Department of Public Service

16 NYCRR Part 92 Operating Manual

March 14, 2003

1) Overview

The procedures contained in this operating manual have been established in order to provide guidance to utility and non-utility meter service providers (MSPs) in instituting practices for testing and maintaining electricity meters in order to promote a high degree of metering performance.

2) Traceability

Traceability refers to the process by which an assigned value of measurement is compared, directly or indirectly, through a series of calibrations (or comparisons) to the value established by the National Institute of Standards and Technology as the standard value.

a) Equipment Covered – All equipment used in the measurement of meter accuracy or the establishment of test conditions for the determination of meter accuracy shall be calibrated and traceable to the National Institute of Standards and Technology (NIST). This equipment includes, but is not limited to:

   i) Watt-hour Standards

   ii) VAR Hour Standards

   iii) VA Hour Standards

   iv) Voltmeters

   v) Ammeters

   vi) Power Meters

   vii) Counters or timers

b) Direct Traceability – Where possible, all measurements are to be traceable to NIST through comparison of the specific parameter being measured to a standard based on that same parameter.

   i) This precludes the use of voltage, current, and time to calibrate an energy standard. An energy standard must be traceable to NIST through comparison with other energy standards unless commercially available standards do not offer the level of precision required.

c) Path to NIST – Traceability implies that the instrument has been directly compared with a national standard or that is has been compared with other instruments that are based on an unbroken chain of comparison to a national standard.

i) Direct comparison implies that no other instruments have been used that might have degraded the accuracy of the comparison

(1) A frequency or time standard may be directly compared with the frequency of WWVB, which is a radio station run by NIST.

(2) A direct comparison offers the highest level of accuracy, since it minimizes the uncertainties induced by the inclusion of other instruments.

ii) The use of a standardizing laboratory implies that there is no direct comparison of the instrument under test to a national standard, but that intermediate instruments are used that are based on a comparison to a national standard.

(1) The manufacturer of an instrument may offer calibration services that provide traceability to NIST.

(2) There are a number of independent calibration laboratories that may also offer traceability to NIST.

(3) Generally, the more removed the final calibration is from the national standard, the greater the level of uncertainty in the final calibration.

d) Levels of Precision

i) The calibration of an instrument implies that tests have been performed to certify that the device measures the parameter on which the calibration is based to a specified accuracy.

(1) The manufacturer of the instrument provides specifications that indicate the largest error that may be introduced into a measurement by the device itself.

(2) Actual tests performed with the calibrated instrument may contain errors in excess of the instrument error due to test conditions, test methods, and associated equipment.

(3) Calibration test results providing correction factors at specific test points may be applied to a standard to allow use in applications requiring accuracy higher than the manufacturer’s specification.

(a) In applying the correction factors, care must be taken to insure that any other elements affecting registration accuracy, such as temperature,

operating conditions, and long term drift, are carefully controlled to insure that the correction factors are appropriate.

(b) Multiple tests at each test point may be required to insure that the measurement is repeatable.

(c) Application of correction factors to the calibration of standards is normally performed in a standardizing laboratory by individuals thoroughly familiar with metrology.

ii) At each point in a chain of comparisons to a national standard, the possible errors in the standard device shall be considered in determining the accuracy of the device under test.

iii) Determination of a device's compliance with published specifications implies a calibration with a standard having a higher accuracy than the device under test by a ratio of at least four to one.

iv) Where calibrations are performed with standards which cannot achieve the four to one ratio of accuracy:

(1) The standard must have higher accuracy than the device under test.

(2) The inherent accuracy of the standard must be considered in the determination of compliance with the device under test to published specifications.

(3) The calibration data and an analysis of calibration uncertainties must be submitted to staff for approval before using the instrument in revenue metering applications.

v) Total uncertainties introduced by intermediate calibrations shall not exceed the maximum uncertainty required for the calibration of the final device (in most cases an energy meter at a customer site) to required accuracy specifications.

e) Calibration Intervals

i) All traceable instruments must be calibrated at regular intervals.

ii) The interval of calibration shall not exceed the manufacturer's recommendations or one year.

iii) Standards or test boards used in the direct calibration of customer meters shall be point checked by a standard weekly. This check is not to be considered as a calibration, but rather an indication that there has not been a change in performance of the standard or test board.

f) Care of Instruments:

i) The watt-hour meter standard for alternating current meters should be free of dirt, debris or liquids that may affect its measurement capability. The environmental conditions for both storage and operations of test standards should comply with manufacturer recommendations.

ii) Each test standard should have a corrections card associated with it showing errors at the test points that the standards are being used. Whenever instruments are in use they should be in a level position free from vibration.

g) Records

i) The testing facility shall maintain records for each instrument having calibrations traceable to NIST.

ii) Calibration records must include a calibration history of the instrument, including dates of calibrations, entity performing the calibration, instruments used in the calibration, and the results of the calibration.

iii) Calibration records must be maintained continuously for two years past the last date of use of the instrument.

iv) Any repairs to the instrument must be documented and included in the calibration records.

v) Each instrument must carry a calibration sticker with the calibration date and the date that the instrument is due for calibration clearly marked.

vi) Each instrument should be accompanied with a certificate of calibration.

3) Meter Testing Facility Requirements

a) Each MSP shall maintain or have access to a certified meter test facility equipped to determine the performance of electric meters and associated equipment used for revenue metering by the issue date of the Order indicating the onset of Competitive Metering.

b) The MSP shall have access to a meter test facility within New York State and shall not impose restrictions on its use for tests which are to be witnessed by a customer or staff.

c) The meter test facility shall be equipped and maintained with test equipment to establish test conditions for electric meters and associated equipment as defined in ANSI C12.1 1995 – “Code for Electricity Metering.”

d) The meter test facility shall be managed and staffed by properly trained and competent personnel familiar with testing and maintaining electricity meters and their associated equipment as defined in ANSI C12.1 1995.

e) The use of commercial standardizing laboratories as meter test facilities shall be allowed only when such laboratories can be shown to have appropriate test equipment and staffed by personnel knowledgeable in the testing and maintenance of electricity meters and their associated equipment as defined in ANSI C12.1 1995.

f) No meter test facility or commercial standardizing laboratory is to be used for the testing of electricity meters and associated equipment used for billing purposes unless it has been certified by the staff or its designee.

g) All meter test standards and ancillary equipment and instruments used for the testing of electricity meters must be calibrated and traceable to the National Institute of Standards and Technology (NIST).

h) Meter testing facilities should be situated so that the testing equipment and standards will be sufficiently free from dampness, dust, dirt, vibration, and corrosive vapors.

i) Calibration intervals for all instrumentation used in establishing meter performance shall be determined by the manufacturer of the instrumentation but will not exceed one year in length.

j) Calibration intervals for all instrumentation used in establishing meter performance must be defined in writing and available to staff or the Commission's designee on demand.

k) Records of calibrations of all instruments used for establishing meter performance must be maintained through the life of the instrument and for at least two years after the retirement of the instrument.

4) Test Methods

This section defines the test methods that may be used in either the field, shop or laboratory.

a) Energy Meters

i) Rules for testing watt-hour meters.

(1) Multistator meters should be tested and adjusted with all current circuits connected in series, and potential circuits in parallel.

(a) They may be tested and adjusted using each stator as a single-phase meter, with all potential circuits energized.

(i) In this case, a balance test must be performed to insure appropriate registration on each stator

(ii) The final registration must be determined with all stators driven to insure that there is no interaction between stators.

(b) As an alternate method, meters may be tested with individual current and potential coils energized from independent sources that simulate the service and phase sequence that the meter will be used to monitor.

(2) Meters having multiple electromechanical rate registers, which record alternately shall be tested separately at light load for each register train.

(3) At least one test must be made at each load, and if they fail to agree with ANSI specifications, two tests shall be made up to a total of four tests until agreement within 1% is obtained on two consecutive tests.

(a) If such agreement is not obtained the meter registration shall be reported as “Indeterminate.”

(4) As-found tests of watt-hour meters shall be made with registers, pulse initiators, and any internal attachments that were used in service in place.

(5) As-left tests shall be made on meters that are to be re-installed or which are to remain in service after replacement of any internal component or adjustment.

(a) A meter on which a part or all of the electromagnetic structure is altered or replaced shall also be tested and adjusted if necessary so that its heavy load registration deviates not more than 1% at 0.5 power factor lag from its registration at 1.0 power factor.

(b) When part or all of the electromagnetic structures of a multistator meter are altered or replaced, all stators shall be adjusted (balanced) to have registrations within 1% of each other at 1.0 power factor at the heavy load test point.

(6) Meter locations should be checked for the presence of vibration and other environmental concerns at the meter location. Steps must be taken to mitigate any problem that may affect the accuracy of the meter.

(7) Meter wiring connections should be checked for correctness. When conducting a meter test, the voltage of two-wire circuits and the voltages from each line conductor to neutral on three-wire circuits should be noted. Also, the phase sequence of the meter should be noted.

(8) Gear ratios, register ratios, transformer ratios, and register constants should be checked for correctness of meter registration.

(9) Register dial pointers shall be checked for looseness and eccentricity.

(10) Current, potential, and phasing transformers shall be checked for physical and electrical damage.

ii) Determination of watt-hour meter performance.

(1) A meter shall be reported as "Not Registering" if for any reason it is found not registering at both the light load and heavy load test points, unless it is damaged.

(2) The final average percentage registration of a watt-hour meter, also known as final average accuracy, shall be determined by multiplying the average of the test results at heavy load by four, adding the average of the test results at light load and dividing the total by five:

$$\textbf{Final Average Accuracy (FAA)} = \frac{\textbf{4 HL + LL}}{\textbf{5}}$$

(3) When the error of a current or potential transformer, or a combination of such transformers, affects the final average percentage registration of a watt-hour meter by more than +/-0.5%, a correction for such error shall be applied at each test load in the determination of the final average percentage registration of the watt-hour meter.

(4) A watt-hour meter which integrates the computed iron and copper losses of power transformers and feeder cables together with the customer's use of service shall be adjusted, if necessary, in consideration of the power transformer and line losses.

iii) Watt-hour meter creep:

For electromechanical meters, a continuous motion of the rotor of a meter with normal operating voltage applied and the load terminals open-circuited. For electronic meters, a continuous accumulation of data in a consumption register when no power is being consumed.

(1) Electromechanical meters

(a) No watt-hour meter shall be placed in service if it does not conform to ANSI C12.1–1995, Section 4.7.2.1, Test No. 1 – No Load which states:

(i) The metering device with the voltage circuits(s) energized and current circuit(s) open shall not make one complete revolution of the rotor or more than one equivalent revolution in watt-hours

within 10 minutes and no additional complete revolutions of the rotor or test output indications in the next 20 minutes.

(2) Electronic Meters

(a) No watt-hour meter shall be placed in service if it does not conform to ANSI C12.16-1991, Section 10.1.1, Test No. 1 – No Load which states:

(i) The Meter register or display shall not change more than +/- 1 least significant digit with the voltage circuits energized and the current circuits de-energized for a duration of 24 hours.

iv) Test loads

(1) All watt-hour meters shall be tested at approximately rated voltage or the manufacturers recommended voltage and 1.0 power factor at two load points as specified below:

(a) Heavy load.

(i) Self-contained meters with an “ampere rating” on the nameplate, shall be tested with a load of between 60% and 110% of the “ampere rating”

(ii) Self contained Class 60, Class 100, Class 200, Class 320, and Class 400 meters with a “test amperes” rating on the nameplate shall be tested with a load of between 80% and 120% of the “test amperes”

(iii)Transformer rated meters shall be tested at approximately 100% of the secondary rating of the current transformers or “test amperes”.

(b) Light load.

(i) Self-contained meters shall be tested with a load of between 5% and 10% of the “ampere rating” or “test amperes”

(ii) Transformer rated meters shall be tested with a load of approximately 10% of the secondary rating of the current transformers or 10% of the “test amperes”.

(2) Electronic watt-hour meters may be tested using a single load point if the following conditions are met:

(a) The meter uses a technology that does not provide separate adjustments for heavy and light load registration.

(b) The meter registration curve is linear

(c) The meter has been tested for linearity and correct registration at multiple points during an evaluation test

(d) The meter has been approved for test using a single test point as part of the approval process described in 16 NYCRR Part 93

v) Watt-hour meter adjustment limits.

(1) When a test of a watt-hour meter indicates that its registration is below 99.2% or above 100.8% at either heavy load or light load at 1.0 power factor, the percentage registration of the meter shall be adjusted to within these limits, as closely as practicable to the condition of zero error. When the errors of the instrument transformers used in conjunction with the meter affect the final average percentage registration of the meter by more than 0.5%, the above limits apply to the meter installation as a whole.

(2) Some electronic meters do not have adjustments for registration that are available outside of manufacturer's facilities.

b) Demand Meters and Registers

i) Electromechanical demand meters or registers are those meters or registers which perform a demand measurement using an electromechanical timing mechanism, a gear train or other mechanical means of demand registration, or a thermal element to integrate power over a period of time.

(1) These devices include registers that are internally mounted on meters as well as stand alone devices.

(2) Each device using such mechanisms must be tested and possibly adjusted in accordance with the provisions of this section.

ii) Electronic demand meters, devices, or registers are those meters, registers, or devices using an electronic timing mechanism in conjunction with an electronic means of registering energy use and calculating demand based on energy and time.

(1) These devices include electronic profile recorders, electronic demand registers for electromechanical meters, electronic totalizing demand meters, and fully electronic energy/demand meters.

iii) Rules for testing electromechanical demand meters and registers.

(1) Tests of all demand meters and registers shall cover at least one demand interval and shall be started simultaneously with the demand interval of the demand meter or register.

(2) When a demand meter or register is mechanically actuated by a watt-hour meter or demand-totalizing relay, the test shall be made using the watt-hour meter, relay, or proper equivalent driving force to actuate the demand element.

(3) Test points for demand meters and registers.

(a) All demand meters and registers shall be tested at approximately 50% of full scale.

(4) When a demand meter or register is actuated by pulses from pulse initiators installed in one or more watt-hour meters or relays, each of the associated watt-hour meters and relays shall be caused to transmit at least 20 pulses to the demand meter or register or suitable counting device as a check of the pulse initiators, associated equipment and circuitry. The demand meter or register shall be tested as prescribed.

(5) Where an electromechanical timing element also serves to keep a record of the time of day at which the demand occurs, it must be adjusted if it is in error more than plus or minus two minutes per day.

(a) All electromechanical demand meters, devices, and registers shall be tested prior to installation or within 60 days after installation.

iv) Determination of electromechanical demand meter and register performance.

(1) The percentage registration of all demand meters and registers shall be determined in terms of half-scale value for one demand interval and shall indicate the percentage registration of the demand element alone.

(2) A tolerance of 0.5% shall be allowed for instrumentation and observation errors in the determination of percentage registration.

(a) The percentage registration of a demand meter or register shall be reported as “Indeterminate” when the timing mechanism has become inoperative or when register index is eccentric.

v) Electromechanical demand meters and registers adjustment limits.

(1) When a test of a demand meter or register indicates that its registration is below 99.0% or above 101.0% at half scale, the demand meter or register shall be adjusted to register within these limits.

vi) Demand meters or registers which are found to register incorrectly shall be corrected or removed from service.

vii) Block-interval demand meters or registers that do not properly reset to zero shall be corrected or removed from service.

c) Pulse Initiators.

i) Pulse initiators are defined as any device that provides a change of state of a set of electrical contacts in response to the registration of a fixed quantity of energy.

(1) Pulse outputs are generally available as Form A (2 wire or KY) or Form C (3 wire or KYZ)

(2) Electromechanical meters may provide such a pulse from a mechanical or electronic mechanism tied to disk rotation.

(3) Electronic meters or registers may develop such a pulse by continuously monitoring energy use and generating contact closures when a specific quantity of energy has been recorded.

ii) When it is possible to check the operation of the pulse initiators by means of counters installed for the purpose, no other test need be made of the pulse initiators or their circuits.

(1) Pulse initiators that are found to transmit an incorrect number of pulses shall be corrected or removed from service.

iii) The value of each pulse in kilowatt-hours transmitted by a pulse initiator shall allow the greatest resolution possible. In most cases, this implies pulse constants that do not exceed 0.2% of the sum of the maximum hourly loads of the meters providing input to the pulse initiator. If this is outside the operating range of the devices, the following is offered as a minimum:

(1) For a 60-minute demand interval the value of each pulse shall not exceed 1% of the sum of the kva ratings of the watt-hour meters connected thereto.

(2) For a 30-minute demand interval the value of each pulse shall not exceed 2% of the sum of the kva ratings of the watt-hour meters connected thereto.

(3) For a 15-minute demand interval or less the value of each pulse shall not exceed 4% of the sum of the kva ratings of the watt-hour meters connected thereto.

d) Records of Tests

i) A test record of the most recent test of each watt-hour meter shall be retained for a period of at least 6 years, and the test records of any prior tests shall be retained for a period of at least 2 years.

ii) Test records for meters used in conjunction with instrument transformers and shunts shall give the correction, as specified in Section 4 (a) (ii) (4) above, which shall be applied to the percentage registration of the watt-hour meter.

iii) Test records for meters used in conjunction with phasing transformers shall give the actual voltage ratios between marked terminals of each phasing transformer.

iv) The test record for each current transformer shall indicate the ratio correction factors and phase angles at 10% and 100% of rated primary current with ANSI burden B-0.2 or with any higher burden at which the transformer is to be used. The test record for each potential transformer shall indicate the ratio correction factor and phase angle at normal utilization voltage and with such burdens as to give assurance of satisfactory in-service performance.

v) The test record for an instrument current or potential transformer shall indicate the frequency, the ratio correction factor and phase angle for each burden at which the transformer was tested.

vi) A test record shall be provided for each phasing transformer.

vii) The test record shall be retained while the transformer to which it applies remains in service at the specified location and becomes void upon the removal of such transformer or shunt.

5) Acceptance Testing

a) All shipments of new meters and devices must be examined for continued conformance with the terms associated with the type approval granted by the Public Service Commission for billing purposes.

b) A meter may be retrofitted with other devices or modules. Any device or module being installed in a meter must be certified alone and in combination with the meter being retrofitted.

c) Additionally, a used meter may be refurbished for sale to a party other than the original owner. In this case, if any meter has been repaired or recalibrated it shall be considered as a refurbished meter.

d) Prior to use, retrofitted or refurbished meters shall be tested for accuracy, labeled as retrofitted or refurbished and by whom, and dated accordingly.

e) Any meter or device that has been rebuilt or refurbished by other than the manufacturer or a facility that maintains a business relationship with the manufacturer for the purpose of insuring the quality of rebuilt products, may not conform to the original manufacturer’s specifications. If an MSP selects such a meter or device, it must verify continued type approval before use. The MSP

shall notify staff of the modifications, level of refurbishment, and the previous ownership of the meters or devices.

f) All refurbished or retrofitted meters or devices must be subject to an acceptance test program that is approved by staff prior to use.

g) Watt-hour meter tests.

i) No new watt-hour meter shall be placed in service unless test results indicate a registration between 99.2% and 100.8%.

(1) Performance will be based on the registration of the energy-measuring portion of the meter unless the meter is equipped with a mechanical demand measuring register.

(2) The evaluation of performance is described in the Test Methods Section of this document.

ii) Each new watt-hour meter shall be subject to a test program prior to installation. The test program must conform to one of the following:

(1) Complete testing of a shipment received from the manufacturer

(2) Sample testing of the shipment of products from the manufacturer.

iii) Complete testing of a shipment will be acceptable in all cases

iv) Sample testing will be acceptable provided that prior approval of such sampling procedures has been granted by staff:

(1) Where the sample does not meet the parameters specified in the approved sampling procedures, all meters of the lot shall be tested and adjusted by the MSP or by the manufacturer.

v) When a sampling method is used, that method shall follow ANSI Z1.4-1993, Sampling Procedures and Tables for Inspection by Attributes.

(1) Unless a sufficient history with a specific manufacturer and distributor has been developed, General Inspection Level II must be used.

(2) An Acceptable Quality Level (AQL) of 1.0 must be achieved.

(3) If the shipment fails to meet the specified AQL, the shipment may be rejected and sent back to the manufacturer, or 100% tested with the meters not meeting the standard being sent back to the manufacturer.

vi) Where manufacturer’s data is to be accepted, the following conditions must be met:

(1) The meter must have been received in a box sealed by the manufacturer of the meter.

(2) The meter must be accompanied by a copy of the manufacturer's test report with traceability to NIST, and indicate the results of the final test.

h) Electronic Demand Measuring devices such as electronic recorders, electronic totalizing devices, and electronic registers will not be subject to incoming accuracy tests, but will be subject to checks to insure that no modifications have taken place that might affect performance.

i) Demand performance is one of the parameters used in determination of type approval of a device. That approval is considered sufficient for acceptance of devices unless a change has been made to the device that affects the calculation of demand.

6) In-Service Testing

a) General – Meters and metering devices are type approved by the PSC to guarantee that the metering used within New York State will meet certain minimum standards of performance. In-service testing is used to insure that the population of meters continues to perform within standards while monitoring customer loads.

b) Responsibilities – The MSP is responsible for in-service testing of all meters under their control. Each MSP is expected to complete their test program by the end of the year, however, if it is not completed that year, it must be completed in the ensuing year in addition to its regular test program. If those meters not completed are inaccessible, then the MSP must submit an alternative plan to staff listing the number of meters not tested along with an explanation why. A similar number of meters from the same population will be selected for test the ensuing year.

c) Test Requirements – The following requirements define the level of testing that must be performed for each of the specified types:

i) Single Phase / Network Energy Meters

(1) This category contains all residential and small commercial self-contained meters.

(a) Three phase and CT rated meters are not included in this category

(2) This population may be covered by any of the following test programs:

(a) Variable Interval

(b) Periodic

(c) Selective

(d) Statistical

(3) Where a Demand Device is associated with a single phase or network meter, the additional considerations listed for Demand Devices must be followed.

ii) Polyphase Meters

(1) This category contains all three phase and CT rated meters.

(2) Meters in this category are frequently used for measuring the consumption of large commercial or industrial customers.

(3) These meters must be subject to one of the following test methods:

(a) Variable Interval

(b) Periodic

(c) Selective

(4) Where a Demand Device is associated with a polyphase or CT rated meter, the additional considerations listed for Demand Devices must be followed.

iii) Demand Devices

(1) This category may contain devices used in monitoring the residential and small commercial groups or from the large commercial / industrial group.

(a) Demand devices may be electromechanical or electronic registers mounted in meters or stand-alone devices that are driven by pulses from meters.

(2) Demand measuring devices using electromechanical methods will be subject to any of the following test methods:

(a) Variable Interval

(b) Periodic

(c) Selective

(3) Demand measuring devices that use electronic methods will not be subject to in-service testing

(a) Integrated devices that measure energy and demand will be subject to in service testing only for the energy-measuring portion of the device.

(4) Electromechanical demand registers installed on watt-hour meters shall be tested each time the associated watt-hour meters are tested in conjunction with an In-Service Test Plan.

(a) Additionally, watt-hour meters associated with an electromechanical demand register shall be tested each time the demand register is tested in conjunction with an In-Service Test Plan.

iv) Meter / Device Population Determination

(1) Determination of test quantities under most test methods is dependent on the population of meters supported.

(a) Application of test methods for metering devices provided within New York State will be based solely on meters in service within New York by the entity supporting those devices.

(2) Devices that have been identified as having performance issues do not need to be included in an in-service test plan.

(a) Handling of these devices must be defined in a formal plan filed with and approved by staff.

(3) The selection process for any of the test methods should provide up to 20% more meters than required to account for difficulties in accessing metering locations.

v) Meter performance will be determined in accordance with the methods set forth in the Test Methods Section of this document with the following exceptions:

(1) All meters which are found to be indeterminate or not registering due to causes other than tampering, incorrect connections, overload, or physical damage originating from sources external to the meter shall be reported as having a final average registration outside 98% to 102%.

(2) Tests classified as “damaged” shall not be included in any calculations of meter population performance.

vi) Periodic Testing - All watt-hour meters installed on customers' premises shall be tested at least once every 8 years.

vii) Selective Testing

(1) The minimum number of meters of each type to be tested in each ensuing calendar year (required rate of test) shall be based on the performance of meters of that type during a 12-month period which shall have terminated not more than 4 months prior to the start of the calendar year. Except as provided in (2), (3), and (4) of this section, the required rate of test shall be the percentage as determined from the following formulae:

Let X represent the percent of meters with final average registration more than 102% and Y represent the percent of meters with final average registration outside 98% to 102%. The required percent of meters requiring test shall be calculated with the appropriate one of the following formulae:

(i) $17.5\ [X^2 + (Y/5)^2]$

when $X \leq 0.6$ and $Y \leq 3.0$

(ii) $17.5X^2 + 12.55 - 6.25e^{-7.7((Y-3)/5)}$

when $X \leq 0.6$ and $Y \geq 3.0$

(iii) $25.10 - 6.25[e^{-7.7(X-0.6)} + e^{-7.7((Y-3)/5)}]$

when $X \geq 0.6$ and $Y \geq 3.0$

(iv) $12.55 - 6.25e^{-7.7(X-0.6)} + 17.5(Y/5)^2$

when $X \geq 0.6$ and $Y \leq 3.0$

where e denotes the exponential constant 2.71828 ….

TEST RATES UNDER SELECTIVE TESTING PLAN

Percentage of Meters outside the range of 98.0-102.0% - Final Average Registration (Y)

0.0	0.0													
0.1	0.0	0.2												
0.2	0.0	0.2	0.7											
0.3	0.1	0.2	0.8	1.6										
0.4	0.1	0.3	0.8	1.7	2.9									
0.5	0.2	0.4	0.9	1.8	3.0	4.6								
0.6	0.3	0.4	1.0	1.8	3.1	4.6	6.5							
0.7	0.3	0.5	1.0	1.9	3.1	4.7	6.6	10.0						
0.8	0.4	0.6	1.1	2.0	3.2	4.8	6.7	10.1	11.7					
0.9	0.6	0.7	1.3	2.1	3.4	4.9	6.9	10.2	11.8	12.5				
1.0	0.7	0.9	1.4	2.3	3.5	5.1	7.0	10.4	11.9	12.6	13.0			
1.1	0.8	1.0	1.5	2.4	3.6	5.2	7.2	10.5	12.1	12.8	13.1	13.3		
1.2	1.0	1.2	1.7	2.6	3.8	5.4	7.3	10.7	12.2	12.9	13.3	13.4	13.5	
1.3	1.2	1.4	1.9	2.8	4.0	5.6	7.5	10.8	12.4	13.1	13.4	13.6	13.7	
1.4	1.4	1.5	2.1	2.9	4.2	5.7	7.7	11.0	12.6	13.3	13.6	13.8	13.9	
1.5	1.6	1.8	2.3	3.2	4.4	6.0	7.9	11.2	12.8	13.5	13.8	14.0	14.1	
1.6	1.8	2.0	2.5	3.4	4.6	6.2	8.1	11.4	13.0	13.7	14.0	14.2	14.3	
1.7	2.0	2.2	2.7	3.6	4.8	6.4	8.3	11.7	13.2	13.9	14.3	14.4	14.5	
1.8	2.3	2.4	3.0	3.8	5.1	6.6	8.6	11.9	13.5	14.2	14.5	14.7	14.8	
1.9	2.5	2.7	3.2	4.1	5.3	6.9	8.8	12.2	13.7	14.5	14.8	14.9	15.0	
2.0	2.8	3.0	3.5	4.4	5.6	7.2	9.1	12.5	14.0	14.7	15.1	15.2	15.3	
2.1	3.1	3.3	3.8	4.7	5.9	7.5	9.4	12.7	14.3	15.0	15.3	15.5	15.6	
2.2	3.4	3.6	4.1	5.0	6.2	7.8	9.7	13.0	14.6	15.3	15.7	15.8	15.9	
2.3	3.7	3.9	4.4	5.3	6.5	8.1	10.0	13.4	14.9	15.6	16.0	16.1	16.2	
2.4	4.0	4.2	4.7	5.6	6.8	8.4	10.3	13.7	15.2	16.0	16.3	16.4	16.5	
2.5	4.4	4.6	5.1	6.0	7.2	8.8	10.7	14.0	15.6	16.3	16.6	16.8	16.9	
2.6	4.7	4.9	5.4	6.3	7.5	9.1	11.0	14.4	15.9	16.7	17.0	17.1	17.2	
2.7	5.1	5.3	5.8	6.7	7.9	9.5	11.4	14.8	16.3	17.0	17.4	17.5	17.6	
2.8	5.5	5.7	6.2	7.1	8.3	9.9	11.8	15.1	16.7	17.4	17.7	17.9	18.0	
2.9	5.9	6.1	6.6	7.5	8.7	10.3	12.2	15.5	17.1	17.8	18.1	18.3	18.4	
3.0	6.3	6.5	7.0	7.9	9.1	10.7	12.6	16.0	17.5	18.2	18.6	18.7	18.8	
3.1	7.2	7.4	7.9	8.8	10.0	11.6	13.5	16.8	18.4	19.1	19.5	19.6	19.7	
3.2	8.0	8.1	8.7	9.5	10.8	12.3	14.3	17.6	19.2	19.9	20.2	20.4	20.5	
3.3	8.6	8.8	9.3	10.2	11.4	13.0	14.9	18.3	19.8	20.5	20.9	21.0	21.1	
3.4	9.2	9.3	9.9	10.8	12.0	13.6	15.5	18.8	20.4	21.1	21.4	21.6	21.7	
3.5	9.7	9.8	10.4	11.2	12.5	14.0	16.0	19.3	20.9	21.6	21.9	22.1	22.1	
3.6	10.1	10.2	10.8	11.6	12.9	14.4	16.4	19.7	21.3	22.0	22.3	22.5	22.6	
3.7	10.4	10.6	11.1	12.0	13.2	14.8	16.7	20.1	21.6	22.4	22.7	22.8	22.9	
3.8	10.7	10.9	11.4	12.3	13.5	15.1	17.0	20.4	21.9	22.7	23.0	23.1	23.2	
3.9	11.0	11.2	11.7	12.6	13.8	15.4	17.3	20.6	22.2	22.9	23.2	23.4	23.5	
4.0	11.2	11.4	11.9	12.8	14.0	15.6	17.5	20.9	22.4	23.1	23.5	23.6	23.7	
4.1	11.4	11.6	12.1	13.0	14.2	15.8	17.7	21.1	22.6	23.3	23.7	23.8	23.9	
4.2	11.6	11.7	12.3	13.1	14.4	15.9	17.9	21.2	22.8	23.5	23.8	24.0	24.1	
4.3	11.7	11.9	12.4	13.3	14.5	16.1	18.0	21.4	22.9	23.6	24.0	24.1	24.2	
4.4	11.8	12.0	12.5	13.4	14.6	16.2	18.1	21.5	23.0	23.8	24.1	24.2	24.3	
4.5	11.9	12.1	12.6	13.5	14.7	16.3	18.2	21.6	23.1	23.9	24.2	24.3	24.4	
4.6	12.0	12.2	12.7	13.6	14.8	16.4	18.3	21.7	23.2	23.9	24.3	24.4	24.5	
4.7	12.1	12.3	12.8	13.7	14.9	16.5	18.4	21.7	23.3	24.0	24.4	24.5	24.6	
4.8	12.2	12.3	12.9	13.7	15.0	16.5	18.5	21.8	23.4	24.1	24.4	24.6	24.6	
4.9	12.2	12.4	12.9	13.8	15.0	16.6	18.5	21.9	23.4	24.1	24.5	24.6	24.7	
5.0	12.3	12.4	13.0	13.8	15.1	16.6	18.6	21.9	23.5	24.2	24.5	24.7	24.8	
5.1	12.3	12.5	13.0	13.9	15.1	16.7	18.6	22.0	23.5	24.2	24.6	24.7	24.8	
5.2	12.3	12.5	13.0	13.9	15.1	16.7	18.6	22.0	23.5	24.3	24.6	24.8	24.8	
5.3	12.4	12.5	13.1	13.9	15.2	16.7	18.7	22.0	23.6	24.3	24.6	24.8	24.9	
5.4	12.4	12.6	13.1	14.0	15.2	16.8	18.7	22.0	23.6	24.3	24.7	24.8	24.9	
5.5	12.4	12.6	13.1	14.0	15.2	16.8	18.7	22.1	23.6	24.3	24.7	24.8	24.9	
5.6	12.4	12.6	13.1	14.0	15.2	16.8	18.7	22.1	23.6	24.4	24.7	24.8	24.9	
5.7	12.5	12.6	13.1	14.0	15.3	16.8	18.8	22.1	23.7	24.4	24.7	24.9	24.9	
5.8	12.5	12.6	13.2	14.0	15.3	16.8	18.8	22.1	23.7	24.4	24.7	24.9	25.0	
5.9	12.5	12.7	13.2	14.1	15.3	16.9	18.8	22.1	23.7	24.4	24.7	24.9	25.0	
6.0	12.5	12.7	13.2	14.1	15.3	16.9	18.8	22.1	23.7	24.4	24.8	24.9	25.0	
and above	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	and above

Percentage of Meters above 102% Final Average Registration (X)

Note: When the required test rate is less than 12 ½%, and the number of meters to be tested is less than 200, the minimum number of meters to be tested shall be either 200 or 12 ½% of the number in service, whichever is less.

(2) When the test rate for a meter type as determined by paragraph (1) of this subdivision is less than 12.5% and the number of meters required to be tested by the formulae is less than 200, the minimum number of meters of such type to be tested in the ensuing year shall be either 200 or 12.5% of the number in service, whichever is the lesser. This same minimum number of tests shall apply for a new meter type in the first year after it is placed in service.

(3) Devices that have been identified as having performance issues do not need to be included in an in-service test plan. Handling of these devices must be defined in a formal plan filed with and approved by staff.

viii) Variable Interval Testing

(1) The minimum number of meters of each type to be tested in each ensuing calendar year (required rate of test) shall be based on the performance of meters of that type during a 12 month period which shall have terminated not more than four months prior to the start of the calendar year. Except as provided in (2) and (3) of this section, the required rate of test shall be the percentage as determined from the following formulae:

Let X represent the percent of meters with final average registration more than 102% and Y represent the percent of meters with final average registration outside 98% to 102%. The required percent of meters requiring test shall be calculated with the following formula:

(i) $4 + 0.133 (2X + Y)$

VARIABLE INTERVAL TEST RATES

Percentage of Meters above 102%
Final Average Percent Registration (X)

Percentage of Meters outside the range of 98.0-102.0%
Final Average Percent Registration (Y)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	4.00	4.27	4.53	4.80	5.07	5.33	5.60	5.87	6.13	6.40	6.67	6.93	7.20	7.47	7.73	8.00
1	4.13	4.40	4.67	4.93	5.20	5.47	5.73	6.00	6.27	6.53	6.80	7.07	7.33	7.60	7.87	
2	4.27	4.53	4.80	5.07	5.33	5.60	5.87	6.13	6.40	6.67	6.93	7.20	7.47	7.73	8.00	
3	4.40	4.67	4.93	5.20	5.47	5.73	6.00	6.27	6.53	6.80	7.07	7.33	7.60	7.87		
4	4.53	4.80	5.07	5.33	5.60	5.87	6.13	6.40	6.67	6.93	7.20	7.47	7.73	8.00		
5	4.67	4.93	5.20	5.47	5.73	6.00	6.27	6.53	6.80	7.07	7.33	7.60	7.87			
6	4.80	5.07	5.33	5.60	5.87	6.13	6.40	6.67	6.93	7.20	7.47	7.73	8.00			
7	4.93	5.20	5.47	5.73	6.00	6.27	6.53	6.80	7.07	7.33	7.60	7.87				
8	5.07	5.33	5.60	5.87	6.13	6.40	6.67	6.93	7.20	7.47	7.73	8.00				
9	5.20	5.47	5.73	6.00	6.27	6.53	6.80	7.07	7.33	7.60	7.87					
10	5.33	5.60	5.87	6.13	6.40	6.67	6.93	7.20	7.47	7.73	8.00					
11	5.47	5.73	6.00	6.27	6.53	6.80	7.07	7.33	7.60	7.87						
12	5.60	5.87	6.13	6.40	6.67	6.93	7.20	7.47	7.73	8.00						
13	5.73	6.00	6.27	6.53	6.80	7.07	7.33	7.60	7.87							
14	5.87	6.13	6.40	6.67	6.93	7.20	7.47	7.73	8.00							
15	6.00	6.27	6.53	6.80	7.07	7.33	7.60	7.87								
16	6.13	6.40	6.67	6.93	7.20	7.47	7.73	8.00								
17	6.27	6.53	6.80	7.07	7.33	7.60	7.87									
18	6.40	6.67	6.93	7.20	7.47	7.73	8.00									
19	6.53	6.80	7.07	7.33	7.60	7.87										
20	6.67	6.93	7.20	7.47	7.73	8.00										
21	6.80	7.07	7.33	7.60	7.87											
22	6.93	7.20	7.47	7.73	8.00											
23	7.07	7.33	7.60	7.87												
24	7.20	7.47	7.73	8.00												
25	7.33	7.60	7.87													
26	7.47	7.78	8.00													
27	7.60	7.87														
28	7.73	8.00														
29	7.87															
30	8.00															

(2) If the number of meters of any type being tested is less than 20, the annual test rate will be 4%. This rate will not be affected by the performance of the population.

(3) Where the calculated rate exceeds 8% a special program must be submitted to staff specifying the remedial action that will be taken to reduce the percentage of meters out of limits.

(4) A new meter type shall be tested at a rate of 4% or 100 meters, whichever is lesser in the first year after it is placed in service.

(5) Devices that have been identified as having performance issues do not need to be included in an in-service test plan. Handling of these devices must be defined in a formal plan filed with and approved by staff.

ix) Statistical Sampling

(1) This approach defines a performance level for the population of meters using the following methodology:

(a) Testing a random sample of the population that is sufficient in size to determine the Acceptable Quality Level to a confidence of 95%

(b) Determining the performance of population through attributes of the individual meters tested

(c) Segmenting the population into two segments – electromechanical and electronic.

(d) Evaluating each segment independently to determine adherence to performance standards.

(e) Sorting the results of each test sample by meter type

(f) Evaluating the performance of each type to determine if any one type should be subject to added scrutiny

(g) Developing and submitting a plan to handle those types that do not meet performance specifications

(h) Removing those types covered by a plan from the segment

(2) Selection of test samples is performed in accordance with ANSI Z1.4-1993, American National Standard Sampling Procedures and Tables for Inspection by Attributes

(a) The General Inspection Level II will be used to determine sample size

(b) The meter population must be segmented by technology

(i) Electromechanical meters will represent one segment

(ii) Electronic meters will represent one segment

(c) The total population of meters in each segment will be used in the determination of the sample size for that segment

(d) The selection of meters for test from the segment must be made in a random manner without regard for manufacturer type

(3) Performance of the population is determined by the number of meters that fall outside the specified accuracy range

(a) Meters will be considered outside the accuracy range if the final average registration accuracy is outside the range of 98% to 102%.

(b) An Acceptable Quality Level of 2.5 is required for the each segment of the population.

(i) The maximum number of meters outside of acceptable limits for an AQL of 2.5 may be determined from the Single Sampling Plans for Normal Inspection Master Table published in ANSI Z1.4-1993.

(4) The test results will be sorted and evaluated by manufacturer type

(a) The total number of tests for each type will be listed along with the number of meters whose final average falls outside of acceptable limits.

(b) A meter type will be considered to perform within specification if the percent outside limits falls:

(i) Within +/- 3% in any one year

(ii) Within +/- 2% for any two consecutive years

(c) If the number of tests for any one type is less than 100 and greater than 50, the following limits apply:

(i) Within +/- 4% in any one year

(ii) Within +/- 3% for any two consecutive years

(d) If the number of tests for any one type is less than 50 and greater than 20, the following limits apply:

(i) Within +/- 10% in any one year

(ii) Within +/- 8% in any two consecutive years

(e) If the number of tests is less than 20, no evaluation of that type can be made.

(i) In this case, the type is considered to be within limits.

(5) If a type is found to fall outside of specified limits, the following actions will be taken:

(a) A formal plan will be filed with staff for the replacement of the poorly performing meter type

(i) This plan will include a timetable for the replacement and whether the meter type will be actively sought out for replacement.

(b) In lieu of a replacement plan, a business plan may be developed and filed with staff for handling of the poorly performing meter type. That plan may include:

(i) A root cause analysis will be performed to determine the significance of the results.

(ii) A calculation of the energy and revenue exposure caused by the inaccuracy of the meter

(iii) A calculation of the cost of replacement of the offending meters

(iv) A plan for handling the meter type that takes into account the preceding elements as well as possibly monitoring the existing population of that type

(c) The plan for handling a poorly performing type must be approved by staff.

(6) Once a plan for handling of a poorly performing type has been approved by staff, that type may be removed from the Statistical Sampling Program.

d) Reporting Requirements

i) Reports of In-Service, Complaint, and Office tests of watt-hour meters shall be made each year and filed with staff not later than the 15th day of March of the following year.

ii) All reports of In-Service Tests are to include the number of meters tested, the number of meters found outside of limits, and the size of the population. Where appropriate, the reports should break down the

population of meters by type and be accompanied by appropriate performance parameters for that type.

iii) Where poorly performing types are being reported on, the report will be accompanied by a plan for handling that type.

iv) The annual report must include performance data that might be appropriate for tracking of types that is excluded from In-Service Test Plans because of their coverage by a poor performance action plan.

v) All reports should be filed electronically in a form acceptable to staff.

7) Complaint Testing

a) Overview

i) The purpose of this section is to standardize the minimum requirements for conducting a customer requested complaint test or PSC referee test. Standardized requirements will help protect the interests of the customer and the MSP and ensure compliance with regulations governing safety, service, and meter accuracy.

b) Responsibilities

i) After the customer makes a request for a complaint meter test, it is the responsibility of the MSP to contact all interested parties within 1 business day. The MSP must coordinate the site visit and schedule a date for a meter test within 5 business days. The MSP will coordinate with the customer to remove any physical hazards that may restrict ready access to the meter prior to a complaint or PSC referee test. It is the responsibility of the MSP to contact the parties and inform them of the meter test date, and approximate time of the test. The meter test should be completed within 30 days from receipt of the complaint.

ii) It is also the responsibility of the MSP to provide the following information:

(1) Meter location address;

(2) meter serial number;

(3) premise access instructions;

(4) name and telephone number of person(s) to be contacted for test coordination;

(5) location of meter and main disconnect at the customer’s premise;

(6) service voltage and current ratings;

(7) desired test date, and time; and

(8) date and result of last meter test.

iii) If a customer or an MSP makes a request for a PSC referee test it is the responsibility of staff to notify all interested parties that a test is to be made and to coordinate the date, time, and location of the referee test with all parties.

iv) MSPs must have trained and competent staff to conduct complaint testing. Also, an MSP must provide meter-testing equipment suitable for determination of meter performance at customer's premise and be traceable to NIST. At the discretion of the MSP or staff, electric meters may be removed from service with the original seal intact and taken to a certified meter testing facility for test if conditions preclude on-site testing.

v) At a minimum, the MSP shall keep and maintain the following equipment for on-site complaint meter testing :

(1) watt-hour meter test standard of a type that is suitable for testing any type of approved watt-hour meter by the MSP and traceable to NIST;

(2) a portable indicating voltmeter and ammeter;

(3) a timing interval stopwatch; and,

(4) all necessary wiring and service connections or devices.

c) Witnesses

i) For all complaint and PSC referee meter tests, the customer or their designated agent may witness the test of the disputed meter.

d) General Procedures

The following procedures should be followed when conducting a complaint or PSC referee meter test during an investigation of the customer's use of service:

i) Safety:

(1) Normal safety precautions, as per OSHA, should be followed when performing meter testing. All 265, 277/480 volt meters, will be removed from service and tested in a meter testing facility.

ii) Prior to the Test:

(1) Before the meter is handled it should be identified as the meter scheduled for test with respect to the serial number, company numbers, nameplate

data, premises served, and name of customer. All appropriate readings of the meter dials and registers should be taken preferably by indicating the exact position of the pointers on the dials or data in the electronic register. The register constant and the load at the time of call should be noted.

(2) An inspection of the general conditions around the meter should be made including the condition of the meter seals, the correctness of wiring and connections to the meter and, where appropriate, the physical condition of metering transformers.

e) Referee Tests

i) A referee test is a test of a meter, made or witnessed by staff as a result of a complaint made to the Commission by the customer or at the request of the MSP. Referee tests are generally made by appointment with the customer, the MSP and staff. The MSP will supply all wiring and test equipment. All referee tests shall be made in a manner acceptable to the Commission or its designee.

ii) When the MSP is unable to make the test in the manner designated by staff, or when the accuracy of the meter is indeterminate, staff shall request that the meter be removed from service. Staff shall place its identifying seal on the meter and have the meter immediately delivered to a certified meter test facility designated by the MSP. The meter shall be clearly marked as a PSC referee test meter and held pending the outcome of the complaint.

iii) The objective of a referee test is to determine whether a meter is defective or incorrect to the detriment of the customer. Meter performance is considered acceptable when the final average accuracy test is not less than 98% or greater than 102%.

iv) A referee test of a meter shall be tested in place at the customer's premise, (with the exception of the 265, 277/480 volt meters) where safety permits, under local operating conditions, without moving it prior to the test, except that a detachable meter may be mounted on a test device designed for insertion into the meter mounting. The meter should then be carefully removed from the socket, causing minimum disturbance to the meter. The cover of the meter may be removed at the time of the test.

v) The MSP and staff should each read the test instruments and calculate the accuracy of the meter.

vi) At least two tests shall be made at each load, and if they fail to agree within 1%, tests up to a total of four shall be made until agreement is obtained on two consecutive tests. If such agreement is not obtained the meter registration shall be reported as "Indeterminate." Meter registration shall also be reported as "Indeterminate" when, for any other reason, there is doubt as to whether the accuracy of the registration can be determined. The percentage registration of

a demand register shall be reported as “Indeterminate” when the demand register can not be read accurately.

vii) A meter shall be reported as “Not Registering” if for any reason it is found to be not registering at both light load and heavy load test points.

viii) Where appropriate and operating conditions allow, the meter shall be tested for creep with all of the meter’s potential coils energized and all meter current circuits disconnected. The meter displaying creep will be sealed by staff, removed from service, and sent to a meter test facility or standardizing laboratory for further analysis by the MSP.

ix) After the above tests have been completed and there is agreement between the MSP and staff regarding the computed accuracy, the meter register should be removed and the correctness of the register ratio checked by staff.

x) All worm wheels and gears should be checked for proper and continuous mesh. When the staff is satisfied that a proper test has been completed, the MSP may proceed with additional tests and meter maintenance as may be required.

xi) When this work has been completed the MSP should make “as-left” tests. The meter shall be as left with a final average accuracy between 99.2% to 100.8%. Staff should note the as-left accuracy of the meter.

xii) Testing of demand registers must be performed with the register attached to the corresponding meter when in service.

f) Referee Test of Direct Current Watt-hour Meters:

i) Referee tests are made in a manner similar to the procedure for single phase alternating current watt-hour meters, except that an indicating volt meter and an indicating milli-volt meter with appropriate shunts are used for determining load, and a stop watch for time.