Measuring Devices

Water Meters

Technical Policy • Checklists • Test Procedures

N C W M

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Water Meters

Water Meters Checklist and Test Procedures

A.   Models to be Submitted for Evaluation

This checklist applies to devices used for the measurement of water; generally applicable to, but not limited to, utilities type meters installed in residences or business establishments and meters installed in batching systems.

This checklist does not apply to:

(a) water meters mounted on vehicle tanks; or
(b) mass flow meters.

A type is a model or models of the same design, as defined in the NTEP Policy and Procedures. A complete list and description of all models of a type to be included on the Certificate of Conformance (CC) shall be submitted with the request for type evaluation. All options and features to be included on the CC must be submitted for evaluation. Nonmetrological features may be listed on a CC, but only if the feature has been evaluated by the NTEP Laboratory and operates as intended. If the CC is to include more than one model of the same type, the applicant shall contact the evaluation agency to determine which model or models will be evaluated. A CC will be amended when the manufacturer adds new models of the same type meeting the specified criteria.

B.   Checklist and Test Procedures

The checklist is designed so that the user can determine and record in a logical sequence the conformance of the device with the elements of the checklist. The user should make copies of the checklist to serve as worksheets and preserve the original for reference. Unless specifically requested to do so, the applicant is not required to submit a completed checklist to NTEP prior to the evaluation; however, the applicant is urged to carefully review the checklist prior to submission to ensure that the device meets the requirements of the checklist. In most cases, the results of evaluation for each element can be recorded by checking the appropriate response. In some cases, the user is required to record values, results, or comments. In those cases, space is provided; examples are:

1.   **Yes ☐ No ☐ N/A ☐**

2.   ☐ EXTERNAL   ☐ INTERNAL   ☐ N/A

3.   Comment _____
_____
_____

This checklist is a guide for conducting prototype examinations to determine compliance with the requirements of NIST Handbook 44. These criteria shall apply only to type evaluation examinations, not on a retroactive basis to devices that are currently in service. The General Code requirements apply to all classes of devices. The specific code requirements supersede General Code requirements in all cases of conflict.

1.   General

Code Reference: G-S.1. Identification

Virtually all weighing and measuring equipment must be clearly and permanently marked with the manufacturer's name or trademark, model designation, and serial number. Dispensers, consoles, cash registers interfaced with dispensers, retrofit computing registers, and customer card-activated terminals must all have these markings. As a practical matter, some equipment does not need a serial number. "Satellite" modules in a modular system (e.g., keyboard module and cash drawer) need not have serial numbers because they do not have any "intelligence."
A serial number is required in the following circumstances:

Separate Device: A device is capable of operating as a weighing or measuring device without being interfaced with or connected to other components.

Separate Main Element: Primary indicating elements must be marked. The device is a major element in the weighing or measuring system. That is, it is metrologically significant to the operation and/or performance of the system and interfaces with different compatible main elements. Examples: Indicating elements, weighing elements, meter registers, meter measuring elements (vehicle tank meters and loading rack meters).

Component: The device is a component in a system, may be used in different models of devices, and is sufficiently complex to warrant a separate evaluation and a separate CC (e.g., load cells and vapor recovery nozzles). Such a device may or may not be placed into an enclosure with other components of the system. When installed in an enclosure, the complete device must be marked with a serial number, and the one serial number will suffice for the entire collection of components. If it is not placed in an enclosure with other components, the component must be marked with a serial number.

Equipment must be marked on a surface that is an integral part of the device, and the marking must be visible after installation. If the required information is not positioned in a visible location after installation, a duplicate, permanent identification badge must be located in a visible location. A removable cover is an acceptable location for the required information only if a permanent ID badge is located elsewhere on the device.

The information may be on a metal or plastic plate that is attached with pop rivets, adhesive, or other means, but may not be fastened by removable bolts or screws. A foil or vinyl badge may be used provided that the badge can survive wear and tear, remains legible, and is difficult to remove. The printing on a foil badge must be easily readable and not easily obliterated by rubbing with a relatively soft object (e.g., the wood of a pencil)

Location of the information:

_____

_____

Code Reference: G-S.1. Identification

All equipment shall be clearly and permanently marked on an exterior visible surface after installation. It must contain the following information (prefix lettering may be initial capitals, all capitals, or all lower case):

1.1.	Name, initials, or trademark of the manufacturer.	**Yes** ☐ **No** ☐ **N/A** ☐
1.2.	A model designation that positively identifies the pattern or design. The Model designation shall be prefaced by the word "Model", "Type", or "Pattern". These terms may be followed by the term "Number" or an abbreviation of that word. The abbreviation for the word "Number" shall, at a minimum, begin with the letter "N" (e.g., No or No.) The abbreviation for the word "Model" shall be "Mod" or "Mod.".	**Yes** ☐ **No** ☐ **N/A** ☐
1.3.	Except for not built-for-purpose, software-based devices, a nonrepetitive serial number. The serial number shall be prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required serial number. Abbreviations for the word "Serial" shall, as a minimum, begin with the letter "S," and abbreviations for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., S/N, SN, Ser. No, and S No.).	**Yes** ☐ **No** ☐ **N/A** ☐
1.4.	For not built-for-purpose, software-based devices the current software version or revison designation. The version or revision identifier shall be prefaced by the word "Version" or "Revision" as appropriate and either word may be followed by the word "Number." The abbreviations for the word "Version" shall, as a minimum, begin with the letter "V". The abbreviation for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.).	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference G-S.1. (e).

1.5.   The NTEP Certificate of Conformance (CC) Number or a corresponding CC addendum number for devices that have a CC. The number shall be prefaced by the terms "NTEP CC", "CC", or "Approval". These terms may be followed by the word "Number" or an abbreviation for the Word "Number". The abbreviation shall as a minimum begin with the letter "N" (e.g., No or No.).   **Yes** ☐ **No** ☐ **N/A** ☐

The device must have an area, either on the identification plate or on the device itself, suitable for the application of the Certificate of Conformance Number. If the area for the CC Number is not part of an identification plate, then note its intended location below and how it will be applied.

Location of CC Number if not located with the identification:

_____

_____

Code Reference: G-S.1.1.   Location of Marking Information for Not Built-for-Purpose, Software-Based Devices Not Built-for-Purpose Devices, Software-Based

1.6.   For not built-for-purpose, software-based devices the following shall apply:

1.6.1.   The required information in G-S.1 Identification. (a), (b), (d), and (e) shall be permanently marked or continuously displayed on the device; or

1.6.2.   The Certificate of Conformance (CC) Number shall be:
- permanently marked on the device; or
- continuously displayed; or
- accessible through an easily recognized menu and, if necessary, a submenu. Examples of menu and submenu identification include, but are not limited to "Help," "System Identification," "G-S.1. Identification," or "Weights and Measures Identification."

Note: For (1.6.2.), clear instructions for accessing the information required in G-S.1. (a), (b), and (d) shall be listed on the CC, including information necessary to identify that the software in the device is the same type that was evaluated.

1.7.   The identification badge must be visible after installation.   **Yes** ☐ **No** ☐ **N/A** ☐

1.8.   The identification badge must be permanent.   **Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.2. Facilitation of Fraud

This applies to all metering systems, including dispensers controlled from a remote location and vehicle tank meters. An exception is permitted if the unit price can be changed at a dispenser only through the use of a key to gain access to the unit price mechanism, e.g., mechanical computing registers. Such action would be obvious to a consumer and would inhibit changing the unit price during a delivery.

This requirement addresses the process of changing the unit price or unit prices set in a metering system, but not the selection of a unit price from prices among several posted on dispensing system. Specific criteria for selecting unit prices for dispensers are given in the retail motor-fuel section of the checklist.

1.9.   The system shall prevent a change of unit price during a delivery.   **Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.3. Permanence

Equipment shall be of such materials, design, and construction that, under normal service conditions:

1.10.   Accuracy will be maintained.   **Yes** ☐ **No** ☐ **N/A** ☐

1.11.   Operating parts will continue to function as intended,   **Yes** ☐ **No** ☐ **N/A** ☐

1.12.   Adjustments will remain reasonably permanent.   **Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.4. Interchange or Reversal of Parts

If a metering system has parts that may be interchanged or reversed in normal field assembly, the system shall either be constructed so that reversal will not affect the accuracy of the system or the parts must be marked to indicate their proper position. For most metering devices, this applies only to the reversal of connectors of cables to peripheral devices.

If a metering system has any parts that may be interchanged or reversed in normal field assembly, the parts must either be:

1.13.	Constructed so that reversal will not affect performance,	**Yes** ☐ **No** ☐ **N/A** ☐
1.14.	Marked or keyed to indicate the proper position.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.5.1. Indicating and Recording Elements

Several general requirements facilitate the reading and interpretation of displayed values. Each display for quantity or total price must be appropriate in design and have sufficient capacity for particular applications to be suitable for the application. Metering devices must be capable of indicating the maximum quantity and money values that can normally be expected in a particular application.

1.15.	The maximum money value and quantity indications and unit prices are appropriate for the intended use.	**Yes** ☐ **No** ☐ **N/A** ☐
1.16.	The indications must be clear, definite, and accurate.	**Yes** ☐ **No** ☐ **N/A** ☐
1.17.	The indications must be easily read under normal operating conditions.	**Yes** ☐ **No** ☐ **N/A** ☐
1.18.	Totalizer values must be accurate to the nearest minimum interval with decimal points displayed or subordinate digits adequately differentiated from others, if applicable.	**Yes** ☐ **No** ☐ **N/A** ☐
1.19.	Symbols for decimal points shall clearly identify the decimal position. (Generally acceptable symbols are dots, small commas, or x.)	**Yes** ☐ **No** ☐ **N/A** ☐

2. Graduations, Indications, and Recorded Representations

Code Reference: G-S.5.2.1. Analog

2.1.	An analog device must have graduations and a suitable indicator to provide an accurate indication of quantity and money values.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.5.2.2. Digital Indication and Representation

Basic operating requirements for devices:

2.2.	All digital values of like value in a system shall agree.	**Yes** ☐ **No** ☐ **N/A** ☐
2.3.	A digital value shall agree with its analog representation to the nearest minimum graduation.	**Yes** ☐ **No** ☐ **N/A** ☐
2.4.	Digital values shall round off to the nearest digital division that can be indicated or recorded.	**Yes** ☐ **No** ☐ **N/A** ☐
2.5.	When a digital zero display is provided, the zero indication shall consist of at least one digit to the left and all digits to the right of the decimal point.	**Yes** ☐ **No** ☐ **N/A** ☐

Agreement of indications shall be checked for several deliveries. The totalizer shall be checked for accuracy and agreement with individual deliveries and with other totalizers in the system. Indications may disagree if digital indications receive quantity pulses from a nonresettable pulser.

2.6.	All digital values of like value in a system agree with one another.	**Yes** ☐ **No** ☐ **N/A** ☐
2.7.	Digital values coincide with associated analog values to the nearest minimum graduation.	**Yes** ☐ **No** ☐ **N/A** ☐
2.8.	Digital values "round off" to the nearest minimum unit that can be indicated or recorded.	**Yes** ☐ **No** ☐ **N/A** ☐
2.9.	The device totalizer shall agree with the total of the individual deliveries and with other totalizers in the system.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.5.2.3. Size and Character

Digits used for comparable values must be uniform in size and character, but subordinate values may be displayed in different and less prominent digits than more significant values. The latter more likely occurs on analog devices. In digital indications, the digits are usually of uniform size throughout a particular display. The size of digits may differ for different quantities, for example, the quantity and unit price digits may be smaller than the total price digits.

2.10.	Corresponding graduations shall be uniform in size and character.	**Yes** ☐ **No** ☐ **N/A** ☐
2.11.	Subordinate graduations, indications, and recorded representations shall be appropriately portrayed or designated.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.5.2.4. Values Defined

2.12.	Values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations, which are uniformly placed so that they do not interfere with the accuracy of the reading.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.5.2.5. Permanence

2.13.	Graduations, indications, or recorded representations and their defining figures, words, and symbols shall be of such character that they will not tend to easily become obliterated or illegible.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.5.3., G-S.5.3.1. Values of Graduated Intervals or Increments

2.14.	Graduations, digital and analog indications, and recorded representations shall be uniform in size, character, and value throughout any series. Graduations must have a regular pattern and the increments must be consistent. Quantity values shall be defined by the specific unit of measure in use.	**Yes** ☐ **No** ☐ **N/A** ☐
2.15.	Graduations and indications shall be uniform throughout any series.	**Yes** ☐ **No** ☐ **N/A** ☐
2.16.	Quantity values shall be identified by the unit of measure.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.5.4. Repeatability of Indications

The quantity measured by a device shall be repeatable within tolerance for the same indication. One condition that may create a problem is that the value of the quantity division may be large relative to the tolerance. A delivery must be within tolerance wherever the delivery is stopped within the nominal indication of the test draft. Meters that may be at the tolerance limit may be out of tolerance at an extreme limit of the nominal quantity indication.

2.17.	When a digital indicator is tested, the delivered quantity shall be within tolerance at any point within the quantity-value division for the test draft.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.5.6. Recorded Representations

2.18.	All recorded values shall be digital. (See also G-UR.3.3.)	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.5.7. Magnified Graduations and Indications

2.19.	Magnified indications shall conform to all requirements for graduations and indications.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.6. Marking, Operational Controls, Indications, and Features

All operational controls, indications, and features shall be clearly and definitely identified. Nonfunctional keys and annunciators shall not be marked because their marking implies that the key or annunciator is functional and should be inspected or tested by the enforcement official. Keys and operator controls that are visible to a customer in a direct sale transaction shall be marked with words or symbols to the extent that they can be understood by the customer and aid in understanding the transaction. Keys that are visible only to the console operator need to be marked only to the extent that a trained operator can understand the function of each key.

2.20.	All operational controls, indications, and features including switches, lights, displays, and push buttons shall be clearly and definitely identified.	**Yes** ☐ **No** ☐ **N/A** ☐
2.21.	All dual function (multi-function) keys or controls shall be marked to clearly identify all functions.	**Yes** ☐ **No** ☐ **N/A** ☐
2.22.	Non-functional controls and annunciators shall not be marked.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.7. Lettering, Readability

2.23.	Required markings and instructions shall be permanent and easily read.	**Yes** ☐ **No** ☐ **N/A** ☐

Code Reference: G-S.8. Sealing Electronic Adjustable Components, and Provision for Metrologist Sealing of Adjustable Components or Audit Trial

2.24.   Electronic adjustable components that affect the performance of a device shall provide for an approved means of security (e.g. data change audit trail) or for physically applying a security seal. These components include the following: (1) mechanical adjustment mechanism for meters, (2) the electronic calibration factor and automatic temperature compensator for electronic meter registers, (3) selection of pressure for density correction capability and correction values, and (4) pulser setting and gallon/liter conversion switches when they may accidentally or intentionally be used to perpetrate fraud.   **Yes** ☐ **No** ☐ **N/A** ☐

The following philosophy and list of sealable parameters applies to provision for sealing all liquid/vapor-measuring devices.

An electronic data audit trail is a means of allowing a weights and measures inspector to review how many times any electronic adjustment, which affects the accuracy of a weight, or volume measurement has been changed. The information contained in the audit trail shall consist of a cumulative and non-destructible number (even if a power failure occurs) which increments each time any of the adjustments required to be sealed have been changed. The electronic data audit trail information shall be capable of being recalled by the official on the main display of the device.

As a minimum, devices which use an audit trail to provide security for sealable parameters shall satisfy the following criteria and shall use the format set forth in Appendix A of the checklist for Liquid-Measuring Devices.

Philosophy for Sealing
Typical Features to be Sealed

Principles for Determining Features to be Sealed

The need to seal some features depends upon:

- The ease with which the feature or the selection of the feature can be used to facilitate fraud; and
- The likelihood that the use of the feature will result in fraud not being detected.

Features or functions which the operator routinely uses as part of device operation, such as setting the unit prices on dispensers and maintaining unit prices in price look-up codes stored in memory, are not sealable parameters and shall not be sealed.

If a parameter (or set of parameters) selection would result in performance that would be obviously in error, such as the selection of parameters for different countries, then it is not necessary to seal the selection of these features.

If individual device characteristics are selectable from a "menu" or a series of programming steps, then access to the "programming mode" must be sealable. (Note: If an audit trail is the only means of security, then the audit trail shall update only after at least one sealable parameter has been changed; simply accessing the sealable parameters via a menu shall not update the audit trail.)

If a physical act, such as cutting a wire is required to change a parameter setting and physically repairing the cut is required to reactivate the parameter, then this physical repair process would be considered an acceptable way to select parameters without requiring a physical seal or an audit trail.

Typical Features and Parameters to be Sealed

The following provides examples of configuration and calibration parameters that are to be sealed. The examples are provided for guidance and are not intended to cover all possible parameters.

Calibration Parameters: Calibration parameters are those parameters whose values are expected to change as a result of accuracy adjustments. Examples include the following.

1.   Measuring element adjustments where linearity corrections are used, e.g., flow rate 1 and meter factor 1, flow rate 2 and meter factor 2, etc.
2.   Mass flow meter adjustments for zero adjustments (not simply setting the display to zero) and span settings.

Configuration Parameters: Configuration parameters are those parameters whose values are expected to be entered only once and not changed after all initial installation settings are made. Examples include the following.

1.   Octane or other blend setting ratios (optional in Canada at this time)
2.   Temperature, pressure, density, and other sensor settings for zero, span, and offset values
3.   Measurement units (in Canada, only if not displayed or printed on the primary register)
4.   Temperature compensation table, liquid coefficient of expansion, or compressibility factors or tables
5.   Liquid density setting (in Canada, only if not displayed or printed on the primary register) and allowable liquid density input range
6.   Vapor pressures of liquids if used in calculations to establish the quantity
7.   Meter or sensor temperature compensation factors
8.   False or missing pulse limits for dual pulse systems (Canada only)
9.   On/off status of automatic temperature, pressure, or density correction
10.   Automatic or manual data input for sensors
11.   Dual pulse checking feature status on or off
12.   Flow control settings (optional in Canada)
13.   Filtering constants

Liquid-Measuring Device Features and Parameters	
Typical Features or Parameters to be Sealed	**Typical Features or Parameters Not Required to be Sealed**
Measuring element adjustment (both mechanical and electronic)	Analog-to-digital converters
Linearity correction values	Quantity division value (display resolution)
Measurement units (e.g., gallons to liters)	Double pulse counting
Octane blend setting for retail motor-fuel dispensers	Communications
Any tables or settings accessed by the software or manually entered to establish the quantity (e.g., specific gravity, pressure, etc.)	
Density ranges	
Pulsers	
Signal pick-up (magnetic or reluctance)	
Temperature probes and temperature offsets in software	
Pressure and density sensors and transducers	
Flow control settings, e.g., flow rates for slow-flow start, quantity for slow-flow start and stop	
Temperature compensating systems (on/off)	
Differential pressure valves	
As a point of clarification, the flow control settings referenced above are those controls typically incorporated into the installations of large-capacity meters (wholesale meters). The reference does not include the point at which retail motor-fuel dispensers slow product flow during a prepaid transaction to enable the dispenser to stop at the preset amount.	

Note: The above examples of adjustments, parameters, and features to be sealed are to be considered "typical" or "normal." This list may not be all inclusive. Some parameters other than those listed, which affect the metrological performance of the device, must be sealed. If listed parameters or other parameters, which may affect the metrological function of the device, are not sealed, the manufacturer must demonstrate that all settings comply with the most stringent requirements for the application of the device (i.e., the parameter does not affect compliance with Handbook 44).

(Section 3.33. of Handbook 44, Code for Cryogenic Liquid-Measuring Devices, does not include specific design criteria for electronic audit trails. Based upon G-A.3., Special and Unclassified Equipment, and G-S.8., Provisions for Sealing Electronic Adjustable Components, Table S.2.2.of the Liquid-Measuring Devices Code, Categories of Device and Methods of Sealing, will be applied to the type evaluation of cryogenic devices until specific design criteria are added to Section 3.33. of Handbook 44 for the design of audit trails installed in cryogenic liquid-measuring devices.)

Category 1 Devices (Devices with No Remote Configuration Capability):

- The device is sealed with a physical seal or it has an audit trail with two event counters (one for calibration, the second for configuration).   **Yes ☐ No ☐ N/A ☐**

- A physical seal must be applied without exposing electronics.   **Yes ☐ No ☐ N/A ☐**

- Event counters are non-resettable and have a capacity of at least 000 to 999.   **Yes ☐ No ☐ N/A ☐**

- Event counters increment appropriately.   **Yes ☐ No ☐ N/A ☐**

- The audit trail information must be capable of being retained in memory for at least 30 days while the device is without power.   **Yes ☐ No ☐ N/A ☐**

- Accessing the audit trail information for review shall be separate from the calibration mode.   **Yes ☐ No ☐ N/A ☐**

- Accessing the audit trail information must not affect the normal operation of the device.   **Yes ☐ No ☐ N/A ☐**

- Accessing the audit trail information shall not require removal of any additional parts other than normal requirements to inspect the integrity of a physical security seal. (e.g., a key to open a locked panel may be required).   **Yes ☐ No ☐ N/A ☐**

Category 2 Devices (Devices with Remote Configuration Capability but Controlled by Hardware):

- The physical hardware enabling access for remote communication must be on- site.   **Yes ☐ No ☐ N/A ☐**

- The physical hardware must be sealable with a security seal or   **Yes ☐ No ☐ N/A ☐**

- The device must be equipped with at least two event counters: one for calibration, the second for configuration parameters
        - calibration parameters event counter
        - configuration parameters event counter   **Yes ☐ No ☐ N/A ☐**

- Adequate provision must be made to apply a physical seal without exposing electronics.   **Yes ☐ No ☐ N/A ☐**

- Event counters are non-resettable and have a capacity of at least 000 to 999.   **Yes ☐ No ☐ N/A ☐**

- Event counters increment appropriately.   **Yes ☐ No ☐ N/A ☐**

- Event counters may be located either:
        - at the individual measuring device or
        - at the system controller   **Yes ☐ No ☐ N/A ☐**

- If the counters are located at the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.   **Yes ☐ No ☐ N/A ☐**

- An adequate number (see table below) of event counters must be available to monitor the calibration and configuration parameters of each individual device.   **Yes ☐ No ☐ N/A ☐**

- The device must either:
        -clearly indicate when it is in the remote configuration mode or
        -the device shall not operate while in the remote configuration mode.   **Yes ☐ No ☐ N/A ☐**

- If capable of printing in the calibration mode, it must print a message that it is in the calibration mode.   **Yes ☐ No ☐ N/A ☐**

- The audit trail information must be capable of being retained in memory for at least 30 days while the device is without power.   **Yes ☐ No ☐ N/A ☐**

- The audit trail information must be readily accessible and easily read.   **Yes ☐ No ☐ N/A ☐**

Minimum Number of Counters Required		
	Minimum Counters Required for Devices Equipped with Event Counters	**Minimum Event Counter(s) at System Controller**
Only one type of parameter accessible (calibration or configuration)	One (1) event counter	One (1) event counter for each separately controlled device, or one (1) event counter, if changes are made simultaneously.
Both calibration and configuration parameters accessible	Two (2) event counters	Two (2) event counters for each separately controlled device, or two (2) or more event counters if changes are made to all controlled devices simultaneously.

Category 3 Devices (Devices with Unlimited Remote Configuration Capability):

Category 3 devices have virtually unlimited access to sealable parameters or access is controlled though a password.

- For devices manufactured after January 1, 2001, the device must either: **Yes ☐ No ☐ N/A ☐**
    - Clearly indicate when it is in the remote configuration mode, or
    - The device shall not operate while in the remote configuration mode

- The device is equipped with an event logger   **Yes ☐ No ☐ N/A ☐**

- The event logger automatically retains the identification of the parameter changed, the date and time of the change, and the new value of the parameter.   **Yes ☐ No ☐ N/A ☐**

- Event counters are nonresettable and have a capacity of at least 000 to 999.   **Yes ☐ No ☐ N/A ☐**

- The system is designed to attach a printer, which can print the contents of the audit trail.   **Yes ☐ No ☐ N/A ☐**

- The audit trail information must be capable of being retained in memory for at least 30 days while the device is without power.   **Yes ☐ No ☐ N/A ☐**

- The event logger must have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required.   **Yes ☐ No ☐ N/A ☐**

- The event logger drops the oldest event when the memory capacity is full and a new entry is saved.   **Yes ☐ No ☐ N/A ☐**

- Describe the method used to seal the device or access the audit trail information.

Code Reference: G-UR.1.1. Suitability of Equipment

A device must be properly designed and have sufficient capacity to be suitable to use in a particular application. A device must measure the appropriate characteristics of a commodity to accurately determine the quantity, have the necessary components (e.g. vapor eliminator) to eliminate factors that may cause measurement errors during normal use, have sufficient capacity to indicate the quantity measured and the associated total price if it is a computing device. The meter must have the proper flow rate capacity to operate over the actual flow rates for the application, and the device must have a quantity division appropriate for the application. Some specific requirements for device characteristics are given in the specific codes for particular devices.

2.25.   The equipment is suitable for its intended application.   **Yes ☐ No ☐ N/A ☐**

Code Reference: G-UR.1.2. Environment

2.26.   Equipment shall be suitable for use in the environment in which it will be used.   **Yes ☐ No ☐ N/A ☐**
            Suitability with respect to environment includes the effects of wind, weather, temperature
            variations, and radio frequency interference. A device must work and remain accurate
            under its actual conditions of use.

Code Reference: G-UR.3.3. Position of Equipment

Paragraph G-UR.3.3. requires that the primary indicating element be visible from a reasonable customer position. Many electronic vehicle-mounted metering/controlling systems on which transaction information is displayed are mounted inside the cab of the delivery vehicle. This location is not considered visible from a reasonable customer position. Some systems provide a remote customer display as a standard feature and some do not. The application section of any Certificate of Conformance issued to a vehicle-mounted metering/controlling system must limit the system to installations where a customer indicator is provided and located in a reasonable customer position (e.g., at the meter on the rear of the vehicle).

Additional Checklist and Test Procedures for Water Meters

45.   Indicating and Recording Elements

Code References S.1.1.1. General

45.1.   A water meter shall be equipped with a primary indicating element and may also be equipped with a primary recording element. Such elements shall be visible at the point of measurement or be stored in non-volatile and non-resettable memory. The display may be remotely located provided it is readily accessible to the customer.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.1.2. Units

45.2.   A water meter shall indicate and record, if the device is equipped to record, its deliveries in terms of liters, gallons or cubic feet or binary or decimal subdivisions thereof except batch plant meters, which shall indicate deliveries in terms of liters, gallons or decimal subdivisions of the liter or gallon only.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.1.3. Value of the Smallest Unit

45.3.   The value of the smallest unit of indicated delivery and recorded delivery, if the device is equipped to record, shall not exceed the equivalent of:

45.3.1.   50 L (10 gal or 1 ft3) on utility type meters, sizes 1 in and smaller, or   **Yes ☐ No ☐ N/A ☐**

45.3.2.   500 L (100 gal or 10 ft3) on utility type meters, sizes 1-1/2 in and 2 in, or   **Yes ☐ No ☐ N/A ☐**

45.3.3.   0.2L (1/10 gal or 1/100 ft3) on batching meters delivering less than 375 L/min (100 gal/min or 13 ft3/min), or   **Yes ☐ No ☐ N/A ☐**

45.3.4.   5 L (1 gal or 1/10 ft3) on batching meters delivering 375 L/min (100 gal/min or 13 ft3/min) or more.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.1.4. Advancement of Indicating and Recording Elements.

45.4.   Primary indicating and recording elements shall be susceptible to advancement only by the mechanical operation of the device.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.1.5. Return to Zero

45.5.   If the meter is so designed that the primary indicating elements are readily returnable to a definite zero indication, means shall be provided to prevent the return of these elements beyond their correct zero position.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.2.1. Graduation Length

45.6.   Graduations shall be so varied in length that they may be conveniently read.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.2.2. Graduation Width

45.7.   In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 percent greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.2.3. Clear Interval Between Graduations

45.8.   The clear interval shall not be less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

3.8.1.   (a) along the line of relative movement between the graduations at the end of the indicator, or   **Yes ☐ No ☐ N/A ☐**

3.8.2.   (b) if the indicator is continuous, at the point of widest separation of the graduations.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.3.1. Indicator Symmetry

45.9.   The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.3.2. Indicator Length

45.10.   The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.3.3. Indicator Width

45.11.   The width of the index of an indicator in relation to the series of graduations with which it is used shall not be greater than: **Yes ☐ No ☐ N/A ☐**
(a) the width of the widest graduation, and
(b) the width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

Code Reference: S.1.3.4. Clearance

The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.1.3.6. Parallax

Parallax effects shall be reduced to the practicable minimum.   **Yes ☐ No ☐ N/A ☐**

46.   Measuring Elements

Code Reference: S.2.1. Provision for Sealing

46.1.   Adequate provision shall be made for applying security seals in such a manner that no adjustment or interchange may be made of: **Yes ☐ No ☐ N/A ☐**
(a) any measurement elements, and
(b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries.
The adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

47.   Batching Meters Only

Code Reference: S.2.2.1. Air Elimination

47.1.   Batching meters shall be equipped with an effective air eliminator.   **Yes ☐ No ☐ N/A ☐**

Code Reference: S.2.2.2. Directional Flow Valves

47.2.   Valves intended to prevent reversal of flow shall be automatic in operation.   **Yes ☐ No ☐ N/A ☐**

48.   Multi-Jet Meter Identification

48.1.   Multi-jet water meters shall be clearly and permanently marked as such on the device or identified on the Certificate of Approval.   **Yes ☐ No ☐ N/A ☐**

L   Laboratory Evaluation and Permanence Tests for Utility Type Water Meters

All new-design meters are subject to a permanence test. NTEP reserves the right to require a permanence test based on the result**s** of the initial examination.

Initial Examination

1. All meters of the new type installed at the type evaluation location are subject to evaluation. At least three meters of the same model must be tested.

2. At least three meters will be chosen for throughput testing on water. The minimum number of tests to be conducted for each of these meters will include the following:

- Three tests at the maximum flow rate
- Three tests at the intermediate flow rate
- Three tests at the minimum flow rate

3. All meters must perform within acceptance tolerance

4. Repeatability - When multiple tests are conducted at approximately the same flow rate, each test shall be within the applicable tolerances and the range of test results shall not exceed the following values:
1. 0.6 percent for tests conducted at Normal Flow Rates
2. 2.0 percent for tests conducted at Intermediate Flow Rates
3. 4.0 percent for tests conducted at Minimum Flow Rates

Subsequent Examination

1. Following the period of use, the tests listed above are to be repeated. All results within the range of flow rates are to be included on the certificate of conformance provided the results are within the applicable tolerances.

2. The examination will be conducted as applicable:

- 200,000 gallons for throughput testing for mechanical changes of metrological significance
- Flow rates during throughput testing are not to exceed 50% of the manufacturers rated maximum flow rate

3. Three tests at maximum, intermediate and minimum flow rate will be made on the throughput meters. Only one test at each flow rate needs to be performed on any remaining meters.

4. Repeatability – When multiple tests are conducted at approximately the same flow rate, each test shall be within the applicable tolerances and the range of test results shall not exceed the following values:

1. 0.6 percent for tests conducted at Normal Flow Rates
2. 2.0 percent for tests conducted at Intermediate Flow Rates
3. 4.0 percent for tests conducted at Minimum Flow Rates