentation as required by the Act is completed and contains all required and relevant information for a verified meter.

5.13.2 General

The Act stipulates that a certificate shall be issued to the meter owner for a meter which is verified by an inspector or an authorized service provider (ASP) who is not the owner of the meter. The Regulations prescribe information that shall be contained in the certificate. Additional information pertaining to the meter and its verification status is also required. Where the ASP is also the owner of the meter, either a certificate may be issued, or the owner may choose to maintain all of the required information as part of the "owners records" or "authorized service provider's records".

5.13.3 Procedure

5.13.3.1
Clarification of requirements and terms in section 21 of the Regulations:

1) "date of the verification" refers to the date that the verification was completed.

2) "identification numbers of the meter" include the manufacturer designated serial number, and the contractor assigned inspection number.

3) "class, type or design" includes the model designation.

4) "identification numbers of all measuring apparatus" include the designated standard number assigned by MC, the identification number assigned by the ASP or the serial number designated by the manufacturer, for the certified measuring apparatus.

5) "the errors" include all errors determined for all points tested.

6) "identification or listing of the parent group or lot" can be achieved by assigning an alphanumeric number to the lot. The individual meters within the lot shall be identified, but are not required to be on or attached to the certificate. The meters tested shall be identified on the certificate or as a separate listing attached to the certificate.

5.13.3.2
Clarification of requirements and terms in section 5.7.1 of the Specifications:

1) "verified" includes a meter which has never been previously verified and sealed. "reverified" includes any meter which has previously been verified and sealed.

2) "pulse value" means the value of the measured quantity for each output pulse. Expressed in units per pulse, (K_P). "pulse type or form" means either: Form A (2 wire), Form C (3 wire), or solid state (digital).

3) "conformance status" means whether the meter conforms to the requirements, (accepted) or does not conform, (rejected).

4) "year in which the meter will be due for reverification" is calculated to be the year in which the meter is verified, plus the applicable meter verification period, as established by MC.

5) "meter multipliers" are the factors by which the meter reading shall be multiplied by to obtain the correct magnitude of the measured quantity.

6) "voltage rating" and "current rating" should be recorded as the minimum to maximum for range rated meters, or the maximum for nominally rated meters.

7) "values of all statistics" include the mean ($\bar{x}$), and population standard deviation (s).

8) "conformance status" means whether the lot conforms to the requirements, (accepted) or does not conform, (rejected).

9) "level" is determined from sampling plans as specified by MC.

10) "extension period" is determined from a list of extension of meter reverification periods established and specified by MC.

11) "type of demand meter" refers to the meters response characteristic to a given load. For example: Block-interval, rolling block, or exponential responses.

13) "element configuration" includes all applicable element configurations, or "Auto Service Detect" if applicable, as marked on the meter nameplate.

14) In some instances verification testing may take place while the meter is not operating in the state that it will operate in service. Where any metrological parameters are allowed to, and have been changed subsequent to the testing of the meter, the certificate shall list or make reference to a list of those parameters. Such parameters may include changing the meter multiplier, meter output constant (K_h), or removing an approved measurement quantity.

15) The certificate shall list or make reference to a list of all the approved measurement quantities for which the meter has been programmed to measure, and functions for which the meter has been programmed to perform. These will include applicable legal units of energy and demand, loss compensation, outputs (including registers, optical port, solid state, etc.) meter multiplier, and firmware revision.

5.13.3.3 Meter verified and sealed pursuant to the Act by an Inspector or ASP who is not the owner of the meter

1) Record all the required information as prescribed in Section 21 of the Regulations.

2) Record all the required applicable information as stated in section 5.7.1 of the Specifications.

3) Ensure all information recorded in Steps 1) and 2) are contained on the certificate of inspection and that the certificate is signed by the person issuing it.

4) Issue the certificate to the owner of the meter(s). The certificate is to be maintained by the owner as part of the "owner's records".

5.12.3.4 Meter verified and sealed pursuant to the Act by an AMV who is the owner of the meter

1) Follow Steps 1) and 2) from 5.13.3.3 above.

2) Ensure that the recorded information is maintained as part of the "owner's records" or as part of "accredited meter verifier's records".

5.14 Nameplate Markings

5.14.1 Scope

This procedure relates to section 5.8 of the Specifications. It is intended to ensure that the meter is marked with appropriate identification information.

5.14.2 General

Individual meters shall be uniquely identifiable, as well as be identifiable as an approved meter. This is a requirement of the Specifications for Approval of Type for Electricity Meters, and shall be confirmed for each meter during verification.

5.14.3 Procedure

Ensure that the meter is marked with all the required information as specified in the Specifications.

5.14.4 Remarks

1) If any marking are found to be deficient or non-existent, the meter shall not be sealed.

2) In addition to the identification markings, certain technical information and markings are also required on meters. Procedures to assess those marking are provided in Section 6 of the Specifications.

6.0 Procedures for Assessing Technical Requirements

6.1 General

These procedures are intended to ensure that meters meet all established technical requirements of the Specifications.

6.2 Mechanical Integrity

6.2.1 Scope

This procedure relates to section 6.1.1 of the Specification. It is intended to ensure that meters are mechanically fit, free of damage, defects or deficiencies which could affect the meter's ability to comply with the requirements of the Specifications.

6.2.2 General

In order to establish a level of confidence that a meter will continue to operate within specified requirements, a visual inspection is performed to detect any obvious damage or defects.

6.2.3 Procedure

Examine the meter to ensure that:

1) the meter composition, construction and performance is identical in every material respect to that described in the Notice of Approval;

2) the meter is equipped with provisions which allow for the application of the verification seal as required by the Notice of Approval;

3) the meter is free of any physical damage, which could affect the meter's ability to comply with the Specifications and meter usage requirements;

4) the meter is free of dirt, debris and other foreign substances, both internally and externally.

5) the meter has appropriate jumper connections where jumpers are used to establish the meter configuration. Refer to the Notice of Approval.

6.3 Nameplate and Nameplate Markings

6.3.1 Scope

This procedure relates to section 6.2 of the Specifications. It is intended to ensure that the meter has the required nameplate(s), and is marked with the required information.

6.3.2 General

The markings of a meter provide administrative and technical information which is used to ensure that the meter is appropriate for the intended service conditions, and clearly identifies the metrological functions for which the meter has been approved and verified for use.

6.3.3 Procedure

1) Visually examine the meter to ensure that the nameplate and the applicable markings identified in section 6.2.1 of the Specification are present.

2) Ensure that:

a) the nameplate is attached to the meter base or frame and visible from the front of the meter, as specified in 6.2.1 (2) and (3) of the Specifications.

b) the auxiliary nameplate, (for meters which are fitted with an auxiliary nameplate to accommodate all required markings information), will be accessible for viewing when the meter is installed.

c) the meter has a contractor assigned number on the nameplate.

d) the nameplate cannot be modified once the meter has been sealed.

3) Visually examine the meter to ensure that all nameplate markings as required by section 6.2.2 of the Specifications, (as applicable to each meter), are present and correspond with the meter's actual operational condition(s) and the Notice of Approval.

4) Ensure that all meter markings as required by section 6.2.2 of the Specifications, are indelible, distinct, and readily visible from the front of the meter, with the meter cover in place.

5) Visually examine the meter to ensure that all other nameplate markings as required by section 6.2.2.3 of the Specifications, (as applicable to each meter), are present and correspond with the meter's actual operational condition(s) and the Notice of Approval.

6) Ensure that:

a) self-contained single-phase meters that are not socket-based, have the word “line” marked on the terminal cover and on the meter inputs that are designated for line connections, and self contained single-phase socket based meters have the word “line” marked on the base.

b) all meters, except single phase socket-based meters, have a complete diagram of internal connections marked on the nameplate.

c) meters equipped with accessories such as a reverse running detent, re-transmitting contacts, etc., have markings indicating their presence on the nameplate or an auxiliary nameplate, as well as a diagram of connections for any such accessories as specified in Approval Notices and other MC requirements.

d) meters equipped with ancillary devices which operate with a voltage rating different than the meter, are marked with this voltage rating on either the nameplate or auxiliary nameplate.

e) single phase transformer type meters, are marked with the words “Transformer Type” on the nameplate in red, or in an otherwise appropriately conspicuous manner.

f) all transformer-rated meters, (meters designed for use with specific size CT’s and/or PT’s), are marked with the following:

i) the words “transformer rated”
ii) the meter’s primary disc constant
iii) the specific Current Transformer rating, e.g. 1000-5A
iv) the specific Voltage Transformer rating, e.g. 2400-120V.

g) the full-scale demand rating for demand meters equipped with an electro-mechanical demand register is indicated on the nameplate.

h) demand meters display the following:

i) the demand response type(s) measured (exponential, block, sliding window, etc.)
ii) the length of the time for one response period for thermal or exponential type demand meters
iii) the length of the time of one demand interval for block type demand meters
iv) the length of the time of the demand sub-interval used for sliding window demand determination.

i) meters which are internally compensated for line or transformer losses have “LOSS COMPENSATED” indelibly marked in red or displayed in an appropriately conspicuous manner on the nameplate.

j) meters which are capable, (and approved) of automatically determining service configuration are marked with the words “Auto Service Detect” on the nameplate.

k) meters equipped with pulse initiators have the following information for the pulse initiators clearly marked on the nameplate:

i) the type or form, number of contacts (2 or 3 wire)
ii) the pulse value for each pulse output
iii) a connection diagram or similar terminal or lead marking to ensure that each terminal for the output of a pulse initiator is clearly identified for connection to a pulse receiving meter.

7) Where an induction type watt hour meter is intended to be used with approved phase shifting transformers to measure var hours or q hours, ensure that the meter has the following markings, (as required by section 6.5.5 of the Specifications):

a) indicating the units being measured.

b) indicating that external phase shifting transformers are required.

8) Where an induction type watt hour meter is intended to be cross connected in order to measure Q hours, ensure that the meter has the following markings (as required by section 6.5.5 of the Specifications):

a) indicating the units being measured.

b) indicating that it has been cross connected.

6.3.4 Remarks

Any meter which does not have the required information marked accordingly does not meet the specified requirements.

6.4 Mechanical Registers and Electronic Displays

6.4.1 Identification of Measurement Units

6.4.1.1 Scope

This procedure relates to section 6.3.1.1 of the Specifications. It is intended to ensure that approved legal units of measurement provided by a meter are properly identified.

6.4.1.2 General

Where legal units of measurement registered and displayed by a meter are approved for use in billing, those units shall be identified to ensure that the value registered corresponds to the correct unit of measurement.

6.4.1.3 Procedure

1) Examine each displayed measurement quantity and ensure that the quantity displayed is readily identifiable by its appropriate measurement unit. These units may be expressed in standard abbreviation for the measurement units (eg, kWh for kilowatt-hour, VA for volt-ampere).

2) Where the meter is equipped with electronic displays which use a coded identifier to identify measurement quantities, examine each displayed measurement quantity to ensure the coded identifiers correspond with the table of codes of associated measurement units resident in the meter memory (The table of codes shall be displayed by the meter, or located on the meter nameplate or any other readily viewable location of the meter that is under the meter seal.).

3) For multi register meters capable of displaying multiple quantities, examine each displayed measurement quantity to ensure that there is an identifier present to distinguish between the different measured values and that each measured value is identified by its appropriate unit of measurement.

6.4.2 Meter Multipliers

6.4.2.1 Scope

This procedure relates to section 6.3.2 of the Specifications. It is intended to ensure that meters which display or provide readings for approved legal units of measurement (the value of which shall be multiplied to obtain the true value), are marked with the value of the multiplier(s).

6.4.2.2 General

Some meters display or provide readings for units of measurement that are only a fraction of the true value of the quantity registered. Where that is the case the meter shall be marked with the appropriate value of multiplier(s) required to obtain the true value of the quantity to be used for billing.

6.4.2.3 Procedure

1) Where a meter multiplier is other than unity (1), examine the meter according to the following steps to ensure it is marked with the appropriate multiplier.

2) For electro-mechanical energy meters ensure that the meter multiplier is marked permanently and prominently, preferably in red, on the register or scale face.

3) For electro-mechanical demand or combination demand/energy meters, ensure that the meter multiplier is marked permanently and prominently, preferably in red on either the register or nameplate.

4) For an electro-mechanical meter that has different multipliers for different measurement quantities, ensure that the applicable multiplier for each register and/or scale is marked in the proximity of the energy and demand units markings, in a manner which readily identifies the associated function multiplier.

5) For electronic meters ensure that the meter multiplier is distinctly marked on the meter's nameplate or electronic display.

6.4.3 Mechanical Register Markings and Register Ratio

6.4.3.1 Scope

This procedure relates to sections 6.3.3 and 6.3.4 of the Specifications. It is intended to ensure that the mechanical registers of a meter are suitably marked with the required information only, to ensure identification of the values and quantities recorded.

6.4.3.2 General

Only limited information is allowed to be present on a mechanical register in order to clearly and concisely identify the values and quantities recorded by the register, and to identify the make of the register.

6.4.3.3 Procedure

1) Examine all meters with mechanical registers to ensure that:

a) there are no markings on the register face except for the manufacturer's name, trade mark, the direction of rotation indicator, register ratio, rotation index mark, multiplier, or marks pertaining to the reading of the register.

b) where the register face and nameplate are integral, any markings do not interfere with the reading of the register.

c) the magnitude of either the complete indication or of the divisions is not indicated above or below any individual dial or drum.

2) Examine all induction type meters to ensure that the register ratio is permanently marked on the register and is legible when the register is installed in the meter.

3) Ensure that the register is the appropriate register for the meter by reviewing the Notice of Approval to determine the correct register ratio match for the K_h and multiplier of the meter.

6.4.3.4 Examples

1) RR = 13 $^{8}/_{9}$, K_h = 7.2, Mult = 1
2) RR = 138 $^{8}/_{9}$, K_h = 7.2, Mult = 10

6.4.4 Demand Registers

6.4.4.1 Scope

This procedure relates to section 6.3.5 of the Specifications.

6.4.4.2 Procedure

Examine meters with mechanical demand registers to ensure that the driving pointer is of a colour distinctly different from that of the driven pointer.

6.4.5 Electronic Displays

6.4.5.1 Scope

This procedure relates to section 6.3.6 of the Specifications. It is intended to ensure that the electronic displays of a meter provide the required information to ensure suitable identification of the values and quantities recorded.

6.4.5.2 Procedure

1) Activate the display segment check feature and verify that all segments are illuminated.

2) Where a meter with an electronic display utilizes that display to present any required demand meter nameplate markings as permitted under section 6.2.2.3 (g) of the Specifications, (including demand response type, response period or demand interval sub-interval for sliding window demand), ensure that the information is correctly presented on the display instead of the meter's nameplate.

6.4.5.3 Remarks

If any segments are found to be missing in step 1 above the meter does not comply with the specified requirements.

6.4.6 Register Resets

6.4.6.1 Scope

This procedure relates to section 6.3.7 of the Specifications. It is intended to ensure that accumulated values are stored in a secure manner, and are not reset to zero or any other value. It is also intended to ensure reset device operate correctly.

6.4.6.2 General

Some meters may use a reset device to reset accumulated values to zero; if so, the meter shall transfer the value which was previously in the reset register into another register for storage. Otherwise registers that store accumulated values are not permitted to be reset. Demand meters may make use of registers that are capable of being reset but the reset action shall not affect energy registers or interfere with the normal operation of the meter at all other times.

6.4.6.3 Procedure

1) Check the reset device to ensure that it is not possible to reset (i.e. reset to zero or any other value) or modify energy registers when the meter is sealed.

2) Where it is possible to reset or modify energy registers, ensure that the values stored in the register prior to the reset action are stored in another sealed memory or register location for recall at any time.

3) Check the device for resetting peak demand to ensure that:

a) for the case of electromechanical meters, the resetting device will not come into contact or interfere with any demand pointers or demand registers over the entire demand scale while resting in its normal position.

b) it resets or is capable of resetting the maximum demand indicator to zero at no load conditions, or to the equivalent current demand position if under load.

c) upon activation, the values stored in the peak demand register prior to the reset action are incrementally added to any associated cumulative demand register.

6.4.6.4 Remarks

Verification of the register above requirements can be completed in conjunction with the testing of the demand section of the meter. A meter not meeting all of the applicable requirement of this section shall be rejected.

6.5 Mechanical Energy Register Test

6.5.1 Scope

This procedure relates to section 6.3.2 (2) of the Specifications and is intended to verify the correct assembly, gearing, and operation of the mechanical register of a meter.

6.5.2 General

This test may be performed by applying a load to a meter for an extended test period and comparing the number of disc revolutions to energy accumulation on the register. This test can be combined with the comparative registration test of section 7.3.2.2 of the specification.

6.5.3 Procedure

1) Set up the meter for testing following the comparative energy test procedure found in section 7.3.2.2 of this document.

2) Set up the test consoles' disc revolution counter following instructions from the test console's documentation.

3) Calculate the number of disc revolutions required for the meter's test dial or least significant digit to make one full revolution using the meter's Kh and multiplier.

4) Record the meter register pointer positions.

5) Run the test counting the number of revolutions of the meter's disc. Stop the test when the calculated number of disc revolutions determined above has been completed.

6) Observe the final positions of the meter register pointers.

7) Compare the test dial's position (or the least significant digit pointer) to ensure it has completed one complete revolution. The next pointer shall have advanced one full division.

6.6 Data Retention

6.6.1 Scope

This procedure relates to section 6.4 of the Specifications. It is intended to ensure that all registered values and metrologically significant data are retained in the event of power loss.

This applies to all meters which utilize an electronic memory for programming or retention of data recording.

6.6.2 General

Meters shall be capable of retaining metrologically significant data including registered values under typical operating conditions as well as power outages.

6.6.3 Procedure

1) Record or make a printout of the meter's programmed functions and configuration.

2) Record the readings of each energy and demand register at the completion of any verification test(s), where all registers have some value greater than zero.

3) If the meter has a power outage register, record the current number of power outages displayed.

4) De-energize all voltage inputs to the meter for a period of at least one minute or any other period approved by MC.

5) Upon re-energization, (allowing for any start-up time required by the meter), examine the programming and configuration for any changes. Where the meter is approved with chronological carry-over capability, examine all chronological information.

6) Compare all demand register and energy register readings of meter to all previously recorded demand register and energy register readings.

7) If the meter has a power outage register, ensure that the number of power outages register has incremented by 1.

6.6.4 Remarks

The meter is considered to have met the data retention requirements if it correctly retained all meter program or configuration information, current accumulations for all energy registers, and all peak demand readings.

6.7 Carry-Over Battery

6.7.1 Scope

This procedure relates to section 6.4.2 of the Specifications. It is intended to ensure that where a carry-over battery is used to power the meters memory during a power outage, the battery condition is sufficient for the meter to meet the data retention requirements of section 6.4.1 of the Specifications.

6.7.2 General

Meters shall be capable of retaining metrologically significant data and registered values under typical operating conditions, including power outages. The condition of the battery may be assessed at verification through several means. It is recommended the battery condition be verified following the meter manufacturer's recommended procedure.

6.7.3 Procedure

1) For meters with a battery condition indicator, check the indicator to confirm that it shows the battery as being good.

2) Measure the battery's voltage, provided this measurement can produce a valid indication of the battery's status.

3) Compare the measured voltage to that expected based on the battery specifications. The voltage should be at least 95% of that expected.

4) Evaluate the battery using manufacturers data on expected battery life.

5) Ensure that the remaining battery life will be sufficient for the seal period of the meter.

6.8 Circuit Association Test

6.8.1 Scope

This procedure relates to section of 6.5.1 of the Specifications. It is intended to ensure that each voltage and current circuit of a multi-element meter are internally connected correctly.

6.8.2 General

The correct measurement of a polyphase service requires a multi-element electricity meter. A multi-element meter makes use of multiple voltage measuring circuits and current measuring circuits. In order for the meter to correctly measure energy or demand for a polyphase service, each voltage circuit shall measure the voltage associated with a specific current circuit, and vice versa. The circuit association test is performed by applying voltage to a single voltage circuit of the meter, and by simultaneously applying current to the current circuit(s) which are not associated with that voltage circuit.

6.8.3 Procedure

6.8.3.1 General

Perform the test by applying the rated voltage for the meter. Apply any convenient current which is not less than 25% of the rated current for the meter, and not greater than the rated current for the meter.

6.8.3.2 Electro-Mechanical Energy and Integrating Demand Meters

NOTE: This test should be combined with the demand coil association test whenever possible.

1) Set up and connect the meter to perform a normal single element verification test, (all meter voltage circuits energized with one meter current circuit energized).

2) Energize the meter and ensure that the disc is rotating.

3) Switch the test console off and connect the voltage input to only one meter voltage circuit.

4) Disconnect the current input from the meter current circuit under test. Connect the current input to the other meter current circuit(s), (those which are not associated with the voltage circuit being examined).

5) Energize the meter and determine if there is any disc rotation.

6) Repeat steps 3) to 5) for each remaining meter voltage circuit.

7) If any registration or disk rotation occurs during step 5), the meter does not comply with the specified requirements.

6.8.3.3 Thermal Demand (Non Recti-thermal)

1) Set up and connect the meter to perform a normal single element verification test (all meter voltage circuits energized with one meter current circuit energized).

2) Energize the meter and ensure that the demand pointer moves upscale.

3) Switch the test console off and connect the voltage input to only one meter voltage circuit.

4) Disconnect the current input from the meter current circuit under test. Connect the current input to the other meter current circuit(s) (those which are not associated with the voltage circuit being examined).

5) Energize the meter and determine if the demand pointer moves upscale or downscale.

6) Repeat steps 3) to 5) for each remaining meter voltage circuit.

7) If the demand pointer moves noticeably upscale during step 5), the meter does not comply with the specified requirements. If the demand pointer moves noticeably downscale during step 5), the meter does comply with the specified requirements.

6.8.3.4 Electronic Meters - with high resolution register display

1) Set up and connect the meter to perform a single element verification test, connecting only the meter voltage circuit that powers the meter electronics, and only the meter current circuit associated with that voltage circuit.

2) Energize the meter and ensure that the meter is registering. If no registration, the meter does not comply.

3) Switch the test console off and connect the voltage input to only one meter voltage circuit.

4) Disconnect the current input from the meter current circuit under test. Connect the current input to the other meter current circuit(s) (those which are not associated with the voltage circuit being examined).

5) Energize the meter and determine if there is any registration. Switch the test console off. No further testing required for a two-element or two and a half-element meter.

6) For a three-element meter, connect two meter voltage circuits, and only the meter current circuit that is associated with the non-energized voltage circuit.

7) Energize the meter and determine if there is any registration. Switch the test console off.

8) Repeat steps 6) and 7) switching the non-energized voltage circuit with the remaining voltage circuit, disconnect the previously connected current circuit, and connect the current circuit that is associated with the non-energized voltage circuit.

9) If any registration occurs during step 5) or 7), the meter does not comply with the specified requirements.

6.8.3.5 Remarks

For any remaining circuit combinations that could not be tested above, the coil association will be inherently proved by process of elimination through those tests which were performed, and the results obtained during the metrological tests for individual elements.

6.9 Pulse Initiators

6.9.1 Scope

This procedure relates to section 6.5.2 of the Specifications. It is intended to ensure that the pulse initiators of a meter conform to the performance requirements of the Specification, as configured and marked on the meter.

6.9.2 General

1) All approved pulse initiators representing legal units of measurement under the Act are required to be verified. Verification of the pulse initiators may require complete accuracy verification testing to specified tolerances, or a general functionality testing to confirm the correct operation and pulse values. Pulse initiators which are used as the fundamental means for establishing time-related demand shall be verified for accuracy to a tolerance of ±1.0% with a resolution of 0.1%. Pulse initiators used as part of a telemetering system to transmit electricity measurement information from a source meter to a remote location are not subject to verification and sealing if it only duplicates the legal units of measure established and recorded in the source meter (See policy Bulletin GEN 33, Conditional Permission for using Electricity and Gas Telemetering Devices and Systems in Service without Verification and Sealing).

2) The extent of testing required to verify the pulse initiator is defined as follows:

a) Any pulse initiator which represents a metrological function that is not verified by other means, such as an accuracy test of the functions register, shall be verified at all applicable energy meter test points using the applicable tolerances for energy functions, as specified in section 7 (Metrological Requirements) of the Specifications. Example: a meter with a VAh pulse output but no VAh register available - the VAh pulse initiator shall be tested at all applicable test points; the testing of the pulse initiators may be performed following the procedure below to a resolution of 0.1%.

b) Where a Notice of Approval states that a meter contains pulse initiators which generate pulses from sources that are independent of the circuitry that provides registration for the same energy function, the pulse initiators shall be verified by performing a complete accuracy verification test.

6.9.3 Procedure

Perform the following steps to verify pulse initiators:

NOTE: This test can be performed during the dial test or demand tests where applicable to improve efficiency.

1) Connect the pulse counter to the meter's KY or KYZ terminals as applicable.

2) Ensure that the meter pulse outputs are working and enabled before testing begins. Reset the meter energy register to zero.

3) Using the pulse constant (K_T), of the meter, calculate the minimum amount of energy required to produce adequate number of pulses to provide the resolution required, (minimum 1000 pulses).

4) Start the pulse test by applying the rated voltage and gradually increase the current to a magnitude sufficient to expedite the test, but not exceeding the maximum current rating of the meter.

5) While this test is in progress, conduct a verification test to determine the error of the meter at this applied voltage and current.

6) Upon conclusion of the test, (minimum 1000 pulses), record the actual number of pulses counted. Record the energy measured and displayed by the meter.

7) Calculate the energy that is represented by the number of pulses generated by the meter. Multiply the number of pulses by the meter pulse constant (K_T).

8) Subtract the result recorded in step 6) from that calculated in step 7), then divide that result by the result recorded in step 7), then multiply by 100, [(R-T) / T × 100%]. This is the pulse initiator error (%) in relation to the meter error (%).

10) Subtract the meter error, as determined in step 5), from the result obtained in step 8). This is the true error of the pulse initiators expressed in percentage.

6.10 Pulse Recorder

6.10.1 Scope

This procedure relates to section 6.5.3 of the Specifications. It is intended to ensure that the pulse recorders conform to the performance requirements of the Specifications.

6.10.2 General

All approved pulse recorders shall be verified to ensure that input channels recording pulses representative of legal units of measurement under the Act accurately record those values. Verification of the recorders require testing to confirm each approved input channel will correctly record a minimum of 100 pulses or to a resolution of ± 2 pulses. Recorders intended for use in determining demand shall have the demand interval verified as well subject to the requirements of section 6.6.5 of the Specification. Pulse recorders which convert pulses to energy values are also subject to the multi-register metering requirements of section 6.6.2 of the Specifications.

6.10.3 Procedure

1) Connect a pulse generator to all pulse input channels of the meter as applicable.

2) Set the generator pulse rate to a value less than the maximum capacity rating of the recorder.

3) Ensure that the recorder is initialized and that each channel is enabled and working before testing begins.

4) Start the pulse generator at a determined time interval and pulse a minimum of 100 pulses into each input channel.

5) Upon conclusion of the test, record the actual number of pulses recorded by each channel and compare that to the pulses generated. The pulses recorded are to be within ±2 pulses.

6) Recorders intended for use in determining legal units of measure for demand shall have the demand interval verified as in accordance with demand interval verification requirements of section 6.6.5 of the Specifications.

7) Recorders which convert pulses to energy values are required to be verified as per the requirements of multi-register metering of section 6.6.2 of the Specifications.

6.11 Reverse Operation

6.11.1 Scope

This procedure relates to section 6.5.4 of the Specifications. It is intended to ensure the meters intended for use in a bi-directional environment meet the requirements of the Specifications.

6.11.2 General

Meters intended to be used where a reverse energy flow may be present shall function in such a manner as to indicate which direction the energy is flowing. Meters equipped with pulse outputs, shall have suitable detents to ensure the output pulses are not derived from the aggregate energy measured in both directions.

6.11.3 Procedure

6.11.3.1
Examine meters intended for bi-directional or reverse energy flow to ensure that the flow direction indicator correctly indicates the direction of flow.

1) Connect the input current to the meter in the normal manner, such that the meter measures in the forward direction. Record the resulting indicated direction of flow.

2) De-energize the test console, and reverse the polarity of the current connections to the meter so the current delivered to the meter is now reversed.

3) Energize the test console and record the resulting indicated direction of flow.

4) Any meter in which the flow direction indicator does not correctly indicate the correct direction of energy flow does not meet the specified requirements.

6.11.3.2
Examine meters equipped with pulse initiators to ensure that the detents prevent pulses from being output when the meter is subject to a load in the reverse direction.

1) This test should be performed after the verification tests are completed for each of the pulse initiators.

2) De-energize the test console, and reverse the polarity of the current connections to the meter so the current delivered to the meter is now reversed. Reset the pulse counters.

3) Energize the test console, ensure that the flow direction indicator is now reversed and continue the test for a period of time such that multiple pulses would be generated if the meter was operating in the appropriate direction.

4) Repeat steps 2) and 3) for all pulse initiators as necessary.

5) Where any pulses are generated during the performance of step 3), the meter does not meet the specified requirements.

6.11.3.3
For meters equipped with detent type registers, examine each register to ensure that there is no change in the register reading if the meter is connected to a load in the reverse direction.

1) This test should be performed after the verification tests are completed for each of the pulse initiators.

2) Record the register readings, or set the registers to read zero.

3) Reverse the polarity of the current connections to the meter so the current delivered to the meter is now reversed.

4) Energize the test console, ensure that the current flow is now reversed, and continue the test for a period of time such that an amount of energy would be displayed if the meter was operating in the appropriate direction.

5) Repeat steps 2) through 4) for all detent type registers.

6) Where any register(s) readings change during the performance of step 4), the meter does not meet the specified requirements.

6.11.4 Remarks

On some mechanical meters there exists some slack prior to the engagement of the detent. The slight reverse rotation of the disc may cause the pulse initiator to provide one pulse. The pulse initiator is considered acceptable should no further pulses be recorded once the detent is engaged.

6.12 Verification of Advanced Meter Functions

6.12.1 Scope

This procedure relates to section 6.6 of the Specifications. It is intended to ensure that meters equipped with advanced functions are inspected in a manner that will confirm the correct operation of the function.

6.12.2 General

Advanced meter functions are features in electronic meters which process measured data to provide additional information which can be used for the purpose of establishing a charge for electricity. There may be a number of factors used in advanced meter functions that are programmable or fixed within the meter's firmware. The advanced functions are evaluated at the time of meter approval, and do not require comprehensive dynamic testing at the time of verification. Verification of these functions may typically be accomplished through a thorough examination of the meter's configuration file or interrogation of the meter's display. Verification for these advanced functions ensures that the meter programming is consistent with nameplate markings and values of the meter quantities indicated. It is important that the meter verifier, who is performing the verification of meters with these advanced functions, be assured that each of the advanced functions programmed into the meter is performing accurately.

6.12.3 Procedures

6.12.3.1 General

NOTE: A number of advanced meter functions may be verified through a standard procedure by using one or more of the following methods:

1) Examine the program in the meter by following the meter manufacturer's documentation and operational procedures, to ascertain the quantity or function under examination. The examination may require the use of software or push-buttons. Where the quantity or function under examination is programmed into one of the meter's display sequences, record the value or setting.

2) Perform a dynamic verification test of suitable type and duration to the required level of accuracy.

3) Perform testing or evaluation of the meter using other means approved by MC which the meter verifier has demonstrated to provide adequate assessment capacity for the quantity or function under examination.

6.12.3.2 Meter Programming

6.12.3.2.1
The following steps are not required upon reverification if the meter has not been reprogrammed and the meter seal has not been broken or damaged.

6.12.3.2.2
Examine the meter to ensure that it is programmed or configured as requested by the meter owner, that the programmed functions and values match meter nameplate information, and that the meter meets the requirements as stated in the applicable Notice of Approval in its final programmed configuration. This examination shall be completed at the end of the verification process since some functions or programmable values may be changed during verification to expedite the process.

Procedure:

1) Ensure that the meter configuration indicated in the display matches the nameplate configuration.

2) Ensure that all billing functions desired by the utility or the manufacturer are present.

3) Ensure each item displayed has either an annunciator indicated, or a code that determines what quantity or function the item represents.

6.12.3.3 Multi-register Meter Functions

1) Verify the multi-register meter functions by using one of the methods listed in section 6.12.3.1 (General).

2) Where verification of the multi-register meter functions is performed through dynamic inspection. Apply a load to the meter to operate each applicable individual register. Examine that the meter is functioning appropriately and ensure accumulation of energy is applied to each individual register.

6.12.3.4 Prepayment Meters

1) Verify the prepayment meter function by using one of the methods listed in section 6.12.3.1 (General).

2) Where verification of the prepayment function is performed through dynamic inspection. Apply a load to the meter by operating the applicable prepayment mechanism. Examine that the meter is functioning appropriately and ensure the correct accumulation of energy to the applicable payment.

6.12.3.5 Multiplier

1) Verify the meter multiplier by using one of the methods listed in section 6.12.3.1 (General).

2) Where verification of the multiplier is performed through dynamic inspection, examination of the programmed multiplier can be completed during a demand test and an energy accumulation test and verify that the energy registration provided on the meter register at the completion of the test interval is within ± 1.0%.

6.12.3.6 Demand Interval

1) Verify the demand interval by using one of the methods listed in section 6.12.3.1 (General).

2) Where verification of the demand interval is performed through dynamic inspection, this examination can be completed by timing the interval (and sub-intervals) during the demand test of 7.3.3.2.2.2 of this procedure.

3) Meters equipped with more than one demand interval, either for different demand quantities or multiple demand input channels such as used for mass memory, shall have each interval assessed using one of the method listed in section 6.12.3.1 (General).

6.12.3.7 Demand Type

1) Demand Type refers to the calculation method for which a meter is programmed to measure demand. Demand types include integrating (block/rolling block) or lagged (exponential) demand.

2) Verify the demand type by using one of the methods listed in section 6.12.3.1 (General).

3) Where verification of the demand type is performed through dynamic inspection, this examination can be completed by monitoring the rate of the demand accumulation during the demand test of 7.3.3.2.2 of this procedure.

6.12.3.8 Pulse Constants

1) Examine the pulse constants (K_T), for each set of pulse outputs (e.g. KYZ) available on the meter to ensure correctness of the programmed value.

2) Where a single programmed parameter determines the pulse constant for all pulse outputs, then only one verification test is required.

3) Verify the pulse constant by using one of the methods listed in section 6.12.3.1 (General).

4) Where verification of the pulse outputs is performed through dynamic inspection, this examination can be completed during the verification testing specified under section 6.9 of this procedure.

6.12.3.9 Pulse Output Detent

1) Examine the detent of each pulse output for meters equipped with more than one pulse output and which have detents that are separately programmable.

2) Where a single programmed parameter determines the detent for all pulse outputs, then only one verification test is required.

3) Verify the pulse detent by using one of the methods listed in section 6.12.3.1 (General).

4) Where choosing to verify the pulse output detent through step 3) of section 6.12.3.1, perform the procedure as outlined in section 6.11.3.2.

6.12.3.10 Loss Compensation

1) Examine meters equipped with loss compensation to ensure that the loss compensation factor(s) programmed in the meter are applied correctly.

2) Verify the application of the loss compensation factors by using one of the methods listed in section 6.12.3.1 (General).

3) Here verification of loss compensation is performed through dynamic inspection, this examination can be completed by applying the load that corresponds to the base conditions for the applicable compensation factor (e.g. 1.8% compensation at base conditions of 120 volts, 5 amps 100% PF). Perform the standard metrological accuracy test as applicable for any register to which loss compensation factors are applied. The duration of this test shall be sufficient to determine that the factor is correct to a resolution of 0.1%.

4) Record the registration as measured and displayed by the meter, (compensated).

5) Record the registration displayed by the calibration console or certified standard (uncompensated). This is the “registered value”.

6) Multiply the compensation factor by the result obtained in step 4). Subtract this value from the result obtained in step 5). This is the “true value”.

7) Using the formula for error determination, (section 5.4 of Procedures), calculate the compensated meter error.

6.13 Firmware Verification

6.13.1 Scope

This procedure relates to section 6.7 of the Specifications. It is intended to ensure that the meter is programmed with an approved firmware version.

6.13.2 General

Many electronic meters are programmed through use of a specific firmware. Since metrological functions and parameters are determined through the specific firmware, each version of firmware used in a meter shall be approved. Only approved firmware versions or revisions may be used to program a meter which is intended to be used to determine the basis for a charge.

6.13.3 Procedure

1) Determine the meter firmware version by accessing the meter display sequence in which the version number is located. The examination may require the use of software or push-buttons.

2) Where the version number is not available in the meter display sequence or internal register, it shall be marked on the meter's processor chip. Access the processor chip to determine the firmware version.

3) Review the applicable Notice of Approval for the meter type and verify that the firmware version of the meter under test is listed as approved.

7.0 Procedures for Assessing Metrological Requirements

7.1 General

1) These procedures for the Metrological Requirements shall be used in conjunction with the requirements, test points and tolerances found in section 7.0 of the "*Specifications for the Verification and Reverification of Electricity Meters", S-E-02*.

2) Although the procedures, test points and tolerances which are provided in the Specifications are sufficient for evaluating most meter types, MC may establish additional test points and tolerances as may be required for a specific meter type.

3) Unless otherwise noted all testing should be performed in order to establish meter errors in terms of %true error. The procedure for error determination is provided in section 5.5.4 of this procedure.

4) Meters should be fully assembled and calibrated before undergoing verification or reverification tests. Removal of the meter cover or access to sealable components, or reprogramming during the verification process is permitted only when test procedures used have been issued or accepted by MC. It is not permitted to adjust or re-calibrate meters once testing has begun. However, where permitted, certain programable parameters may be modified for the case of some electronic meters which require programming for efficient or effective meter testing.

5) All errors determined by the verification accuracy tests specified in the Specifications shall be determined to a resolution of 0.1% unless otherwise stated.

6) When verifying or reverifying thermal responding demand meters, the demand errors shall be determined after the test load has been applied for three full demand response periods.

7.2 Reference Conditions for Metrological Requirements

Ensure that all of the required reference conditions specified in section 7.2 of the Specifications are met.

7.3 Performance Requirements

7.3.1 General

Unless otherwise stated, each function of an electricity meter shall comply with the requirements set out in section 7.3, as applicable.

7.3.1.1 General Setup

1) Although every meter type will require some unique and specific meter test setups, this section provides information that is applicable to most types of meters.

2) Unless otherwise stated, a calibration console certified to MC requirements for the *Calibration, Certification and Use of Electricity Calibration Consoles* (S-E-01) is required for all tests specified herein. The console should be equipped with the applicable reference meter.

3) Ensure that the calibration console is operated in accordance with established operating procedures and manuals when performing meter verification tests.

4) Ensure the following as applicable:

a) any test links should be opened or closed as required.

b) all voltage and current connections should be correct and in accordance with the test console operating manual.

c) the calibration console should be set to provide the required test load.

d) all ancillary components to the console including light, or disk pickups, gating devices, software etc., should be set up and operating correctly.

7.3.2 Electromechanical Meters

7.3.2.1 Zero Load Performance

This procedure is intended to verify that an electromechanical energy meter will not register energy when voltage is applied without the presence of current.

7.3.2.1.1 Setup

1) The general meter setup found in section 7.3.1.1 above may be followed for the initial meter setup.

2) Set the console to apply the rated voltage (as specified on the meter nameplate) to the voltage circuit(s) of the meter.

3) On calibration consoles equipped with a creep test switch, activate the switch such that the current circuits of the meter are de-energised. For the case of calibration consoles which are not equipped with a creep switch disconnect the meter current circuits from the console. Ensure that the console current circuits are shorted if required for proper and safe operation.

7.3.2.1.2 Procedure

1) Energise the voltage circuits of the meter and monitor the disk.

2) The length of the test is determined from the following criteria:

a) If the disk is stopped the test may be terminated and the meter will be deemed to have met the criteria of 7.3.2.1 of the specification.

b) If the disk is moving it shall be monitored for up to ten minutes. If the disk stops moving before ten minutes, the test may be terminated and the meter will be deemed to have met the criteria of 7.3.2.1 of the specification.

7.3.2.1.3 Acceptance Criteria

The acceptance criteria for zero load performance is found in section 7.3.2.1 of the Specifications.

7.3.2.2 Comparative Registration (Dial Test)

This procedure relates to section 7.3.2.2 of the Specifications. The purpose of this test is ensure that there is a direct and correct engagement between the register, the gear train, and the rotating disk on an electromechanical meter.

7.3.2.2.1 General

The comparative registration test for electromechanical meters is performed by applying a load to the meter and verifying that the energy registration provided on the meter register at the completion of the test interval is within the specified tolerance.

7.3.2.2.2 Setup

1) The general meter setup procedure section 7.3.1.1 may be followed for the initial meter setup.

2) Set the calibration console to supply a test load at unity power factor.

3) Set the test voltage at the rated nameplate voltage for the meter under test.

4) Set the test current to the highest possible current available on the test console without exceeding the maximum current rating for the meter under test.

7.3.2.2.3 Procedure

1) Record the meter register reading including the test dial position. If possible ensure that the pointer of the test dial or the first dial (least significant dial, where no test dial is present) will rotate in the upward direction when energised.

2) Record the reference meter reading.

3) Determine the energy equivalent to that required to complete one revolution of the test dial or the first dial for the case where no test dial is present.

4) Energise the meter and monitor the reference meter until it has registered energy equivalent to that determined in 3) above.

5) De-energise the console at the time when the reference meter has registered the energy determined in 3) above.

6) Observe the position of the test dial or the first dial where no test dial is present.

7) Compare the final registration and position of the test dial with the initial registration and position of the test dial.

7.3.2.2.4 Acceptance Criteria

The acceptable tolerance for the register test is found in section 7.3.2.2 of the Specifications.

7.3.2.2.5 Remarks

1) If the comparison made in step 7) of 7.3.2.2.3 above shows the test dial final position is within one third division of its initial position, and the next dial has moved one division on its scale, the meter shall be deemed to have passed this test.

2) While the meter is energised it is beneficial to monitor the rotation of the register dials to ensure that their relative movements are in accord with the applied test load. If it is seen that a dial is moving substantially out of its expected alignment additional care should be taken to ensure that the registration is in fact correct.

7.3.2.3 Electromechanical Energy Meters, General

7.3.2.3.1 Single Phase 1 and 1½ Element Energy Meters

This procedure relates to section 7.3.2.3.1 of the Specifications. The purpose of this procedure is to ensure that Single Phase 1 and 1½ Element Energy Meters are evaluated using the tests points and tolerances identified in Table 7.1

7.3.2.3.1.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Set the calibration console to supply a test load as determined from the applicable data in Table 7.1 of the Specifications.

7.3.2.3.1.2 Procedure

1) Verification of electromechanical meters is most easily accomplished by monitoring the revolutions of the meter disk.

2) Follow the procedure established for the console being used to test the meter and ensure that meter disk revolutions are counted correctly.

3) Errors for meters can be determined manually for consoles which do not provide meter errors automatically. Refer to documentation on the console and its reference meter information, in order to determine the method for calculating meter errors manually.

4) Record meter errors.

5) Repeat the tests for each applicable test point found in Table 7.1 of the Specifications.

7.3.2.3.1.3 Acceptance Criteria

The acceptable tolerance for the energy test recorded in step 4) of section 7.3.2.3.1.2 above is found in section 7.3.2.3.1 of the Specifications.

7.3.2.3.2 Polyphase 2½ element Wye Energy Meters

This procedure relates to section 7.3.2.3.2 of the Specifications. The purpose of this procedure is to ensure that Polyphase 2½ element Wye Energy Meters are evaluated using the tests points and tolerances identified in table 7.2 of the Specifications.

7.3.2.3.2.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

NOTE: For the case of Varh and Qh meters, which have been designed to be tested using a watt hour standard, alternate connections or phasing transformers may be required. As an example, Varhour meters which operate on the cross phase principle (e.g. VA-63, KYR FMFR) shall be tested as watthour meters. See manufacturer's documentation and/or applicable approval notices.

2) Set the calibration console to supply a test load as determined from the applicable data in Table 7.2 of the Specifications.

7.3.2.3.2.2 Procedure

1) Verification of electromechanical meters is most easily accomplished by monitoring the revolutions of the meter disk.

2) Follow the procedure established for the console being used to test the meter and ensure that meter disk revolutions are counted correctly.

3) Errors for meters can be determined manually for consoles which do not provide meter errors automatically. Refer to documentation on the console and its reference meter information, in order to determine the method for calculating meter errors manually.

4) Record meter errors.

5) Repeat the tests for each applicable test point found in Table 7.2 of the Specifications.

7.3.2.3.2.3 Acceptance Criteria

The acceptable tolerance for the energy test recorded in step 4) of section 7.3.2.3.2.2 above is found in section 7.3.2.3.2 of the Specifications.

7.3.2.3.3 Polyphase 2 Element,2½ element Delta and 3 Element Energy Meters

This procedure relates to section 7.3.2.3.3 of the Specifications. The purpose of this procedure is to ensure that Polyphase 2 Element, 2½ element Delta and 3 Element Energy Meters are evaluated using the tests points and tolerances identified in Table 7.3 of the Specifications.

7.3.2.3.3.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

NOTE 1: For the case of Varh and Qh meters, which have been designed to be tested using a watt hour standard, alternate connections or phasing transformers may be required As an example, Varhour meters which operate on the cross phase principle (e.g. VA-63, KYR FMFR) shall be tested as watthour meters. See manufacturer's documentation and/or applicable approval notices.

NOTE 2: The 2-wire element and the 3-wire element (in series) of a 2½ Element Delta meter, shall be subject to all individual element tests.

NOTE 3: The individual tests for each element shall be conducted at the rated voltage of the respective potential coil. The series tests for a 3 element 4-wire meter shall be conducted using the lowest rated potential coil.

2) Set the calibration console to supply a test load as determined from the applicable data in Table 7.3 of the Specifications.

7.3.2.3.3.2 Procedure

1) Verification of electromechanical meters is most easily accomplished by monitoring the revolutions of the meter disk.

2) Follow the procedure established for the console being used to test the meter and ensure that meter disk revolutions are counted correctly.

3) Errors for meters can be determined manually for consoles which do not provide meter errors automatically. Refer to documentation on the console and its reference meter information, in order to determine the method for calculating meter errors manually.

4) Record meter errors.

5) Repeat the tests for each applicable test point found in Table 7.3 of the Specifications.

7.3.2.3.3.3 Acceptance Criteria

The acceptable tolerance for the energy test recorded in step 4) of section 7.3.2.3.3.2 above is found in section 7.3.2.3.3 of the Specifications.

7.3.2.3.4 Electromechanical Bi-directional Energy Meters

This procedure relates to section 7.3.2.3.4 of the Specifications. This procedure is intended to verify that approved Electromechanical Bi-directional Energy Meter will register energy in each direction of energy flow.

7.3.2.3.4.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Set the calibration console to supply a test load as determined from the applicable data in Tables 7.1, 7.2 or 7.3 of the Specifications, as applicable.

7.3.2.3.4.2 Procedure

1) Verification of electromechanical meters is most easily accomplished by monitoring the revolutions of the meter disk.

2) Follow the procedure established for the console being used to test the meter and ensure that meter disk revolutions are counted correctly.

3) Errors for meters can be determined manually for consoles which do not provide meter errors automatically. Refer to documentation on the console and its reference meter information, in order to determine the method for calculating meter errors manually.

4) Record meter errors.

5) Repeat the tests for each applicable test point found in Table 7.1, 7.2 or 7.3 of the Specifications, as applicable.

6) Reverse the direction of the energy flow and repeat step 1) to 5).

7.3.2.3.4.3 Acceptance Criteria

The acceptable tolerance for the energy test recorded in step 4) of section 7.3.2.3.4.2 above is found in sections 7.3.2.3.1, 7.3.2.3.2 or 7.3.2.3.3 of the Specifications, as applicable.

7.3.2.4 Electromechanical Demand Meters

7.3.2.4.1 General

This procedure relates to section 7.3.2.4 of the Specifications. This procedure is applicable to electromechanical thermal demand meters.

7.3.2.4.1.1 Hysteresis Test (grease memory)

The purpose of this test is to ensure that the driven pointer on an electromechanical thermal demand meter maintains free movement such that when the driven pointer is no longer engaged with the driving pointer the driven pointer maintains its position. This test may be conducted after any other thermal demand test has been performed so that the driven pointer is resting upscale.

7.3.2.4.1.2 Procedure

1) Use the demand reset mechanism to move the driven pointer a minimum of two (2) major scale divisions down to a cardinal division mark on the scale. Hold this position for a maximum of three (3) seconds.

2) Note the scale marking that the driven pointer is being held to.

3) Return the demand resetting mechanism to the non-active (full scale) position.

4) Monitor any movement of the driven pointer and note the final position of rest.

7.3.2.4.1.3 Acceptance Criteria

The maximum permissible movement of the driven pointer observed in step 4) of 7.3.2.4.1.2 above, is found in section 7.3.2.4.1 (1) of the Specifications.

7.3.2.4.1.4 Pull-back Test

The purpose of this procedure is to assess the ability of an electromechanical thermal demand meter to maintain the demand reading provided by the driven pointer after the load has been removed.

7.3.2.4.1.5 Procedure

1) This test can be conducted at the end of a performance test where a load has already been applied to the meter.

2) Record the demand reading provided by the driven pointer of the meter while the load applied to the meter.

3) Remove the applied load to the meter.

4) Record the demand reading provided by the driven pointer of the meter after the driving pointer has disengaged from the driven pointer.

7.3.2.4.1.6 Acceptance Criteria

The reading recorded in step 4) of 7.3.2.4.1.5 above, should be the same as the reading recorded in step 2) of 7.3.2.4.1.5. The acceptable limits of movement of the driven pointer moved down scale is provide in section 7.3.2.4.1 (2) of the Specifications.

7.3.2.4.1.7 Zero Load Registration

The purpose of this test is to ensure that after an applied load has been removed and the meter has reached thermal stability, a thermal demand meter shall maintains a zero load reading.

7.3.2.4.1.8 Procedure

1) Remove any applied load to the meter.

2) Allow the meter to cool down for a minimum of three response periods. Certain meter types may require additional time. Refer to appropriate reference material (Notice of Approval, manufacturers literature, etc) as necessary, for a given meter type to determine if any additional time is required.

3) Record the position of the driving pointer once the meter has reached thermal stability.

7.3.2.4.1.9 Acceptance Criteria

The position of the driving pointer as observed in step 3) of 7.3.2.4.1.8 above, should be at the zero mark on the scale within the tolerance specified in section 7.3.2.4.1 (3) of the Specifications.

7.3.2.4.1.10 Determination of thermal demand errors

For the purpose of evaluating thermal demand, readings of the driven pointer shall be taken only after the driving pointer has disengaged.

7.3.2.4.2 Performance Testing - Electromechanical 1 and 1½ Element Thermal Demand Meters

This procedure relates to section 7.3.2.4.2 of the Specifications. This procedure is intended to evaluate the accuracies of electromechanical 1 and 1½ element thermal demand meters.

7.3.2.4.2.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Set the calibration console to supply a test load as determined from the applicable data in Tables 7.4 of the Specifications.

7.3.2.4.2.2 Procedure

1) Apply the test load as determined in step 2) of 7.3.2.4.2.1 above, for three response periods.

2) Remove the applied load and record the reading provided by the driven pointer.

3) Reset the meter.

4) Repeat steps 1), 2) & 3) above for each applicable test point as determined from table 7.4 of the Specifications.

7.3.2.4.2.3 Acceptance Criteria

The readings recorded in step 2) of 7.3.2.4.2.2 above, shall not exceed the applicable tolerances specified in table 7.4 of the Specifications.

7.3.2.4.3 Performance Testing - Electromechanical 2, 2½ and 3 Element Thermal Demand Meters

This procedure relates to section 7.3.2.4.3 of the Specifications. This procedure is intended to evaluate the accuracies of electromechanical 2, 2½ and 3 element electromechanical thermal demand meters.

7.3.2.4.3.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Set the calibration console to supply a test load as determined from the applicable data in Tables 7.5 of the Specifications.

7.3.2.4.3.2 Procedure

1) Apply the test load as determined in step 2) of 7.3.2.4.3.1 above, for three response periods.

2) Remove the applied load and record the reading provided by the driven pointer.

3) Reset the meter.

4) Repeat steps 1), 2) & 3) above for each applicable test point as determined from table 7.5 of the Specifications.

7.3.2.4.3.3 Acceptance Criteria

The readings recorded in step 2) of 7.3.2.4.3.2 above, shall not exceed the applicable tolerances specified in table 7.5 of the Specifications.

7.3.2.4.4 Electromechanical Integrating Demand Meters

The procedure relates to section 7.3.2.4.4 of the Specifications. This procedure is intended to evaluate demand meters which are equipped with a demand indicator that is driven by the rotating disk of an integrating (energy) meter.

7.3.2.4.4.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Set the calibration console to supply a test load such that the demand meter will indicate 66% of the full scale value provided by the demand register of the meter under test.

7.3.2.4.4.2 Procedure

1) Energise the meter for two full demand intervals.

2) Remove the applied load.

3) Record the demand indication on the meter.

7.3.2.4.4.3 Acceptance Criteria

The readings recorded in step 3) of 7.3.2.4.4.2 above, shall not exceed the applicable tolerances specified in section 7.3.2.4.4 of the Specifications.

7.3.2.4.5 Accuracy of the Demand Interval

The procedure relates to section 7.3.2.4.5 of the Specifications. This procedure is intended to verify that the demand interval for block interval demand meters is within prescribed limits of tolerance.

7.3.2.4.5.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) A stopwatch is required for the procedure.

3) Set the calibration console to supply any convenient test load which will allow a demand registration of at least 35% full scale.

7.3.2.4.5.2 Procedure

1) Apply the test load.

2) Reset the demand.

3) Monitor the demand interval timing mechanism on the meter under test. When the demand interval timing mechanism engages for a demand interval, start the stopwatch.

4) Continue to monitor the demand interval timing mechanism on the meter under test. When the demand interval mechanism disengages, stop the stopwatch.

5) Record the reading provided by the stopwatch.

7.3.2.4.5.3 Acceptance Criteria

The reading recorded in step 5) of 7.3.2.4.5.2 above, should be with the tolerance specified in section 7.3.2.4.5 of the Specifications.

7.3.3 Procedures for Assessing Performance Requirements for Electronic Meters

7.3.3.1 Zero Load Performance

This procedure relates to section 7.3.3.1 of the Specifications. It is intended to verify that an electronic energy meter will not register energy when voltage is applied without the presence of current.

7.3.3.1.1
Assessment of electronic meters for zero load performance may be accomplished in a number of ways, three of which are described in these procedures. The fourth is a provision to allow a meter verifier to establish a procedure which upon approval by MC may also be used for assessing zero load performance. The decision to use a specific one of the three procedures below, should be based on testing efficiency and an ability of the given meter to provide resolution of registration to the degree necessary to ascertain any zero load registration.

7.3.3.1.2
The three procedures which are presented assess zero load performance by monitoring either demand registration, pulse output, or energy registration. The period of time that the respective test is conducted is based on the time necessary for the meter to register the energy given by a load of 0.05% I_{max} at the meter's rated voltage the test conditions described in 7.3.3.1.3 to 7.3.3.1.7 below.

7.3.3.1.3 Zero Load Performance Using the Demand Test Method

This test method entails using the demand function to determine if a meter registers demand under zero load conditions. This procedure is applicable to meters which are capable of providing registration to a resolution which would be sufficient to display a demand load of 0.05% I_{max} at the rated meter voltage and unity power factor. Meters that are incapable of registering demand at this load cannot be assessed for zero load performance using this procedure.

7.3.3.1.3.1 Setup

1) The basic setup for evaluating the demand function may be applied for this function.

2) Set the console voltage circuits to provide the rated voltage for the meter under test.

7.3.3.1.3.2 Procedure

1) Set the meter to operate in test mode if applicable.

2) Energise the voltage circuits of the meter at the rated nameplate voltage. Do not apply current to the meter.

3) If the calibration console is equipped with a creep switch, activate it.

4) Record any registration after a minimum of three response periods.

7.3.3.1.3.3 Acceptance Criteria

No registration is permitted as specified in section 7.3.3.1.2 of the Specifications.

7.3.3.1.3.4 Zero Load Performance Using the Pulse output or Disk Revolution Simulator Test Method

This procedure involves monitoring the pulse output or LED output (or similar disk revolution simulator outputs) for a period equivalent to the amount of time required for the meter to generate one pulse at load of 0.05 % I_{max} at the rated meter voltage at unity power factor. This procedure is most convenient and recommended for those meters which have a programmable pulse output such that the pulse weight may be set to a value which will allow registration of the theoretical load within an acceptable time frame.

7.3.3.1.3.5 Setup

1) The basic setup for evaluating energy functions may be applied for this function.

2) Set the console voltage circuits to provide the rated voltage for the meter under test.

7.3.3.1.3.6 Procedure

1) Energise the voltage circuits of the meter at the rated nameplate voltage. Do not apply current to the meter.

2) If the calibration console is equipped with a creep switch, activate it.

3) Monitor the meter pulse output or LED, or disk simulator output as the case may be, for a period of time equivalent to the period of time necessary for the meter to register energy via the pulse output or LED, or disk simulator output as the case may be, if the a load of 0.05% I max, rate voltage and unity power factor were applied to the meter. (See remarks section for determining the time for test).

4) Record the number of pulses observed during the test.

7.3.3.1.3.6.1 Remarks

1) The time required for monitoring pulses is influenced by the Kp, Kh, Ke, etc, as the case may be, and can be determined by using the following example.

Meter characteristics:

Voltage rating:120V (V)
Current rating: 200A (I_{max})
Pulse weight : 3 Wh/pulse (K_p)
Meter multiplier: 1
Number of elements: 2

Time required for test in minutes:

$$T_{test} = (Kp \times 100 \times 60 \times 1) / (0.05 \times I_{max} \times V \times 2)$$

$$T_{test} = (3 \times 100 \times 60 \times 1) / (0.05 \times 200 \times 120 \times 2)$$
$$= 7.5 \text{ minutes}$$

2) If no pulse outputs or LED flashes occurred during the monitoring period of step 4) of 7.3.3.1.3.6 above, the meter is deemed to have met the zero load requirements.

7.3.3.1.3.7 Zero Load Performance Using the Energy Test Method

This procedure assesses zero load performance of a meter my checking for energy registration, when no current is applied to the meter.

7.3.3.1.3.8 Setup

1) The basic setup for evaluating energy functions may be applied for this function.

2) Set the console voltage circuits to provide the rated voltage for the meter under test.

7.3.3.1.3.9 Procedure

1) Energise the voltage circuits of the meter at the rated nameplate voltage. Do not apply current to the meter.

2) If the calibration console is equipped with a creep switch, activate it.

3) Monitor the energy register of the meter either via the display or through a communications feature of the meter for a period of time equivalent to the period of time necessary for the meter to register energy if the a load of 0.05% I max, rate voltage and unity power factor were applied to the meter. (See remarks section for determining the time for test).

4) Record the energy, if any, that was registered by the meter.

7.3.3.1.3.10 Remarks

1) The time required for monitoring energy may be determined by using the following example.

Meter characteristics:

Voltage rating:120V (V)
Current rating: 10A (I_{max})
Maximum displayable energy resolution : 0.1Wh (D_{res})
Meter multiplier: 1
Number of elements: 2

Time required for test in minutes:

$T_{test} = (D_{res} \times 100 \times 60 \times 1) / (0.05 \times I_{max} \times V \times 2)$

$T_{test} = (0.1 \times 100 \times 60 \times 1) / (0.05 \times 10 \times 120 \times 2)$
$= 5.0$ minutes

2) If there is no energy recorded in step 4) of 7.3.3.1.3.9 above, the meter is deemed to have passed the zero load performance requirements.

7.3.3.2 Accuracy Requirements for Electronic Meters

This procedure relates to section 7.3.3.2 of the Specifications and applies to electronic meters meeting the criteria identified in the Specifications.

7.3.3.2.1 General - Electronic Energy Meters not Programmed with W•h Function

1) This procedure applies to all electronic meters. It is not expected that meters will be programmed without a W•h function however, electronic meters which are not programmed with the W•h function shall be tested for each programmed function at the applicable test points found in table 7.6 for the energy functions and table 7.7 for demand functions, of the Specifications.

2) Electronic meters which are programmed with the W•h function shall be tested using the test points found in table 7.8 for the energy functions and table 7.9 for the demand functions, of the Specifications, as applicable.

7.3.3.2.1.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Set the calibration console to supply a test load as determined from the applicable data in Table 7.6 of the Specifications.

7.3.3.2.1.2 Procedure - Electronic Energy Meters not Programmed with W•h Function

1) Verification of the energy function in electronic meters may be accomplished using any one of a number of different methods, depending on the test provisions of the meter. It is however assumed that the meter is equipped with a pulsing test LED, LCD, or other pulsing device. Meters which do not have such provision, will require an additional test procedure specific to the meter under test.

2) Use procedures established for the calibration console for testing meters with LED, LCD or other pulsing output.

3) Errors for meters can be determined manually for consoles which do not provide meter errors automatically. Refer to documentation on the console and its reference meter information in order to determine the method for calculating meter errors manually.

4) Record meter errors to a minimum resolution of 0.1%.

5) Repeat the tests for each applicable test point found in Table 7.6 of the Specifications.

7.3.3.2.1.3 Acceptance Criteria

The acceptable tolerance for the errors determined in step 4) of 7.3.3.2.1.2 above is provided in section 7.3.3.2.1 of the Specifications.

7.3.3.2.1.4 Electronic Demand Meters not Programmed with W•h Function

This procedure relates section 7.3.3.2.1 of the Specifications and applies to electronic meters which are not programmed with W•h function. The purpose of this procedure is to ensure that electronic meters equipped with a demand function perform accurately.

7.3.3.2.1.5 Setup

Set the calibration console to supply a test load for demand testing as determined from the applicable data in Table 7.7 specified in section 7.3.3.2.1 of the Specifications.

7.3.3.2.1.6 Procedure - Exponential Demand Meter

1) Place the meter in the test mode of operation if so equipped and approved.

2) Apply one of the test load set in 7.3.3.2.1.5 above, for three response periods.

3) Remove the applied load and record the demand reading registered by the meter.

4) Repeat steps 1) to 3) for all of the applicable demand load points specified in Table 7.7.

7.3.3.2.1.7 Procedure - Block Interval Demand Meter

1) Place the meter in the test mode of operation if so equipped and approved.

2) Apply one of the test load set in 7.3.3.2.1.5 above, for a period of at least one demand interval.

3) Remove the applied load and record the demand reading registered by the meter.

4) Repeat steps 1) to 3) for all of the applicable demand load points specified in Table 7.7.

7.3.3.2.1.8 Acceptance Criteria

The readings recorded in step 3) of 7.3.3.2.1.6 and 7.3.3.2.1.7 above shall not exceed the tolerances specified in section 7.3.3.2.1 of the Specifications.

7.3.3.2.2 General - Electronic Energy Meters Programmed with W•h Function

This procedure applies to all electronic meters which are programmed with the W•h function. Applicable test points are found in table 7.8 of the Specifications.

7.3.3.2.2.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Set the calibration console to supply a test load as determined from the applicable data in Table 7.8 of the Specifications.

7.3.3.2.2.2 Procedure - Electronic Energy Meters Programmed with W•h Function

1) Verification of the energy function in electronic meters may be accomplished a number of different ways, depending on the test provisions of the meter. It is however assumed that the meter is equipped with a pulsing test LED, LCD, or other pulsing device. Meters which do not have such provision, will require an additional test procedure specific to the meter-under-test.

2) Use procedures established for the calibration console for testing meters with LED, LCD or other pulsing output.

3) Errors for meters can be determined manually for consoles which do not provide meter errors automatically. Refer to documentation on the console and its reference meter information in order to determine the method for calculating meter errors manually.

4) Record meter errors to a minimum resolution of 0.1%.

5) Repeat the tests for each applicable test point found in Table 7.8 of the Specifications.

7.3.3.2.2.3 Acceptance Criteria

The acceptable tolerance for the errors determined in step 4) of 7.3.3.2.2.2 above is provided in section 7.3.3.2.2 of the Specifications.

7.3.3.2.3 Electronic Demand Meters Programmed with W•h Function

7.3.3.2.3.1 General

1) This procedure relates section 7.3.3.2.3 of the Specifications and applies to electronic demand meters which are programmed with the W•h function.

2) The purpose of this procedure is to ensure that electronic meters equipped with a demand function perform accurately.

3) The intent of Note (1) below Table 7.9 of the Specification is to ensure at least one demand function is tested and also to introduce provisions to exempt other demand functions which have had their equivalent energy functions already verified. As an example, a meter which has been assessed for the VA•h function and/or Var•h function, will not need the have the equivalent VA and/or Var demand function assessed unless, the VA or Var function is the only demand function programmed in the meter.

7.3.3.2.3.2 Setup

Set the calibration console to apply a Series connected load of 50% Imax as specified in section 7.3.3.2.3. As an option, a load of 25% Imax may be substituted for the series connected load, if the meter can provide demand registration to a resolution of 0.1%.

7.3.3.2.3.3 Procedure - Exponential Demand Meter

1) Place the meter in the test mode of operation if so equipped and approved.

2) Apply either test load as applicable set in 7.3.3.2.3.2 above, for three response periods.

3) Remove the applied load and record the reading registered by the meter.

7.3.3.2.3.4 Procedure - Block Interval Demand Meter

1) Place the meter in the test mode of operation if so equipped and approved.

2) Apply the test load set in 7.3.3.2.3.2 above, for a period of at least one demand interval.

3) Remove the applied load and record the reading registered by the meter.

7.3.3.2.3.5 Acceptance Criteria

The readings recorded in step 3) of 7.3.3.2.3.3 or 7.3.3.2.3.4 above shall not exceed the tolerances specified in section 7.3.3.2.3 of the Specifications.

The procedure relates to section 7.3.3.2.4 of the Specifications. This procedure is intended to evaluate electronic meters which are capable of operating at multiple voltages.

7.3.3.2.4 Meters with Multiple of Auto-ranging Voltages

7.3.3.2.4.1 General

An electronic meters which is capable of operating at multiple voltages should be assessed at one additional voltage corresponding to a standard nominal service voltage which is within the range of approved voltages for the meter.

7.3.3.2.4.2 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Set the calibration console at a nominal service voltage which falls within the range of voltages approved for the meter and has not been previously used in verification testing for this meter.

3) Set the current and power factor to values which have been used previously (i.e. 25% Imax, 0.5 Pf).

7.3.3.2.4.3 Procedure

1) Perform accuracy tests using the procedure in section 7.3.3.2.1.2, 7.3.3.2.1.6 or 7.3.3.2.1.7 for meters that are not programmed with the W•h function or in section 7.3.3.2.2.2, 7.3.3.2.3.3 or 7.3.3.2.3.4 for meters that are programmed with the W•h function, as applicable.

7.3.3.2.4.4 Acceptance criteria

The readings recorded in step 1) above shall not exceed the tolerances specified in section 7.3.3.2.2 of the Specifications.

7.3.3.2.5 Voltage Squared Hour Meters

The procedure relates to section 7.3.3.2.5 of the Specifications. It is intended for verifying voltage squared hour meters.

7.3.3.2.5.1 Setup

1) The general setup for assessing electricity meters ay be used for this procedure.

2) Set the calibration console to supply voltage at 95% of the rated voltage for the meter under test.

3) Any convenient current load setting within 2.5% I_{max} and 25%I_{max} may be used for this test.

7.3.3.2.5.2 Procedure

1) If the console is not equipped to determine meter errors automatically for the voltage square hour function, the following procedure may be used.

2) Record the voltage square hour registration for the meter under test.

3) Energise the meter under test at the load established in 7.3.3.2.5.1 above.

4) Monitor the console reference meter registration until there is sufficient registration to establish a reading on the reference meter to a resolution of 0.1%.

5) Ensure that the meter under test has registered sufficient energy to enable the second least significant digit or dial to cycle at least once.

6) De-energise the meter under test and record the meter registration.

7) Record the reference meter registration.

8) Calculate the meter error.

9) Repeat steps 2) to 8) for a voltage setting of 105% of rated meter voltage.

7.3.3.2.5.3 Acceptance Criteria

The errors determined in step 8) of 7.3.3.2.5.2 above should not exceed the tolerance specified in section 7.3.3.2.5 of the Specifications.

7.3.3.2.6 Ampere Squared Hour Meters (Where the W•h function has <u>not</u> been evaluated)

The procedure relates to section 7.3.3.2.6 of the Specifications. It is intended for verifying ampere squared hour meters that have not been evaluated for the W•h function.

7.3.3.2.6.1 Setup

1) The general setup for assessing electricity meters may be used for this procedure.

2) Set the calibration console to supply voltage the rated voltage for the meter under test.

3) Set the current load setting to 2.5% I_{max}.

7.3.3.2.6.2 Procedure

1) If the console is not equipped to determine meter errors automatically for the ampere squared hour function, the following procedure may be used.

2) Record the ampere squared hour registration for the meter under test.

3) Energise the meter under test at the load established in 7.3.3.2.6.1 above.

4) Monitor the console reference meter registration until there is sufficient registration to establish a reading on the reference meter to a resolution of 0.1%.

5) Ensure that the meter under test has registered sufficient energy to enable the second least significant digit or dial to cycle at least once.

6) De-energise the meter under test and record the meter registration.

7) Record the reference meter registration.

8) Calculate the meter error.

9) Repeat steps 2) to 8) for a current load setting of 25% I_{max}.

7.3.3.2.6.3 Acceptance Criteria

The errors determined in step 8) of 7.3.3.2.6.2 above should not exceed the tolerance specified in section 7.3.3.2.6 of the Specifications.

7.3.3.2.7 Ampere Squared Hour Meters (Where the W•h function has been evaluated)

The procedure relates to section 7.3.3.2.6 of the Specifications. It is intended for verifying ampere squared hour meters that have been evaluated for the W•h function.

7.3.3.2.7.1 Setup

1) The general setup for assessing electricity meters may be used for this procedure.

2) Set the calibration console to supply voltage the rated voltage for the meter under test.

3) Set the current load setting to at one convenient test point which is at or greater than 25% I_{max}.

7.3.3.2.7.2 Procedure

Follow steps 1) to 8) of procedure 7.3.3.2.6.2 above.

7.3.3.2.7.3 Acceptance Criteria

The errors determined in step 8) of 7.3.3.2.6.2 above should not exceed the tolerance specified in section 7.3.3.2.6 of the Specifications.

7.3.3.2.8 Electronic Demand Meter Type

This procedure relates section 7.3.3.2.7 of the Specifications. It is intended to ensure that each type of demand (exponential, block, etc.) which has been programmed in a meter is verified. This procedure applies to the demand types that have not already been verified.

7.3.3.2.8.1 Setup

1) Identify which demand type (i.e. exponential or block) function has not been verified.

2) Ensure that the meter is set up to provide registration for the demand type that has not been previously verified.

3) The general meter setup procedure may be followed for the initial meter setup.

4) Set the calibration console at a convenient demand test load selected from Table 7.9 of the Specifications.

7.3.3.2.8.2 Procedure

Perform accuracy tests using the procedure in section 7.3.3.2.1.6 or 7.3.3.2.1.7 for meters that are not programmed with the W•h function or in section 7.3.3.2.3.3 or 7.3.3.2.3.4 for meters that are programmed with the W•h function, as applicable.

7.3.3.2.8.3 Acceptance criteria

The readings recorded in the procedure above shall not exceed the tolerances specified in section 7.3.3.2.3 of the Specifications.

7.3.3.2.9 Meters Equipped with Gain Switching Circuits

This procedure relates to section 7.3.3.2.8 of the Specifications and applies to electronic meters which are equipped with gain switching circuits.

7.3.3.2.9.1 General

Certain electronic meters are designed to improve low signal response characteristics by using amplifiers to raise the level of an input signal. This allows signal processing to occur in a region of operation where the effects of quantization errors are minimal. This procedure is intended to verify the operation of any gain switching circuits. A Notice of Approval will indicate if gain switching circuits are used in any given meter.

Meters which are equipped with gain switching circuits shall be tested at one test point in each gain switching range. This may require additional test points if gain switching ranges of a meter is not evaluated using the standard test points.

7.3.3.2.9.2 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Review the Notice of Approval and determine which loads are required to evaluate the gain switching circuitry of the meter.

3) Set the calibration console to the required load.

7.3.3.2.9.3 Procedure

Perform accuracy tests using the procedure in section 7.3.3.2.1.4 for meters that are not programmed with the W•h function or in section 7.3.3.2.2.2 for meters that are programmed with the W•h function, as applicable.

7.3.3.2.9.4 Acceptance Criteria

The error(s) determined in 7.3.3.2.9.3 above should not exceed that specified in section 7.3.3.2.2 of the Specifications.

7.3.3.2.10 Electronic Bi-directional Energy Meters

This procedure relates section 7.3.3.2.9 of the Specifications and applies to electronic meters which have the capability to perform bi-directional measurement. The purpose of this procedure is to ensure that electronic bi-directional meters perform accurately in both directions. It is expected that the meter operation representing delivered energy (forward direction) has already been verified under all relevant sections of this document. This procedure applies to meter operation representing received energy (reverse direction).

7.3.3.2.10.1 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Set the calibration console to apply loads as specified in Table 7.10 of the Specifications for each received function required to be verified using the procedure below.

7.3.3.2.10.2 Procedure

Follow the procedure provided in 7.3.3.2.2.2 and verify each function approved for the reverse direction.

7.3.3.2.10.3 Remarks

The accuracy tolerances are provided in Table 7.10 of the Specifications.

7.3.4 Combination Electromechanical-Electronic Meters

This procedure relates to section 7.3.4 of the Specifications.

7.3.4.1 General

1) Certain electromechanical electricity meters include an electronic module which monitors the rotating disk and uses the count of the disk rotations to provide additional metering information. These types of meters have been referred to as hybrid meters. These types of meters are required to be verified as follows:

a) for each approved energy function provided electronically the requirements of section 7.3.2 of the Specifications apply.

b) for each approved demand function provided electronically the requirements of section 7.3.3 of the Specifications apply.

2) Certain meters have been designed such that an electronic meter and an electromechanical meter are both housed in one case. For this type of meter the electromechanical meter is verified against the requirements of section 7.3.2 of the Specifications and the electronic portion is verified against section 7.3.3 of the Specifications.

7.3.4.2 Setup

1) The general meter setup procedure may be followed for the initial meter setup.

2) Review 7.3.4.1 above and determine which requirements are applicable for the given meter.

3) Set the calibration console to the required load.

7.3.4.3 Procedure

Perform accuracy tests using the applicable procedure relevant to the meter design as determined by reviewing steps 7.3.4.1 above.