



National Conference on Weights and Measures
National Type Evaluation Program

**Cryogenic Liquid
Measuring Devices**

Technical Policy • Checklists • Test Procedures



NCWM

Publication 14

© 2019

APPENDIX C - 2019 Measuring Sector Summary – Checklist with Revisions Made at the Sector Meeting

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Amendments

Cryogenic Liquid Measuring Devices

Section Number	Amendment	Page	Source
6.	Revise Code Reference S.2.1. to add “Air?”. Also revise the wording of the following paragraph.	CLMD-13	2018 Measuring Sector
6.2.	Add new requirement and renumber remaining requirements.	CLMD-13	2018 Measuring Sector
6.3.	Removed requirement for metal material and revised for the use of non-collapsible material.	CLMD-13	2018 Measuring Sector
8.	Revise Code Reference S.2.1. to add “Air?”.	CLMD-15	2018 Measuring Sector
8.1.	Removed numbering and check boxes.	CLMD-15	2018 Measuring Sector
8.1.	added new paragraph.	CLMD-15	2018 Measuring Sector
8.2.	added new paragraph.	CLMD-15	2018 Measuring Sector
8.3.	added new paragraph.	CLMD-15	2018 Measuring Sector
Document	Please note that the NTEP Measuring Devices publication has been thoroughly reviewed by NCWM staff. Changes have been made, but none are to change intent of the policies, checklists or test procedures, thus considered editorial. Issues or concerns should be brought to the attention of NCWM staff.	Document	Editorial

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National Type Evaluation Program

Cryogenic Liquid Measuring Devices – Checklists and Test Procedures

Introduction

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 National Type Evaluation Program (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.

When test procedures could be briefly described, they have been incorporated in the checklist. Longer test procedures are consolidated at the end of the checklist.

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.

The following are examples of the application of these criteria:

Vehicle Tank Meter:

- Serial number is required on the meter; it is a major component of the system because it is required for the system to operate.
- Serial number is required on the indicating elements.

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):

Code Reference: G-S.1. (a)

- 1.1. The name, initials, or trademark of the manufacturer or distributor. Yes No No

Code Reference: G-S.1. (b)

- 1.2. A model identifier that positively identifies the pattern or design of the device. The model identifier shall be prefaced by the word "Model," "Type," or "Pattern." These terms may be followed by the word "Number" or an abbreviation of that word. Yes No No

- 1.2.1. The abbreviation for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.) Yes No No

- 1.2.2. The abbreviation for the word "Model" shall be "Mod" or "Mod." Prefix lettering may be initial capitals, all capitals, or all lower case. Yes No No

Code Reference: G-S.1. (c)

- 1.3. Except for equipment with no moving or electronic component parts and software, a non-repetitive serial number. Yes No No

- 1.3.1. The serial number shall be prefaced by the words "Serial Number" or an abbreviation, or a symbol, that clearly identifies the number as the required serial number. Yes No No

- 1.3.2. 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 No

Code Reference: G-S.1. (d)

Not built-for-purpose, software based devices shall be marked with the following:

Note: Effective January 1, 2022, this will apply to all software-based devices (or equipment).

1.4. The current software version designation.

- 1.4.1. 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." Yes No No

If equipment is capable of displaying the version or revision identifier but is unable to meet the formatting requirement, through the NTEP type evaluation process, other options may be deemed acceptable and described in the CC.

If this option is used, describe the option below:

- 1.4.2. The version or revision identifier shall be continuously displayed or be accessible via the display. Instructions for displaying the version or revision identifier shall be described in the CC. As an alternative, permanently marking the version or revision identifier shall be acceptable providing the device does not always have an integral interface to communicate the version or revision identifier. Yes No No

If this option is used, describe the option below:

- 1.4.3. Abbreviations for the word "Version" shall, as a minimum, begin with the letter "V." Abbreviations for the word "Revision" shall, as a minimum, begin with the letter "R." The abbreviations for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.) Prefix lettering may be initial capitals, all capitals, or all lowercase. Yes No No

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

- 1.5. An NTEP Certificate of Conformance (CC) Number or a corresponding CC addendum number for devices that have (or will have) a CC. Yes No No

- 1.5.1. 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." Yes No No

- 1.5.2. The abbreviation for the word "Number" shall as a minimum begin with the letter "N" (e.g., No or No.) Yes No No

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.

1.5.3. Location of CC Number if not located with the identification information:

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

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** Yes No No

1.6.2. The Certificate of Conformance (CC) Number shall be:

1.6.2.1. Permanently marked on the device. **OR** Yes No No

1.6.2.2. Continuously displayed. **OR** Yes No No

1.6.2.3. 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." Yes No No

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 No

1.8. The identification badge must be permanent. Yes No No

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 No

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 No

1.11. Operating parts will continue to function as intended. Yes No No

1.12. Adjustments will remain reasonably permanent. Yes No No

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.

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

1.13.1. Constructed so that reversal will not affect performance. Yes No No

1.13.2. Marked or keyed to indicate the proper position. Yes No No

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.

- 1.14. The maximum money value and quantity indications and unit prices are appropriate for the intended use. Yes No No
- 1.15. The indications must be clear, definite, and accurate. Yes No No
- 1.16. The indications must be easily read under normal operating conditions. Yes No No
- 1.17. 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 No
- 1.18. Symbols for decimal points shall clearly identify the decimal position. (Generally acceptable symbols are dots, small commas, or x.) Yes No No
- 1.19. The zero indication must consist of at least the following minimum indications as appropriate:
- 1.19.1. One digit to the left and all digits to the right of a decimal point. Yes No No
- 1.19.2. If a decimal point is not used, at least one active decade plus any constant zeros. Yes No No
- 1.19.3. A fixed or constant zero cannot appear after a decimal point; e.g., all decades to the right of a decimal point must be active.* Yes No No
- *A fixed zero may appear after a decimal point on a receipt and/or console if the system is unable to distinguish if the digit is fixed or active.

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 No

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

- 2.2. Basic Operating Requirements for Devices:
- 2.2.1. All digital values of like value in a system shall agree. Yes No No
- 2.2.2. A digital value shall agree with its analog representation to the nearest minimum graduation. Yes No No
- 2.2.3. Digital values shall round off to the nearest digital division that can be indicated or recorded. Yes No No
- 2.2.4. 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 No
- 2.2.5. 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 non-resettable pulser. Yes No No
- 2.3. All digital values of like value in a system agree with one another. Yes No No
- 2.4. Digital values coincide with associated analog values to the nearest minimum graduation. Yes No No

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- 2.5. Digital values "round off" to the nearest minimum unit that can be indicated or recorded. Yes No No
- 2.6. The device totalizer shall agree with the total of the individual deliveries and with other totalizers in the system. Yes No No

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.

- 2.7. Corresponding graduations shall be uniform in size and character. Yes No No
- 2.8. Subordinate graduations, indications, and recorded representations shall be appropriately portrayed or designated. Yes No No

Code Reference: G-S.5.2.4. Values Defined

- 2.9. 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 No

Code Reference: G-S.5.2.5. Permanence

- 2.10. 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 No

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

- 2.11. 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 No
- 2.12. Graduations and indications shall be uniform throughout any series. Yes No No
- 2.13. Quantity values shall be identified by the unit of measure. Yes No No

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.

- 2.14. 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 No

Code Reference: G-S.5.6. Recorded Representations

- 2.15. All recorded values shall be digital. *See also G-UR.3.3.* Yes No No

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

- 2.16. Magnified indications shall conform to all requirements for graduations and indications. Yes No No

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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.

- 2.17. All operational controls, indications, and features including switches, lights, displays, and push-buttons shall be clearly and definitely identified. Yes No No
- 2.18. All dual function (multi-function) keys or controls shall be marked to clearly identify all functions. Yes No No
- 2.19. Non-functional controls and annunciators shall not be marked. Yes No No

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

- 2.20. Required markings and instructions shall be permanent and easily read. Yes No No

Code Reference: G-S.8. Sealing Electronic Adjustable Components; Provision for Sealing of Adjustable Components; Provision for Metrological Data Change or Audit Trail and G-S.9. Metrologically Significant Software Updates

- 2.21. 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: and (5) software updates that change the metrologically significant software. Yes No No

Appendix A provides the philosophy and list of sealable parameters that apply to provision for sealing all liquid 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 measurement, has been changed since the previous inspection. The information contained in the audit trail shall consist of an accumulative and non-destructible number (even if a power failure occurs) which increments each time any of the adjustments that are 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, Minimum Requirements for Audit Trails for Liquid Measuring Devices.

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

- 2.22. 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 No
- 2.23. A physical seal must be applied without exposing electronics. Yes No No
- 2.24. Event counters are non-resettable and have a capacity of at least 000 to 999. Yes No No
- 2.25. Event counters increment appropriately. Yes No No
- 2.26. 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 No
- 2.27. Accessing the audit trail information for review shall be separate from the calibration mode. Yes No No
- 2.28. Accessing the audit trail information must not affect the normal operation of the device. Yes No No
- 2.29. 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 No

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

- 2.30. The physical hardware enabling access for remote communication must be on- site. Yes No No
- 2.31. The physical hardware must be sealable with a security seal. **OR** Yes No No
- 2.32. The device must be equipped with at least two event counters: one for calibration, the second for configuration parameters:
 - 2.32.1. At the individual measuring device. **OR** Yes No No
 - 2.32.2. At the system controller. Yes No No
- 2.33. 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 No
- 2.34. 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 No
- 2.35. The device must either:
 - 2.35.1. Clearly indicate when it is in the remote configuration mode. **OR** Yes No No
 - 2.35.2. The device shall not operate while in the remote configuration mode. Yes No No
- 2.36. If capable of printing in the calibration mode, it must print a message that it is in the calibration mode. Yes No No
- 2.37. 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 No
- 2.38. The audit trail information must be readily accessible and easily read. Yes No No

Minimum Number of Counters Required

	Minimum Counter(s) 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.

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

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

- 2.39. For devices manufactured after January 1, 2001, the device must either:
- 2.39.1. Clearly indicate when it is in the remote configuration mode. **OR** Yes No No
- 2.39.2. The device shall not operate while in the remote configuration mode. Yes No No
- 2.40. The device is equipped with an event logger. Yes No No
- 2.41. 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 No
- 2.42. Event counters are nonresettable and have a capacity of at least 000 to 999. Yes No No
- 2.43. The system is designed to attach a printer, which can print the contents of the audit trail. In addition to the hard copy, the information may also be made available electronically. Yes No No
- 2.44. 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 No
- 2.45. 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 No
- 2.46. The event logger drops the oldest event when the memory capacity is full and a new entry is saved. Yes No No
- 2.47. Describe the method used to seal the device or access the audit trail information.
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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.

- 2.48. The equipment is suitable for its intended application. Yes No No

Code Reference: G-UR.1.2. Environment

- 2.49. Equipment shall be suitable for use in the environment in which it will be used. 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. Yes No No

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.)

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3. Indicating Elements, Recording Elements and Recorded Representations

Code Reference: S.1.1. Primary Elements – General

- 3.1. A device shall be equipped with a primary indicating element. Yes No No
- 3.2. Is the device equipped with a primary recording element? Yes No No

Code Reference: S.1.1.5. Return to Zero

The primary indicating elements on a vehicle tank meter must be returnable to zero before a delivery. If the register has a printer, the printer is not required to return to zero. If it is returnable to zero, then neither the indicating nor the recording element shall go beyond their correct zero position. Due to the manner in which vehicle tank meters operate, the outlet side of the meter shall be automatically or manually filled with product before the indicating and recording elements are set to zero.

- 3.3. Primary indicating elements shall be readily returnable to a definite zero indication. Means shall be provided to prevent the return of the primary indicating or recording elements beyond their correct zero position. Yes No No
- 3.4. Automatic or manual means shall be provided to assure that the system on the outlet side of the meter is completely filled with product before recording an initial zero condition as required by UR.2.1. Yes No No
- 3.5. A printer shall be so designed that the recording of zero shall reflect the actual initial condition of the meter prior to deliver. Yes No No

Code Reference: S.1.3. Advancement of Indicating and Recording Elements

Primary indicating and recording elements may advance only as a result of the mechanical operation of the device. However, during the process of resetting the indicating and recording elements to zero, the elements may advance to zero provided that once the advancing movement is started, it cannot be stopped until zero is reached or, in the case of indicating elements, the indications are automatically obscured during the reset process until the correct zero position is reached.

- 3.6. Indicating and recording elements shall advance only by the mechanical operation of the device (except for clearing the device to zero.) Yes No No
- 3.7. If the indicating and recording elements advance to zero during the reset operation, the advancing movement cannot be stopped until zero is reached, or in the case of indicating elements only, the elements shall automatically be obscured until the elements reach the correct zero position. Yes No No

4. Graduations

Code Reference: S.1.4.1. Length

- 4.1. Graduations shall vary in length such that they may be conveniently read. Yes No No

Code Reference: S.1.4.2., S.1.4.3. Width, Clear Interval between Graduations

For the purpose of visibility and ease of reading, several requirements exist for the length and width of graduations and the clear space between graduations. Although main graduations are permitted to be wider than subordinate graduations, it is recommended that all graduations be of uniform width. The clear interval between graduations must be at least 1.0 mm (0.04 in.) If the graduations are not parallel, then the clear interval is measured at specified points depending upon the type of indicator that is used. The points of measurement are (a) along the line of movement between the graduations and the end of the indicator or (b) if the indicator extends over the entire length of the graduations measure at the point of widest separation of the graduations.

- 4.2. Graduations shall be at least 0.2 mm (0.008 in) wide. Yes No No
- 4.3. The clear interval between graduations shall be at least 1.0 mm (0.04 in). Yes No No
- 4.4. Graduations shall not be wider than the clear interval between the graduations. Yes No No
- 4.5. Main graduations shall not be more than 50% wider than subordinate graduations. Yes No No

5. Indicators

To facilitate reading values indicated on analog indicating elements, the index of the indicator must have a shape, length, and width that promote the accurate reading of values. The index must be properly positioned to reduce reading errors.

Code Reference: S.1.5.1. Symmetry

- 5.1. The index shall be symmetrical with respect to the graduations. Yes No No

Code Reference: S.1.5.2. Length

- 5.2. The index shall reach to the finest graduations with which it is used unless the indicator and graduations are in the same plane. Yes No No
- 5.3. If the indicator and graduations are in the same plane, the distance between the end of the indicator and the ends of the graduations shall not exceed 1.0 mm (0.04 in.) Yes No No

Code Reference: S.1.5.3. Width

- 5.4. The width of the index shall not exceed the width of widest graduation. Yes No No
- 5.5. The width of the index shall not exceed the width of the clear interval between graduations. Yes No No
- 5.6. If the index extends along the entire length of a graduation, the portion of the index that overlay the graduation shall be of constant width throughout the length of the graduation. Yes No No

Code Reference: S.1.5.4. Clearance

- 5.7. The clearance between the index and the graduations shall not exceed 1.5 mm (0.06 inch.) Yes No No

Code Reference: S.1.5.5. Parallax

- 5.8. Parallax effects shall be reduced to practicable minimum. Yes No No

6. Measuring Elements

Code Reference: S.2.1. Air/Vapor Elimination

Note: Only applies to product metered in liquid state.

If air/vapor enters a metering system or the product changes into the vapor state as it passes through the system, then the system must be equipped with an effective air/vapor eliminator or other automatic means to prevent the passage of air/vapor through the meter. To prevent air/vapor eliminator vent lines from being pinched closed and reopened without being detected, the vent lines shall be made of appropriate non-collapsible material. If the system is designed such that air/vapor will not enter the system, then an air/vapor eliminator is not required. One example is when a product is being pumped from the bottom of a tank and a low-level detector in the tank shuts off the pump before the liquid level gets to the point where air could enter the system.

- 6.1. The metering system is equipped with an effective air/vapor eliminator. Yes No No
- 6.2. Other effective, automatic means are provided to prevent air/vapor from passing through the system. Describe the means provided and list this information on the Certificate of Conformance. Yes No No
-
- 6.3. The vent lines are made of appropriate non-collapsible material to prevent the lines from being pinched closed and re-opened without being detected. Yes No No

7. Indicating and Recording Elements

Code Reference: G-S.5.1., G-UR.1.1. General

Indicating elements must be appropriate in design and adequate in amount. Specifically, a device must have sufficient display capacity to indicate the quantities and total prices that normally are encountered if this applies, in the intended application. Electronic devices shall either have sufficient display capacity to indicate the normal quantities and money values or automatically stop the delivery before exceeding the display capacity of either the quantity or total price. Analog indicating elements must have sufficient display capacity for the device to be suitable for the application.

- 7.1. Analog dispensers shall have adequate display capacity for the application. Yes No No
- 7.2. An electronic digital indicating element shall either:
- 7.2.1. Have adequate display capacity for the application. Yes No No
- 7.2.2. Automatically stop the delivery before exceeding the maximum quantity or maximum total price that can be indicated. Yes No No

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

- 7.3. Basic operating requirements for devices:
- 7.3.1. All digital values of like value in a system shall agree. Yes No No
- 7.3.2. A digital value shall agree with its analog representation to the nearest minimum graduation. Yes No No
- 7.3.3. Digital values shall round off to the nearest digital division that can be indicated or recorded. Yes No No
- 7.3.4. 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 No
- 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 non-resettable pulser.
- 7.3.4.1. All digital values of like values in a system agree with one another. Yes No No

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- 7.3.4.2. Digital values coincide with associated analog values to the nearest minimum graduation. Yes No No
- 7.3.4.3. Digital values "round off" to the nearest minimum unit that can be indicated or recorded. Yes No No
- 7.3.4.4. The device totalizer shall agree with the total of the individual deliveries and with other totalizers in the system. Yes No No

Code Reference: S.1.1.2. Units

- 7.4. The device shall indicate, and record if equipped to record, its deliveries in terms of kilograms or pounds; liters or gallons of liquid at the normal boiling point of the specific cryogenic product; cubic meters, or cubic feet of gas at a normal temperature of 21 °C (70 °F) and an absolute pressure of 101.325 kPa (14.696 psia); subdivisions or multiples of the measured units cited above. Yes No No

Code Reference: S.1.1.3. Value of Smallest Unit

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

- 7.5. For small delivery devices (max. rated flow 75 gpm or less) Yes No No
1. 1 L
 2. 0.1 gal
 3. 1 kg
 4. 1 lb
 5. 0.1 m³ of gas
 6. 10 cu. Ft of gas
- 7.6. For large delivery devices (max. rated flow greater than 75 gpm) Yes No No
1. 10 L
 2. 1 gal
 3. 10 kg
 4. 10 lb
 5. 1 m³ of gas
 6. 100 ft³ of gas

Code Reference: S.1.1.4. Travel Indicator

If the most sensitive element of the indicating system uses an indicator and graduations, the relative movement of these parts corresponding to a delivery of the smallest indicated value must be no less than 5 mm (0.20 in.)

Code Reference: S.1.1.5 Money Values – Mathematical Agreement

Any digital money value indication and any recorded money value on a computing-type device must mathematically agree with its associated quantity indication or representation to within one cent of money value. (Quantity X Unit Price = Sale Price ± 1 cent)

Note: At least four decimal places in cents must be carried to determine the proper round off of money values.

8. Measuring Elements

Code Reference: S.2.1. Air/Vapor Elimination on Wholesale and Loading Rack Metering Systems

A measuring system shall be equipped with an effective air/vapor eliminator or other effective means to prevent the measurement of vapor that will cause errors in excess of the applicable tolerances. *See NIST Handbook 44, Cryogenic Liquid-Measuring Devices, Section T.*

- 8.1. The metering system is equipped with an effective air/vapor eliminator. Yes No No
- 8.2. Other effective, automatic means are provided to prevent air/vapor from passing through the system. Describe the means provided and list this information on the Certificate of Conformance. Yes No No

- 8.3. The vent lines are made of appropriate non-collapsible material to prevent the lines from being pinched closed and re-opened without being detected. Yes No No

Code Reference: S.2.5. Provision for Sealing

For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

Measuring elements shall be designed to provide for an approved means of security (e.g. data change audit trail and/or physically applying security seals) such that an adjustment to the measuring element or the flow rate control (if the flow rate affects the accuracy of deliveries) cannot be made without breaking the security seal. The adjusting mechanism shall be readily accessible for the purposes of affixing a security seal.

- 8.4. Adequate provision shall be made to apply security seals so that no adjustment or interchange may be made to:
 - 8.4.1. Any measuring element. Yes No No
 - 8.4.2. Any adjustable element controlling the delivery rate if the flow rate affects the accuracy of deliveries. Yes No No
 - 8.4.3. Any automatic temperature or density compensating system. Yes No No
 - 8.4.4. Any other adjusting mechanism. Yes No No
- 8.5. When applicable, the adjusting mechanism shall be readily accessible for the purpose of affixing a security seal. Yes No No
- 8.6. Audit trails shall use the format set forth in the Common and General Code Criteria Section of this checklist (Code Reference G-S.8) and in Appendix A, Audit Trail checklist for Liquid-Measuring Devices of the Liquid-Measuring Devices Checklist. Yes No No

Code Reference: S.2.2. Directional Flow Valves

- 8.7. Valves intended to prevent the reversal of flow shall be automatic in operation. Yes No No

Code Reference: S.2.3. Maintenance of Liquid State

- 8.8. A device shall be so designed that the product being measured will remain in a liquid state during passage through the device. Yes No No

Code Reference: S.2.4. Automatic Temperature or Density Compensation

- 8.9. A device shall be equipped with automatic means to adjust the indication and/or recorded representation of the measured quantity of the product, to indicate and/or record in terms of liters or gallons of liquid at the normal boiling point of the specific product; or the Yes No No

equivalent cubic meters or cubic feet of gas at a normal temperature of 21 °C (70 °F) and an absolute pressure of 101.325 kPa (14.696 psia.)

- 8.9.1. When a compensator system malfunctions, the indicating and recording elements may indicate and record in uncompensated volume if the mode of operation is clearly indicated (e.g. by a marked annunciator, recorded statement, or other obvious means).

Yes No No

9. Discharge Lines and Discharge Line Valves

Code Reference: S.3.1. Diversion of Measured Liquid

- 9.1. No means shall be provided to allow any measured liquid to be diverted from the measuring chamber of the device or the discharge line, except for a manually controlled outlet that may be opened to purge or drain the measuring system shall be permitted. Effective means shall be provided to prevent liquid passing through any such outlet during normal operation of the device and to indicate clearly and unmistakably when the valve controls are so set as to permit passage of liquid through such outlet.

Yes No No

Code Reference: S.3.2. Discharge Hose

- 9.2. The discharge hose of a measuring system shall be of the completely draining dry-hose type.

Yes No No

10. Marketing Requirements

Code Reference: S.5.1. Limitation on Use

- 10.1. If a device is intended to accurately measure only products having particular properties, or under specific installation or operating conditions, or when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently marked on the device.

Yes No No

Code Reference: S.5.2. Discharge Rates

- 10.2. The designed maximum and minimum discharge rates must be marked on the device.

Yes No No

Code Reference: S.5.3. Temperature or Density Compensation

- 10.3. Devices equipped with an automatic temperature or density compensator shall be clearly and conspicuously marked on the primary indicating elements, recording elements, and recorded representations to show that the quantity delivered has been adjusted to the conditions specified in S.2.4.

Yes No No

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11. Computing Type Devices

If a vehicle tank meter can compute the total sales price of a delivery, then the unit price at which the meter is set to compute must be displayed on the outside of the device. The unit price must be displayed in a manner that is clear to both the operator and an observer. The primary indicating element must 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.) The printed ticket must state the quantity delivered and the unit price if the total price is printed on the ticket.

A computing-type meter shall compute the total sale price for all unit prices and quantities for all deliveries. The money value division for analog meters shall be one cent, and the graduations shall be accurately positioned; however, the accuracy of the total price is not specified. On devices with digital indications, the total price shall be computed on the basis of a quantity-value division of 0.2 L (0.1 gal) or less. The total price indication on a digital device shall be accurate to within one cent.

Code Reference: S.1.4.1. Printed Ticket

- 11.1. Any printed ticket with the total computed price indicated must also have clearly printed the total quantity delivered in terms of liters, gallons, kilograms, or cubic meters of gas, or cubic feet of gas and the appropriate fraction, and the unit price. Yes No No

Code Reference: S.1.4.3. Money Value Computations

- 11.2. The device shall be of the full computing type. Yes No No
- 11.3. Money-value graduations shall be supplied and accurately positioned. Yes No No
- 11.4. The value of each graduated interval shall be one cent. Yes No No
- 11.5. On electronic devices with digital indications, the total price may be computed on the basis of the quantity indicated when the value of the smallest division indicated is equal to or less than the values specified in S.1.1.3. Yes No No

Code Reference: S.1.4.4. Money Values - Mathematical Agreement

Any digital money value indication and any recorded money value on a computing type device must mathematically agree with its associated quantity indication or representation to within one cent of money value (Quantity x Unit Price = Sale Price ±1 Cent.) Check mathematical agreement:

- 11.6. At various flow rates, including the maximum and minimum. Yes No No
- 11.7. At several unit prices including low prices and the maximum pricing capability of the computer. Yes No No

Note: At least four decimal places in cents must be carried to determine the proper round off of money values.

12. Indicating and Recording Elements

Code Reference: G-S.5.1. General/Tax Computation

Digital electronic vehicle tank meters frequently have the capability to compute the taxes that apply to the sale of fuel oil and gasoline. A delivery may have more than one tax. Unless the round-off method for a tax to be applied to a sale is specified, the dollar amount of each tax is to be separately computed, rounded to the nearest cent, and then added to obtain the total price of the sale. A vehicle-tank-meter register must demonstrate that it is capable of rounding the tax money values to the nearest cent (even if the jurisdiction in which the test is conducted specifies another form of round off) because most jurisdictions require round-off to the nearest cent.

- 12.1. Each tax shall be separately computed, rounded to the nearest cent, and added to obtain the total price of the sale. Yes No No

National Type Evaluation Program

Cryogenic Liquid Measuring Devices – Field Evaluations and Permanence Tests

A. Field Evaluation and Permanence Test for Cryogenic Meters (other than Turbine and Mass Flow Meters)

As adopted at the 1985 NCWM Annual Meeting, the following tests are considered to be appropriate for metering systems on cryogenic meters.

- Three tests at the maximum discharge rate.
- Three intermediate flow tests.
- Three slow-flow tests.
- Three vapor or air eliminator tests.

Only one meter is required for the initial test after which the meter will be placed into service for the permanence test. The following minimum throughput criterion is recommended for these meters.

- Maximum rated flow rate x 1500 for meters rated at 227 Lpm (60 gpm) or greater.
- Maximum rated flow rate x 500 for meters rated less than 227 Lpm (60 gpm.)

Note: Based upon past weights and measures experience, this corresponds to 30-60 days. The time period is considered appropriate because these meters have a history of becoming inaccurate more frequently than meters for other fuels.

Following the period of use, the tests listed above are to be repeated. All results must be within acceptance tolerances.

B. Field Evaluation and Permanence Test for Turbine Meters

The following tests are considered to be appropriate for turbine meters:

- At least five tests at each of a minimum of four different flow rates across the range of flow of the meter
- At least two meters are required for each product type for the initial test
- The manufacturer must also submit data to indicate meter performance over the range of viscosity of products to be used with the meter
- Data must also be submitted to indicate meter performance over the temperature range in which the meter is anticipated to be used
- Following the initial test, the meters will be placed into service for the permanence test. The following minimum throughput criterion is recommended for these meters.
- Maximum rated flow rate x 2 000.
- Following the period of use, the tests listed above are to be repeated. All results must be within acceptance tolerances. Following evaluation of test data and analysis of the data presented by the manufacturer for meter performance over temperature and viscosity ranges, the evaluating laboratory may require additional testing prior to issuing a Certificate of Conformance for the meter.

C. Field Evaluation and Permanence Test for Mass Flow Meters

Type Evaluation

The gravimetric test method shall be used for type evaluation.

Gravimetric Standard

The combined error of the standard used for testing measuring instruments shall not exceed 20% of the maximum permissible error to be applied.

Test Drafts

Any test draft shall be equal to at least the quantity that is delivered in one minute at the maximum flow rate. The test drafts shall be equal in quantity regardless of the rate of flow.

Test Data

The following tests are considered to be appropriate for mass flow meters:

- Five tests at each of four different flow rates across the range of flow of the meter are considered to be appropriate for mass flow meters.
- All data points must fall within the maximum permissible error limits.
- Following the initial test, the meters will be placed into service for the permanence test. The minimum throughput criterion recommended for these meters are 60 days or 2 000 x maximum flow rate achieved in the installation, whichever comes first. Following the period of use, the tests listed above are to be repeated. All results must be within acceptance tolerances.

Note: The specified tolerance of 0.3% is to be applied to both the initial and the final tests. No adjustments may be made to the meter during this period. This tolerance is to be applied even if different liquid temperatures and pressures exist between the initial and final tests.

- Determination of performance relative to repeatability, accuracy, and linearity should be tested using accepted statistical methodology. Reference documents include: 1) SAMA Standard PMC 20.1-1973, Process Measurement and Control Terminology; 2) ANSI/ASME MFC-2M-1983, Measurement Uncertainty for Fluid Flow in Closed Conduits; and 3) ANSI/ASME MFC-1M-1979, Glossary of Terms Used in the Measurement of Fluid Flow in Pipes.

D. Tests of Automatic Temperature Compensating Systems on Wholesale Meters**General Code Reference G-A.3. and Liquid-Measuring Devices; Code Reference T.2.3.4.**

The difference between the meter error for results determined with and without the automatic temperature compensating system activated shall not exceed:

- 0.2% of the test draft for mechanical automatic temperature compensating systems. **AND**
- 0.1% of the test draft for electronic automatic temperature compensating systems.
- The results of each test shall be within the applicable acceptance of maintenance tolerance.

E. Repeatability on Cryogenic Liquid Measuring Devices

Code References: **N.5.1.1**, **N.5.3**, and T.4.

When multiple tests are conducted at approximately the same flow rate and draft size, the range or the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance.

Test for repeatability shall include a minimum of three consecutive test drafts of approximately the same size and conducted under controlled conditions where variations in factors, such as, temperature pressure and flow rate are reduced to the extent that they will not affect the results.

Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained. When conducting the tests, the discharge rates shall be within the minimum and maximum discharge rates as marked by the manufacturer. For devices equipped with an automatic temperature or density compensator, results shall be based on either: (1) all runs conducted with the compensated (net) volume (e.g., with the temperature or density compensator activated); or (2) all runs conducted with the uncompensated (gross) volume (e.g. with the temperature or density compensator deactivated).

F. Policy on Remanufactured and Repaired Devices

Refer to the Section Policy on Remanufactured and Repaired Devices in *NCWM Publication 14 Administrative Policy*.

Appendix A

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 using 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.

The current language in *NIST Handbook 44*, paragraph G-S.8. states: "A device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism." Thus, for parameters protected by physical means of security, once a physical security seal is applied to the device, it should not be possible to make a metrological change to those parameters without breaking that seal. Likewise, for parameters protected by electronic means of security, it should not be possible to make a metrological change to those parameters without that change being reflected in the audit trail. Since this philosophy addresses provisions for protecting access to any metrological adjustment, the philosophy should be applied consistently to all electronic device types.

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.

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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.
14. Software updates that change the metrologically significant software.

Liquid Measuring Device Features and Parameters

Typical Features or Parameters to be Sealed	Typical Features or Parameters Not Required to be Sealed
<ul style="list-style-type: none"> • Measuring Element Adjustment (both mechanical and electronic) • Linearity Correction Values • Measurement Units (e.g., gallons to liters) • Octane Blend Setting for Retail Motor Fuel Dispensers • Any Tables or Settings Accessed by the Software or Manually Entered to Establish the Quality (e.g., specific gravity, pressure, etc.) • Density Ranges • Pulsers • Single 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. • Software updates that change the metrologically significant software. 	<ul style="list-style-type: none"> • Analog-to-Digital Converters • Quality Division Value (display resolution) • Double Pulse Counting • Communications

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 (e.g., the parameter does not affect compliance with NIST Handbook 44.)

Section 3.33. of *NIST 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 *NIST Handbook 44* for the design of audit trails installed in cryogenic liquid-measuring devices.