

# National Type Evaluation Program (NTEP) Measuring Sector

**Annual Meeting**  
**September 20-21, 2016 Denver, Colorado**

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**APPENDICES:**

**Appendix A:** Attendance List – 2016 Measuring Sector Meeting

**Appendix B:** Field Evaluation and Permanence Tests for Mass Flow Meters - Master Meters – Ref. Agenda Item 1.

**Appendix C:** Guidance on Empirical Analysis – Ref Agenda Item 2.E.

**Appendix D:** Draft Publication 14 Checklist for Electric Vehicle Fueling Systems (EVFS) – Ref Agenda Item17.

<b>Glossary of Acronyms</b>			
CC	Certificate of Conformance	NTETC	National Type Evaluation Technical Committee
DMS	Division of Measurement Standards	OIML	International Organization of Legal Metrology
ECR	Electronic Cash Register	OWM	Office of Weights and Measures (NIST)
EVFS	Electric Vehicle Fueling Systems	PD	Positive Displacement
HB 44	NIST Handbook 44 “Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices”	Pub 14	NCWM Publication 14
LMD	Liquid Measuring Devices	RMFD	Retail Motor-Fuel Dispenser
mA	milliamp	SI	International System of Units
NCWM	National Conference on Weights and Measures	S&T	Specifications and Tolerances
NIST	National Institute of Standards and Technology	VTM	Vehicle Tank Meter
NTEP	National Type Evaluation Program	W&M	Weights and Measures
This glossary is meant to assist the reader in the identification of acronyms used in this agenda and does not imply that these terms are used solely to identify these organizations or technical topics.			

***Call to Order:***

*Sector Chairman, Mike Keilty (Endress + Hauser) called the meeting to order; reviewed the Sector’s agenda; and described the processes for the meeting. Meeting attendees are shown in Appendix A – Attendance List 2016 Measuring Sector Meeting.*

## **Carry-over Items:**

### **1. Transfer Standards Testing - NIST HB 44 Section 3.32. LPG & NH<sub>3</sub> Liquid-Measuring Devices Code and Section 3.37. Mass Flow Meters Code.**

**Source:** Michael Keilty, Endress + Hauser Flowtec AG; [2014 NCWM S&T Item 332-2 (D)] and [2014 NCWM S&T Item 337-3 (D)] and 2015 Measuring Sector Meeting

**Recommendation:** The Sector is asked to provide input on two proposals being developed by Mr. Michael Keilty (Endress + Hauser Flowtec AG). These items appeared on the 2014 through 2016 NCWM S&T Agendas, most recently appearing as Items 332-5 N.3. Test Drafts and Item 337-3 N.3. Test Drafts.

These proposals recommend the addition of a paragraph to the “Notes” section of the LPG and Anhydrous Ammonia Liquid-Measuring Devices Code and the Mass Flow Meters Code specifying the size of the test draft when using a “transfer standard.” The current proposal is outlined below:

Amend NIST Handbook 44 LPG and Anhydrous Ammonia Liquid-Measuring Devices as follows:

#### **N.3. Test Drafts. –**

**N.3.1 Minimum Test** - Test drafts should be equal to at least the amount delivered by the device in one minute at its normal discharge rate.

(Amended 1982)

**N.3.2. Transfer Standard Test. – When comparing a meter with a calibrated transfer standard, the test draft shall be equal to at least the amount delivered by the device in 2 minutes at its maximum discharge rate.**

Amend NIST Handbook 44 Mass Flow Meters Code as follows:

#### **N.3. Test Drafts. –**

**N.3.1 Minimum Test** - Test drafts should be equal to at least the amount delivered by the device in one minute at its normal discharge rate.

(Amended 1982)

**N.3.2. Transfer Standard Test. – When comparing a meter with a calibrated transfer standard, the test draft shall be equal to at least the amount delivered by the device in 2 minutes at its maximum discharge rate.**

**Background:** At its 2014 meeting, the Measuring Sector was asked to discuss and comment on two proposals that were submitted to the four regional weights and measures associations in Fall 2014. These proposals would amend NIST Handbook 44, LPG and Anhydrous Ammonia Liquid-Measuring Devices and Mass Flow Meters codes, Notes Section, Test Drafts, to allow transfer standards (master meters) to test and place into service. The Sector thoroughly discussed and vetted this item. There was extensive discussion about the transfer standard (also referred to as a “master meter”) itself, such as:

- The need for the master meter to be a superior standard to the meter being examined;
- Verification procedures including the proper reference weighing device’s capacity and division size;
- The need to maintain control charts on the master meter;

- Frequency of re-verification for the master meter;
- The need to develop NIST Handbook 105 series specifications, test procedures, and tolerances for “master meters;”
- Development of criteria and the ability of the master meter to assure legal traceability; and
- Training staff in the correct use of master meters in field applications; etc.

The Sector agreed that transfer standards are valuable in verifying measuring systems that are not readily tested with conventional test methods. Examples include measuring systems used to measure products such as CNG, LNG, viscous products, corrosive products, and other products whose physical properties create challenges in testing. The Sector supported moving these proposals forward as “Voting” items.

At the Sector’s 2015 Meeting, this issue was again discussed and the Sector reached the following decision.

After lengthy discussion on this issue, the Sector did not reach any conclusions on this proposal to share with the submitter or with the S&T Committee. The Sector reiterated points made during its 2014 meeting (see “Background” section earlier in this item). Additionally, while the Sector does not have specific recommendations regarding the proposal, the following “observations” might be useful for further work on this issue.

- The use of master meters has particular appeal for use in testing devices such as CNG metering systems where factors such as product type, safety, environmental factors, and the availability of equipment pose special challenges.
- Use of gravimetric testing for CNG has been reported to pose challenges such as returning/disposing of product; procuring a suitable scale and test tank; and controlling environmental influences that may affect testing results.
- Field standards must comply with the general criteria in NIST Handbook 44, Appendix A, Fundamental Considerations includes general criteria for field standards.
- Recognition of transfer standards in NIST Handbook 44 does not, by itself, ensure recognition or acceptance of these devices as an acceptable test method.
- Specific types of field standards do not have to be specifically identified in NIST Handbook 44 in order for a weights and measures jurisdiction to recognize their use in testing measuring devices.
- Additional provisions must be in place to ensure traceability of measurements using a transfer standard as an official test method. Examples include documentary standards for the field standard (e.g., NIST Handbook 105 applicable to the standard); training for laboratory metrologists in the testing of the field standard; control procedures to ensure continued performance of the transfer standard; training of field staff in the use of the transfer standard; and control procedures for maintaining the master meter.
- A master meter must perform better than the meter under test.

The Sector noted that the selection of appropriate test methods for type evaluation is an issue that is often faced by NTEP evaluating laboratories. The Sector agreed that guidelines on determining an appropriate test method(s) for an evaluation would be helpful to both the laboratories and manufacturers. Several Sector members including the following expressed an interest in working together to develop such guidelines for inclusion in Publication 14:

Marc Buttler, Emerson Process Management/Micro Motion  
John Roach, CA Division of Measurement Standards  
Michael Keilty, Endress + Hauser Flowtec AG, USA  
Tina Butcher, NIST OWM

This subgroup agreed to bring any recommendations it develops back to the Sector at its 2016 meeting as a carryover item, either as part of the H44 item or as a separate item for type evaluation criteria.

At the 2015 and 2016 NCWM Interim and Annual Meetings, the S&T Committee discussed both of the proposals in the “Recommendation” as a single item. The Committee heard comments from the submitter along with a list of benefits to using a master meter as the standard in testing meters used in applications to measure CNG, LNG, and LPG in comparison to using volumetric or gravimetric standards. The Committee also heard a number of comments, which were reiterated and summarized at its 2015 Annual Meeting regarding additional issues that must be carefully considered. See the Committee’s 2016 Interim Report for details on discussions leading up to the 2016 NCWM Annual Meeting. At the NCWM Annual Meeting, the S&T Committee agreed to maintain these two items as developing items to allow the submitter time to address the comments received.

At the 2016 Sector Meeting, the Sector will hear an update on any work that has progressed within the subgroup established at the 2015 Sector Meeting. As of the writing of the agenda, the subgroup did not have any information to report.

**Discussion:** With regard to the items before the S&T Committee, Sector Chairman, Mike Keilty (Endress + Hauser) noted that the items before the S&T Committee were previously “Voting” items on the NCWM S&T Committee’s agenda, but are now “Developing” items to allow additional discussion and input to be gathered. A number of comments were made at the NCWM Annual meeting regarding the proposals before the S&T Committee. Several Sector members concurred that additional development is needed, including how to establish and demonstrate a sufficient degree of accuracy in the test method. Tina Butcher noted that there was an issue regarding the presentation of proposed language in NCWM Publication 15 and 16 versus the language that was originally submitted by the submitter and noted that the S&T Committee is working with the submitter for clarification on this point. Other more technical issues with the proposal were the need to clarify the type of transfer standard being referenced and the associated error and uncertainty with the test method. Mrs. Butcher, Randy Moses (Wayne), and others noted that there did not appear to be any opposition to the concept of recognizing transfer standards, only that additional work is needed on the technical concerns that have been raised and the language before the item is ready for adoption. Marc Buttler (Micro Motion) also noted that there is still a need to address the flow rates and times referenced and commented that he had made a proposal from the floor of the NCWM to specify a time of 2 minutes at the maximum operating flow rate. Mrs. Butcher noted that an additional concern about the proposed language for the Mass Flow Meters Code is that, as currently presented, it would not allow testing of compressed natural gas metering systems at the lower flow rates in accordance with the NTEP Examination Procedure Outline for those systems.

The Sector also discussed the carryover item from the Sector’s 2015 agenda regarding the development of guidance for the NTEP Laboratories to use in assessing the appropriateness of transfer standards and other alternative test methods during type evaluation testing. Mr. Buttler noted that he developed proposed criteria drawing on “essential elements of traceability” identified by NIST OWM’s Laboratory Metrology Program and circulated a draft guidelines document to the Sector the night before this Sector meeting. Several members noted that they did not feel that they had adequate time to review the document before commenting on it, and Mr. Keilty suggested that the document be re-distributed to other Sector members for review and comment. Mrs. Butcher suggested that the small group established at the last Sector meeting continue to work on this issue, noting that the group hadn’t had the opportunity to devote much time to the issue since the last Sector meeting.

Mrs. Butcher also suggested that the Sector (and perhaps the submitter of the S&T Item) consider breaking out the criteria in the draft guidelines to address specific metering technologies, starting with the use of mass flow meters used as transfer standards and, once that language and associated guidelines have been adequately developed, then move on to the use of other technologies. Mr. Buttler noted that the draft guidelines he has been working on for type evaluation could also be used in routine field inspections.

**Decision:** Sector members were generally in support of the concept of using transfer standards for both type evaluation testing and routine field tests, but acknowledged that additional development and details are needed for both the guidelines for NTEP evaluations and the items before the NCWM S&T Committee. The Sector agreed that the draft document developed by Mr. Buttler should be reviewed by Sector members and all Sector members should provide input on the draft to the small working group established in 2015. The Sector also agreed that the small group and the NTEP laboratories should continue to work on the guidelines and present an updated draft to the Sector for review by the next Sector meeting. A copy of the draft distributed to the Sector via the NCWM Measuring Sector List Serve is included in Appendix B.

## New Items:

### 2. Recommendations to Update NCWM Pub 14 to Reflect Changes to NIST HB 44.

**Source:** NCWM S&T Committee

#### **Background:**

At its 101st Annual Meeting, the National Conference on Weights and Measures (NCWM) adopted the following items that will be reflected in the 2017 Edition of NIST Handbook 44. These items were included on the Sector's agenda to inform the Measuring Sector of the NCWM actions and to recommend corresponding changes to NCWM Publication 14. For additional details on these items, refer to the NCWM S&T Committee's 2016 Interim Report and its accompanying appendix, which can be found on the NCWM's web site at:

<http://www.ncwm.net/meetings/annual/archive>

[http://www.ncwm.net/\\_resources/dyn/files/75561831z10b352a8/fn/4-ST-Report-Master-Web.pdf](http://www.ncwm.net/_resources/dyn/files/75561831z10b352a8/fn/4-ST-Report-Master-Web.pdf)

#### **A. G-S.1. Identification (Software)**

**Background:** At the 2016 NCWM Annual Meeting, the NCWM adopted the following changes to General Code Paragraph G-S.1. Identification:

**G-S.1. Identification.** – All equipment, except weights and separate parts necessary to the measurement process but not having any metrological effect, shall be clearly and permanently marked for the purposes of identification with the following information:

- (a) the name, initials, or trademark of the manufacturer or distributor;
- (b) a model identifier that positively identifies the pattern or design of the device;
  - (1) *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. The abbreviation for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.). The abbreviation for the word "Model" shall be "Mod" or "Mod." Prefix lettering may be initial capitals, all capitals, or all lowercase.*  
[Nonretroactive as of January 1, 2003]  
(Added 2000) (Amended 2001)
- (c) *a nonrepetitive serial number, except for equipment with no moving or electronic component parts and ~~not built for purpose software based software devices~~ software;*  
[Nonretroactive as of January 1, 1968]  
(Amended 2003)

- (1) *The serial number shall be prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required serial number.*  
[Nonretroactive as of January 1, 1986]
- (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.).*  
[Nonretroactive as of January 1, 2001]
- (d) the current software version or revision identifier for not-built-for-purpose software-based devices; manufactured as of January 1, 2004 and all software-based devices or equipment manufactured as of January 1, 2022;  
~~[Nonretroactive as of January 1, 2004]~~  
(Added 2003) **(Amended 2017)**
- (1) *The version or revision identifier shall be:*
- i. *prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required version or revision;*  
[Nonretroactive as of January 1, 2007]  
(Added 2006)
- Note: If the 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.**  
**(Added 2017)**
- ii. **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.**  
**[Nonretroactive as of January 1, 2022]**  
**(Added 2017)**
- (2) *Abbreviations for the word “Version” shall, as a minimum, begin with the letter “V” and may be followed by the word “Number.” Abbreviations for the word “Revision” shall, as a minimum, begin with the letter “R” and may be followed by the word “Number.” The abbreviation 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.***  
[Nonretroactive as of January 1, 2007]  
(Added 2006) **(Amended 2017)**
- (e) a National Type Evaluation Program (NTEP) Certificate of Conformance (CC) number or a corresponding CC Addendum Number for devices that have a CC.
- (1) *The CC Number or a corresponding CC Addendum Number shall be prefaced by the terms “NTEP CC,” “CC,” or “Approval.” These terms may be followed by the word “Number” or an abbreviation of that word. The abbreviation for the word “Number” shall, as a minimum, begin with the letter “N” (e.g., No or No.)*  
[Nonretroactive as of January 1, 2003]

**The required information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device. (Amended 1985, 1991, 1999, 2000, 2001, 2003, ~~and~~ 2006 and 2017)**

**Recommendation:** As a result of the changes to General Code Paragraph G-S.1., the Sector was asked to recommend changes to the following NCWM Publication 14 checklists as outlined in the tables below:

- Liquid-Measuring Devices Checklist;
- Hydrocarbon Gas-Vapor Measuring Devices Checklist;
- Cryogenic Liquid-Measuring Devices Checklist;
- ECR Interfaced with RMFD Checklist in NCWM Publication 14.

## **Liquid-Measuring Devices Checklist, Page LMD-20:**

### **1. General**

#### **Code Reference: G-S.1. Identification**

Virtually all weighing and measuring equipment must be clearly and permanently marked with, or display, the manufacturer's name or trademark, model designation, and serial number. Service station 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 need not have 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 interfacing with or connecting to other components.

#### **Separate Main Element**

Primary indicating elements must be marked. The device is a major element in the weighing or measuring system, which means, it is metrologically significant to the operation and/or performance of the system and interfaces with different compatible main elements. Examples include the following: 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 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:

#### **Retail Motor Fuel Dispensers:**

- Whole unit requires a serial number.
- Indicating elements do not require a separate serial number.
- Measuring element does not require a separate serial number.
- The measuring element is metrologically significant because it affects the operation of the system as a whole; however, it is always enclosed in a housing, which has a S/N for the whole device.

*Note: A conventional nozzle on a retail motor fuel dispenser is not a sufficiently complex device to warrant a special type evaluation or a serial number. The nozzle does not affect the accuracy of the delivery. A separate requirement addresses the anti-drain valve. A vapor recovery nozzle does warrant a separate evaluation because it is a complex device, and it does have the potential to affect the accuracy of the device during the normal operation of the device. One model of vapor recovery nozzle can be used on many models of dispensers. The proper operation of a vapor recovery nozzle and system is "important" as defined by federal regulations. Thus, it is reasonable to require a vapor recovery nozzle to be marked with a serial number.*



**Vehicle Tank Meters**

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

**Markings:**

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 after installation. 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 removable bolts or screws are not permitted. A foil or vinyl badge may be used provided that it is able to 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:

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

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

- 1.4. The name, initials, or trademark of the manufacturer or distributor.  Yes  No  N/A

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

- 1.5. 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  N/A

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

- 1.5.2.** 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  N/A

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

- 1.6 Except for equipment with no moving or electronic component parts and ~~not built for purpose, software-based devices software~~, a non-repetitive serial number.  Yes  No  N/A

- 1.6.1.** 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  N/A

**1.6.2.** 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.)

**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).**

1.7. the current software version **or revision identifier** designation.

Yes  No  N/A

**1.7.1.** 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  N/A

**If the 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.**

Yes  No  N/A

**If this option is used, describe the option below:**

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**1.7.2.** **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  N/A

**If this option is used, describe the option below:**

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**1.7.3.** ~~The a~~ 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  N/A

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

1.8. An NTEP Certificate of Conformance (CC) Number or a corresponding CC addendum number for devices that have (or will have) a CC.  Yes  No  N/A

**1.8.1.** 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  N/A

**1.8.2.** The abbreviation for the word "Number" 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.  Yes  No  N/A

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.

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

\_\_\_\_\_

\_\_\_\_\_

**Hydrocarbon Gas Vapor-Measuring Devices (HGVM) Checklist, Page HGVM-2:**

**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  N/A

**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  N/A

**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  N/A

**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  N/A

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

1.3. Except for equipment with no moving or electronic component parts and ~~not built for~~  Yes  No  N/A

~~purpose, software-based devices~~ software, a non-repetitive serial number.

**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  N/A

**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  N/A

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

For not built-for-purpose, software based devices **and all software-based devices (or equipment) manufactured as of January 1, 2022:**

1.4. The current software version designation.  Yes  No  N/A

**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  N/A

**If the 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:**

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**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  N/A

**If this option is used, describe the option below:**

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**1.4.3. ~~The a~~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  N/A

**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  N/A

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  N/A

The abbreviation for the word "Number" 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 information:

\_\_\_\_\_  
\_\_\_\_\_

**Cryogenic Liquid-Measuring Devices Checklist, Page CLMD-2:**

**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  N/A

**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  N/A

**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  N/A

**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  N/A

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

1.3. Except for equipment with no moving or electronic component parts and ~~not built for purpose, software-based devices~~ **software**, a non-repetitive serial number.  Yes  No  N/A

**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  N/A

**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  N/A

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

For not built-for-purpose, software based devices **and all software-based devices (or equipment) manufactured as of January 1, 2022:**

1.4. The current software version designation.  Yes  No  N/A

**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  N/A

**If the 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:**

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**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  N/A

**If this option is used, describe the option below:**

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**1.4.3.** ~~The a~~ 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  N/A

**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  N/A

**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  N/A

**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  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.

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

**Electronic Cash Register Interfaced with Retail Motor-Fuel Dispenser Checklist, Page ECRD-1:**

**1. Identification**

**Code Reference: G-S.1. General**

Each cash register must comply with the appropriate *NIST Handbook 44* identification requirements.

All equipment, except weights and separate parts necessary to the measurement process but not having any metrological effect, shall be clearly and permanently marked for the purposes of identification with the following information (prefix lettering may be initial capitals, all capitals, or all lower case.)

Location of the information:  
\_\_\_\_\_  
\_\_\_\_\_

**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.

**1.2.1.** The abbreviation for the word "Number" shall, as a minimum, begin with the  Yes  No  No

letter "N" (e.g., No or 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 ~~not built for purpose, software based devices~~ **software**, a non-repetitive serial number.

- 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)**

For not built-for-purpose, software based devices **and all software-based devices (or equipment) manufactured as of January 1, 2022:**

- 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 the 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:**

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- 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:**

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**1.4.3.** ~~The a~~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."

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

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**1.5.4.** The required information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.  Yes  No  No

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**Discussion:** The Sector reviewed the proposed changes outlined in the Recommendation. Several Sector members commented that the application of the 2022 nonretroactive date in the reference to paragraph G-S.1.(d) in the LMD checklist was not clear and changes need to be made to clarify it.

The Sector reviewed draft language under development by the Software Sector for possible addition to NCWM Publication 14, including a note regarding the separation of metrologically significant software. NTEP Director, Jim Truex, noted that the Software Sector summary has not been finalized as of the time of the Measuring Sector's meeting and cautioned that the language is not to be distributed. He noted that software experts within the Software Sector indicated that their equipment is already able to comply with the requirements.

After reviewing this information, the Sector considered a proposal to recommend the addition of the following "note" to the checklist after Code Reference G-S.1.1. Location of Marking Information for Not Built for Purpose SW Based

Devices, Section 1.; however, the Sector did not agree with this recommendation. The Sector agreed that individual members are encouraged to provide input directly to the SW Sector.

Note: Manufacturers may choose to separate metrologically significant software from non-metrologically significant software. Separation would allow the revision of the non-metrological portion without the need for further evaluation. In addition, non-metrologically significant software may be updated on devices without breaking a seal, if so designed. Separation of software requires that all software modules (programs, subroutines, objects, etc.) that perform metrologically significant functions or that contain metrologically significant data domains form the metrologically significant software part of a measuring instrument (device or sub-assembly). If the separation of the software is not possible or needed, then the software is metrologically significant as a whole.

Jim Truex noted that the Software Sector envisions eventually taking responsibility for the software portions of the checklists in Publication 14, pulling sections from individual checklists into a single checklist that could be used to evaluate software-based systems. While he hasn't yet determined if he supports this concept, he felt it is important to share these thoughts with the Measuring Sector. He also suggested that the above note be included in Publication 14 now in the General Section of the LMD Checklist right after Section G-S.1.1. Location of Marking Information for Not Built for Purpose SW Based Devices, Section 1.9. He noted that the other Sectors have agreed to the addition of the note and observed that it would be inappropriate for the Measuring Sector to oppose it. Some members indicated that they didn't believe the note would create an issue, but some felt that there was no point to including it. Mike Keilty expressed reservations about including things in Publication 14 that are not reflected in Handbook 44. Joe Eccleston (MD) expressed similar concerns and questioned whether it may create conflicts with the current policy.

Randy Moses (Wayne Refueling) expressed concerns over how this information will be verified, noting that it appears that it will be left to the integrity of the manufacturers to comply with the requirement. He noted he does not oppose the concept, but felt it is important to acknowledge this is a hole in the process and that it needs to be addressed in some fashion.

Multiple members noted that the NTEP evaluation process already relies on an honor system, whereby manufacturers are expected to notify NTEP of metrologically significant changes to software. Mike Keilty noted that the Measuring Sector has made it clear in past meetings that Measuring Sector members are not (generally) software experts. Members' companies have software experts, but those experts are sent to the Software Sector rather than the Measuring Sector to make the best use of their expertise.

Mr. Keilty suggested that Mr. Moses develop a response/comment that could be shared with to the Software Sector to share these concerns. Mr. Moses indicated he plans to develop comments and send them to the Software Sector and will share his comments with the Measuring Sector members. This will allow others on the Sector to echo the comments or provide their own, depending on whether or not they agree with his thoughts. Mr. Truex encouraged other Measuring Sector members to also share their thoughts with Jim Pettinato and ask for clarifications where needed. This will enable the Software Sector to address and respond to any concerns and assist them in developing criteria that will be better accepted and implemented.

**Decision: The Sector agreed to recommend the proposed modifications to the checklists to reflect the changes to NCWM Handbook 44 adopted at the 2016 NCWM Annual Meeting.**

**The Sector agreed to make the following corrections to the proposed changes to G-S.1.(d) in the LMD Checklist to make it clear that the reference to the 2022 nonretroactive date only applies to the latter part of the sentence.**

**For nNot 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).**

**The Sector agreed that the same changes should be made to the other checklists included in the above recommendation. In the interest of brevity of this summary, these changes have been incorporated into the above recommendation rather than repeating the excerpts included in the "Recommendation" section.**

## B. G-S.9. Metrologically Significant Software Updates

**Background:** At the 2016 NCWM Annual Meeting, the NCWM adopted a new General Code Paragraph G-S.9. Metrologically Significant Software Updates as follows:

**G-S.9. Metrologically Significant Software Updates.** - A software update that changes the metrologically significant software shall be considered a sealable event.

**Recommendation:** As a result of the addition of paragraph G-S.9., the Sector is asked to the Sector is asked to recommend changes to the following NCWM Publication 14 checklists as outlined in the tables below:

- Liquid-Measuring Devices Checklist;
- Hydrocarbon Gas-Vapor Measuring Devices Checklist;
- Cryogenic Liquid-Measuring Devices Checklist;
- ECR Interfaced with RMFD Checklist in NCWM Publication 14.

Note that the recommended changes to the Hydrocarbon Gas-Vapor Measuring Devices Checklist also propose the addition of Code References which appear to have been inadvertently omitted from the checklist, perhaps during a previous re-organization of the measuring checklists.

### Liquid-Measuring Devices Checklist:

**Page LMD-25:** Modify the title of Code Reference G-S.8. to include a reference to new paragraph G-S.9. Metrologically Significant Software Updates.

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

*Note: Also reference specific code requirements for sealing and audit trails including Liquid Measuring Devices Code Paragraph S.2.2., Mass Flow Meters Code Paragraph S.3.5, and other applicable specific code requirements.*

- 2.1.8. 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~~ This includes components ~~include such as~~ the mechanical adjustment mechanism of meters; the electronic calibration factor and automatic temperature compensator for electronic meter registers; selection of pressure of density correction capability and correction values; and pulser setting and gallon/liter conversion switches when they may accidentally or intentionally be used to perpetrate fraud; and software updates that change the metrologically significant software.  Yes  No  N/A

**Page LMD-124:** Modify Appendix A as follows to specify that metrologically significant software updates are considered “sealable events.”

### **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 where the values are expected to be entered once only and not changed after all initial installation settings have been made. Examples include the following:

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

Typical Features or Parameters to be Sealed	Typical Features or Parameters <u>NOT</u> Required to be Sealed
<ul style="list-style-type: none"> <li>• Measuring Element Adjustment (both mechanical and electronic)</li> <li>• Linearity Correction Values</li> <li>• Measurement Units (e.g., gallons to liters)</li> <li>• Octane Blend Setting for Retail Motor Fuel Dispensers</li> <li>• Any Tables or Settings Accessed by the Software or Manually Entered to Establish the Quantity (e.g., specific gravity, pressure, etc.)</li> <li>• Density Ranges</li> <li>• Pulsers</li> <li>• Single Pick-up (magnetic or reluctance)</li> <li>• Temperature Probes and Temperature Offsets in Software</li> <li>• Pressure and Density Sensors and Transducers</li> <li>• Flow Control Settings (e.g., flow rates for slow-flow start, quantity for slow-flow start and stop)</li> <li>• Temperature Compensating Systems (on/off)</li> <li>• Differential Pressure Valves</li> <li>• As a point of clarification, the flow control settings referenced above are those controls typically incorporated into the installations of large-capacity</li> </ul>	<ul style="list-style-type: none"> <li>• Analog-to-Digital Converters</li> <li>• Quantity Division Value (display resolution)</li> <li>• Double Pulse Counting</li> <li>• Communications</li> </ul>

	<p>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.</p> <ul style="list-style-type: none"> <li>• <b><u>Software updates that change the metrologically significant software.</u></b></li> </ul>	
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**Hydrocarbon Gas Vapor-Measuring Devices Checklist:**

**Page HGVMD-6:** Add “Code Reference” titles to properly reflect references to NIST HB 44 and to be consistent with the format used in other portions of the checklist. Add General Code References corresponding to other measuring checklist that are missing from the Hydrocarbon Gas Vapor-Measuring Devices Checklist.

**3. Design of Measuring Elements**

...

- 3.2. **Code Reference: S.2.2. Provision for Sealing.**  Yes  No  N/A  
Adequate provision shall be made for applying security seals in such a manner that no adjustment may be made of any measurement element.
- 3.3. **Code Reference: S.2.3. Maintenance of Vapor State.**  Yes  No  N/A  
A device shall be so designed and installed that the product being measured will remain in a vapor state during passage through the meter.
- 3.4. **Code Reference: S.2.4. Automatic Temperature Compensation.**  Yes  No  N/A  
A device may be equipped with an adjustable automatic means for adjusting the indication and registration of the measured volume of vapor to the volume at 15 °C (60 °F.)

**4. Design of Discharge Lines**

**Code Reference: S.3. Design of Discharge Lines.**

- 4.1. **Diversion of Measured Vapor** – No means shall be provided by which any measured vapor can be diverted from the measuring chamber of the meter or the discharge line there from.  Yes  No  N/A

**5. Repeatability of Graduations, Indications, and Recorded Representations**

**Code Reference: G-S.5.2.1. Analog Indication and Representation.**

- 5.1.** 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.5.2.3. 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 may be displayed. The latter more likely occurs on analog devices. In digital indications, the digits are usually uniform throughout a particular display. The size of digits differs for different quantities. For example, the

quantity and unit price digits may be smaller than the total price digits.

**5.2.** Corresponding graduations shall be uniform in size and character.  Yes  No  N/A

**5.3.** Subordinate graduations, indications, and recorded representations shall be appropriately portrayed or designated.  Yes  No  N/A

**Code Reference: G-S.5.2.4. Values**

**5.4.** Values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations and 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**

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

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

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

**5.6.** Graduations and indications shall be uniform throughout any series.  Yes  No  N/A

**5.7.** Graduations must have a regular pattern and the increments must be consistent.  Yes  No  N/A

**5.8.** 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.

**5.9.** 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**

**5.10.** All recorded values shall be digital. See also G-UR.3.3.  Yes  No  N/A

**5.11.** In applications where recorded representations are required, the customer may be given the option of not receiving the recorded representation.  Yes  No  N/A

**5.12.** For systems equipped with the capability of issuing an electronic receipt, ticket, or other recorded representations, the customer may be given the option to receive any required information electronically (e.g., via cell phone, computer, etc.) in lieu of or in addition to a hard copy.  Yes  No  N/A

The electronic copy is provided:

5.12.1. In lieu of a hard copy of the recorded representation.  Yes  No  N/A

5.12.2. In addition to a hard copy of the recorded representation.  Yes  No  N/A

Describe the options provided:

5.12.3. Via Cell phone.  Yes  No  N/A

5.12.4. Computer.  Yes  No  N/A

5.12.5. Other (describe).  Yes  No  N/A

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

**5.13.** 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. Non-functional 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 aid the customer to understand and make 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.

**5.14.** All operational controls, indications, and features including switches, lights, displays, and push-buttons shall be clearly and definitely identified. The use of approved pictograms or symbols shall be acceptable.  Yes  No  N/A

**5.15.** All dual function (multi-function) keys or controls shall be marked to clearly identify all functions.  Yes  No  N/A

**5.16.** Non-functional controls and annunciators shall not be marked.  Yes  No  N/A

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

**5.17.** Required markings and instructions shall be permanent and easy to read.  Yes  No  N/A

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

*Note: Also reference specific code requirements for sealing and audit trails including Liquid Measuring Devices Code Paragraph S.2.2., Mass Flow Meters Code Paragraph S.3.5, and other applicable specific code requirements.*

**5.18.** 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. This includes components such as the mechanical adjustment mechanism of meters; the electronic calibration factor and automatic temperature compensator for electronic meter registers; selection of pressure of density correction capability and correction values; pulser setting and gallon/liter conversion switches when they may accidentally or intentionally be used to perpetrate fraud; and software updates that change the metrologically significant software.  Yes  No  N/A

**Page HGVMD-14:** Modify Appendix A as follows to specify that metrologically significant software updates are considered “sealable events.”

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

#### Hydrocarbon Gas-Vapor Measuring Device Features and Parameters

Typical Features or Parameters to be Sealed	Typical Features or Parameters <u>NOT</u> Required to be Sealed
<ul style="list-style-type: none"> <li>• Measuring Element Adjustment (both mechanical and electronic)</li> <li>• Linearity Correction Values</li> <li>• Measurement Units (e.g., cubic feet to cubic meters)</li> <li>• Any Tables or Settings Accessed by the Software or Manually Entered to Establish the Quantity (e.g., specific gravity, pressure, etc.)</li> <li>• Density Ranges</li> <li>• Pulsers</li> <li>• Single Pick-up (magnetic or reluctance)</li> <li>• Temperature Probes and Temperature Offsets in Software</li> </ul>	<ul style="list-style-type: none"> <li>• Analog-to-Digital Converters</li> <li>• Quantity Division Value (display resolution)</li> <li>• Double Pulse Counting</li> <li>• Communications</li> </ul>



- 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.**

*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 Hydrocarbon Gas Vapor-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 Hydrocarbon Gas Vapor-measuring devices.

**Cryogenic Liquid-Measuring Devices Checklist:**

**Page CLMD-6:** Modify the title and body of the following code reference to include a reference to new paragraph G-S.9. Metrologically Significant Software Updates.

**Code Reference: G-S.8. Sealing Electronic Adjustable Components; ~~and Provision for Metrologist 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  N/A

**Page CLMD-19:** Modify Appendix A as follows to specify that metrologically significant software updates are considered “sealable events.”

### 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.
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"> <li>• Measuring Element Adjustment (both mechanical and electronic)</li> <li>• Linearity Correction Values</li> <li>• Measurement Units (e.g., gallons to liters)</li> <li>• Octane Blend Setting for Retail Motor Fuel Dispensers</li> <li>• Any Tables or Settings Accessed by the Software or Manually Entered to Establish the Quality (e.g., specific gravity, pressure, etc.)</li> <li>• Density Ranges</li> <li>• Pulsers</li> <li>• Single Pick-up (magnetic or reluctance)</li> </ul>	<ul style="list-style-type: none"> <li>• Analog-to-Digital Converters</li> <li>• Quality Division Value (display resolution)</li> <li>• Double Pulse Counting</li> <li>• Communications</li> </ul>

- 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.**

*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.

**Electronic Cash Registers Interfaced with Retail Motor-Fuel Dispensers Checklist:**

**Page ECRD-6:** Modify the title of the following code reference to reflect new paragraph G-S.9. Metrologically Significant Software Updates.

**Code Reference: G-S.8. Provision for Sealing Electronic Adjustable Components and G-S.9. Metrologically Significant Software Updates.**

Remote controllers, which have the capabilities to electronically adjust components that affect the performance of a device, shall have provisions for approved means of security. *See LMD - Appendix A - Philosophy for Sealing, Typical Features to be Sealed.*

**Discussion:** The Sector reviewed the proposed changes to reflect new General Code Paragraph G-S.9. Metrologically Significant Software Updates. Technical Advisor, Tina Butcher (NIST OWM), noted that in preparing the proposed changes to reflect G-S.9., she noted that several sections of the Hydrocarbon Gas Vapor Measuring Devices Checklist that were previously in Publication 14 had been inadvertently omitted from the last several printings. The proposed changes in the “Recommendation” include proposed changes to reinstate these criteria along with additional suggestions for formatting it to reflect the current checklist.

**Decision:** The Sector agreed to recommend the proposed changes to the four checklists to reference new paragraph G-S.9. Metrologically Significant Software Updates. The Sector also agreed to recommend the editorial changes proposed by Technical Advisor, Tina Butcher, to replace sections of

**the Hydrocarbon Gas Vapor Measuring Devices Checklist that had inadvertently been omitted from previous editions of Publication 14.**

**C. LMD Code; VTM Code; and LPG & NH<sub>3</sub> - Return to Zero (S&T 330-1; 331-1; and 332-1)**

*(Note: This section was not marked correctly in the original Agenda and should have appeared as subsection "C" to Item 2 as shown in this summary.)*

**Background:** At the 2016 NCWM Annual Meeting, the NCWM modified the LMD Code and the LPG & NH<sub>3</sub> Code as follows to specify that primary indications are not permitted to be resettable during a delivery:

**LMD Code:**

**S.1.6.3. Return to Zero.**

- (a) The primary indicating elements, and primary recording elements if the device is equipped to record, shall be readily returnable to a definite zero indication. However, a key-lock operated or other self-operated device may be equipped with cumulative indicating or recording elements, provided that it is also equipped with a zero-return indicating element.
- (b) It shall not be possible to return primary indicating elements, or primary recording elements beyond the correct zero position.

**(c) Primary indicating elements shall not be resettable to zero during a delivery.**  
**(Amended 1972 and 20XX)**

**VTM Code:**

**S.1.1.5. Return to Zero.** – Primary indicating elements shall be readily returnable to a definite zero indication. Means shall be provided to prevent the return of primary indicating elements, and of primary recording elements if these are returnable to zero, beyond their correct zero position.  
**Primary indicating elements shall not be resettable to zero during a delivery.**

**LPG NH<sub>3</sub> Code:**

**S.1.4.2. Return to Zero.**

- (a) Primary indicating elements shall be readily returnable to a definite zero indication.
- (b) Primary recording elements on a stationary retail device shall be readily returnable to a definite zero indication if the device is equipped to record.
- (c) Means shall be provided to prevent the return of primary indicating elements and of primary recording elements if these are returnable to zero, beyond their correct zero position.

**(d) Primary indicating elements shall not be resettable to zero during a delivery.**

**(Amended 1990 and 20XX)**

**Recommendation:** The Sector is also asked to consider modifying the LMD Checklist as follows, to reflect the changes to the above three codes with regard to “return to zero” requirements.

**LMD Checklist, Checklist and Test Procedures for RMFDs:**

**Page LMD-37:** Modify Code Reference S.1.6.3. as follows:

**Code Reference: S.1.6.3. Return to Zero**

The primary indicating and recording elements of a retail device shall readily return to a definite zero indication. Key-lock and other self-operated devices must have a zero-return indicating element, but they are not required to have the recording element return to zero. These devices may be equipped with cumulative recording elements. The primary indicating and recording elements shall not go beyond their correct zero position. **Primary indicating elements shall not be resettable to zero during a delivery.**

- |      |  |   |
|------|--|---|
| 7.28 | Does the device have a primary recording element?  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 7.29 | The indicating and recording elements of a retail device shall readily return to a definite zero indication. | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 7.30 | Key-lock and self-operated devices shall have an indicating element that return to zero.                     | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 7.31 | Does the device have:  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
|      | 7.31.1. A cumulative indicating element?   | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
|      | 7.31.2. A cumulative recording element?  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 7.32 | Primary indicating and recording elements shall not go beyond their correct zero position.                   | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 7.33 | <b><u>Primary indicating elements shall not be resettable to zero during a delivery.</u></b>                 | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |

**LMD Checklist, Checklists and test Procedures for Specific Criteria for Vehicle-Tank Meters:**

**Page LMD-58:** Modify Code Reference S.1.1.5. as follows:

**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, it is not required that the printer be returnable 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 are operated, the outlet side of the meter shall be automatically or manually pressurized before the indicating and recording elements are set to zero. **Primary indicating elements shall not be resettable to zero during a delivery.**

- |        |  |   |
|--------|--|---|
| 22.8.  | 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. | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 22.9.  | Automatic or manual means shall be provided to assure that the system on the outlet side of the meter is pressurized before recording an initial zero condition as required by UR.2.1.                                   | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 22.10. | A printer shall be so designed that the recording of zero shall reflect the actual initial condition of the meter prior to deliver.  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 22.11. | <b><u>Primary indicating elements shall not be resettable to zero during a delivery.</u></b>   | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |

**LMD Checklist, Checklists and Test Procedures for Specific Criteria for LPG LMDs:**

**Page LMD-64:** Modify Code Reference S.1.4.2. Return to Zero as follows:

**Code Reference: S.1.4.2. Return to Zero**

The primary indicating element on any retail device shall be returnable to zero before a delivery. However, unless the retail device is a retail motor fuel device (or a stationary retail device), the recording element need not be returnable to zero before a delivery. Consequently, a vehicle-mounted Liquefied Petroleum Gas retail meter is not required to have a recording element that is returnable to zero before a delivery. **Primary indicating elements shall not be resettable to zero during a delivery.**

- 27.13. Is the device equipped with a recording element?  Yes  No  N/A
- 27.14. The primary indicating element shall be capable of being reset to zero before a delivery.  Yes  No  N/A
- 27.15. If the device is a retail motor fuel device and includes a printer, it shall be possible to reset the printer to zero before a delivery.  Yes  No  N/A
- 27.16. Indicating and recording elements shall not go beyond their correct zero position.  Yes  No  N/A
- 27.17. **Primary indicating elements shall not be resettable to zero during a delivery.**  Yes  No  N/A

**Discussion/Decision:** The Sector reviewed and agreed to recommend the proposed changes to reflect the changes adopted by the NCWM at the July 2016 Annual Meeting. There was little discussion on these proposed changes. The Sector noted that this subsection was incorrectly lettered in the original agenda.

**D. LMD Code Paragraph S.1.6.10. Automatic Timeout for Pay-at-Pump RMFDs (S&T 330-2)**

*(Note: This section was not marked correctly in the original Agenda and should have appeared as sub-section "D" to Item 2 as shown in this summary. Subsequent sections have been renumbered accordingly.)*

**Background:** At the 2016 NCWM Annual Meeting, the NCWM adopted a new requirement as shown below for RMFDs which are activated by payment at the pump. The new paragraph requires a transaction to time out if the device is not activated within a specified period of time.

***S.1.6.10. Automatic Timeout – Pay-At-Pump Retail Motor-Fuel Devices.** – Once a device has been authorized, it must de-authorize within two minutes if not activated. Re-authorization of the device must be performed before any product can be dispensed. If the time limit to de-authorize the device is programmable, it shall not accept an entry greater than two minutes.*

*[Nonretroactive as of January 1, 2017]*

*(Added 2016)*

**Liquid-Measuring Devices Checklist, Additional Checklists and Test Procedures for Card-Activated RMFDs:**

**Page LMD-79:** Modify Code Reference G-S.2. as follows:

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

There is great concern regarding the potential for accidental or intentional fraud when card-activated systems are used in service stations, especially because bank-card-activated systems give direct access to bank accounts.

A card-activated system shall authorize the dispensing of product for not more than ~~threetwo~~ minutes of the time between authorization and "handle on" at the dispenser. **Additionally, once a device has been authorized, it must de-authorize within two minutes if not activated.** It shall properly record transactions on the appropriate card account.

When a card-activated system is subjected to power loss of greater than 10 seconds, the dispenser shall deauthorize. Because systems may be installed with separate power lines to the console, card reader, and dispenser, to different parts of the system should be tested with power failures to evaluate the potential for accidental or intentional errors. The appropriate device response depends upon when the power loss occurs during the delivery sequence.

- 38.3. The dispenser must de-authorize in not more than ~~threetwo~~ minutes if the pump "handle" is not turned on.  Yes  No  N/A
- 38.4. The dispenser must de-authorize in not more than two minutes if not activated.**  Yes  No  N/A
- 38.5. If the time limit to ~~deactivated~~**deauthorize** a dispenser is programmable, it shall not accept an entry greater than ~~threetwo~~ minutes.  Yes  No  N/A
- 38.6. When a power loss greater than 10 seconds occurs after the pump "handle" is on, the dispenser must de-authorize.  Yes  No  N/A
- 38.7. When there is a loss of power, but the pump "handle" is not on, the dispenser must de-authorize in not more than three minutes.  Yes  No  N/A

**Liquid-Measuring Devices Checklist, Additional Checklists and Test Procedures for Card-Activated RMFDs:**

**Page LMD-80:** Modify Section 39. Test Methods as follows:

**39. Test Methods**

- 39.1. Authorize the dispenser and, with the pump "handle" on, interrupt power to any part (or all) of the system. The pump should de-authorize immediately. Specifically:
  - 39.1.1. Authorize with a card and turn the "handle" on. Power down briefly then restore power. Try to dispense product, the dispenser must not dispense since the power failure should have de-authorized the dispenser.  Yes  No  N/A
- 39.2. Authorize the dispenser using a card (leaving handle off), wait more than ~~threetwo~~ minutes, and try to start the dispenser. It should not start because the authorization should have timed out. Specifically:
  - 39.2.1. Authorize with a card, but do not turn the "handle" on. Power down for more than ~~threetwo~~ minutes, and then restore power. Try to dispense product, the dispenser should have "timed-out" and not dispense.  Yes  No  N/A
  - 39.2.2. Authorize and dispense with card #1. Allow the system to time out and de-authorize (if it does.) Do not turn off the "handle." Authorize and dispense with card #2. The transactions shall be properly recorded for each card.  Yes  No  N/A

...

**For Multi-Hose Dispensers:**

...

- 39.2.8. Authorize a dispenser with card #1, but do not turn the dispenser "handle" on. Try to authorize the same dispenser with card #2, it should not be accepted until after the ~~threetwo~~-minute time-out.  Yes  No  N/A

The Sector is also asked to consider modifying Section 54 of the LMD Checklist, which includes a corresponding interpretation of G-S.2. Although the change adopted to the LMD Code does not appear in the Hydrogen Measuring Devices Code, it seems the same logic would apply with regard to interpreting G-S.2.

**Liquid-Measuring Devices Checklist, Additional Checklists and Test Procedures for Hydrogen Gas-Measuring Devices:**

**Page LMD-101:** Modify Section 54. Card-Activated Hydrogen Gas-Measuring Devices

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

There is great concern regarding the potential for accidental or intentional fraud when card-activated systems are used in service stations, especially because bank-card-activated systems give direct access to bank accounts. The following criteria and test procedures apply to card-activated retail vehicle fuel dispensers.

A card-activated system shall authorize the dispensing of product for not more than ~~three~~two minutes of the time between authorization and "control" on at the dispenser. It shall properly record transactions on the appropriate card account.

When a card-activated system is subjected to power loss of greater than 10 seconds, the dispenser shall deauthorize. Because systems may be installed with separate power lines to the console, card reader, and dispenser, the different parts of the system should be tested with power failures to evaluate the potential for accidental or intentional errors. The appropriate device response depends upon when the power loss occurs during the delivery sequence.

*Note: The term "control" generically refers to the handle, flapper, start button, on/off switch, or other mechanism used to activate or deactivate the dispenser.*

- |   |                              |                             |                              |
|---|------------------------------|-----------------------------|------------------------------|
| 54.1. The dispenser must de-authorize in not more than <del>three</del> <u>two</u> minutes if the pump "control" is not turned on.                | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |
| 54.2. If the time limit to deactivate a dispenser is programmable, it shall not accept an entry greater than <del>three</del> <u>two</u> minutes. | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |



**Liquid-Measuring Devices Checklist, Additional Checklists and Test Procedures for Hydrogen Gas-Measuring Devices:**

**Page LMD-102:** Modify Section 54. Card-Activated Hydrogen Gas-Measuring Devices

**55. Test Methods for Card-Activated Retail Vehicle Fuel Dispensers**

- 55.1 Authorize the dispenser and, with the pump "control" on, interrupt power to any part (or all) of the system. The pump should de-authorize immediately.  Yes  No  N/A
- 55.1.1. Authorize with a card and turn the "control" on. Power down briefly, then restore power. Try to dispense product: the dispenser must not dispense because the power failure should have de-authorized the dispenser.  Yes  No  N/A
- 55.2 Authorize the dispenser using a card (leaving control off); wait more than ~~threetwo~~ **three** minutes, and try to start the dispenser. It should not start because the authorization should have timed out.
- 55.2.1. Authorize with a card, but do not turn the "control" on. Power down for more than ~~threetwo~~ **three** minutes, and then restore power. Try to dispense product; the dispenser should have "timed-out" and not dispense.  Yes  No  N/A
- 55.2.2. Authorize and dispense with card #1. Allow the system to time out and de-authorize (if it does). Do not turn off the "control." Authorize and dispense with card #2. The transactions shall be properly recorded for each card.  Yes  No  N/A
- 55.2.3. Authorize with card #1. Turn the "control" on, then off. Authorize with card #2. Dispense product and complete the delivery. Check the printed receipt to verify that the delivery has been properly charged to card #2  Yes  No  N/A
- 55.2.4. Turn the dispenser "control" on, and use a card to authorize the dispenser. Turn the "control" off. After a period of 15 seconds, turn the "control" on. Try to deliver product; the dispenser must not dispense.  Yes  No  N/A
- 55.2.5. Authorize with card #1 (do not turn the "control" on) and interrupt power for at least 10 seconds. This should de-authorize the dispenser. Resupply power; turn the "control" on; try to dispense. The dispenser shall not deliver product.  Yes  No  N/A
- 55.2.6. Authorize with card #1 (turn the "control" on) and interrupt power for at least 10 seconds. This should de-authorize the dispenser. Resupply power; turn the "control" on; try to dispense. The dispenser shall not deliver product.  Yes  No  N/A
- Note: This test is not required if the device under test complies with paragraph 10.1.*
- 55.2.7. Authorize a dispenser with card #1, but do not turn the dispenser "control" on. Try to authorize the same dispenser with card #2; it should not be accepted until after the ~~3two~~ **three**-minute time-out.  Yes  No  N/A
- 55.3 Attempt to override or confuse the card system by varying the length of time the card is in the slot, (e.g., vary the "swipe" times) and pushing all other keys on the keypad during each step of the authorization process.  Yes  No  N/A

**Discussion/Decision:** The Sector reviewed and agreed to recommend the proposed changes to reflect the changes adopted by the NCWM at the July 2016 Annual Meeting. There was little discussion on these proposed changes. The Sector noted that this subsection was incorrectly lettered in the original agenda.

## E. LMD & VTM Codes - Verification of Linearization Factors (S&T 330-3 and S&T 331-4)

**Background:** At its 2016 Annual Meeting, the NCWM adopted the following changes to the LMD Code and the VTM Code to add a test note pertaining to the testing of metering systems using linearization factors. A corresponding user requirement was added to each code to describe the user's responsibilities when making adjustments to systems with these capabilities.

### LMD Code:

**N.4.5. Verification of Linearization Factors.** - All enabled linearization factors shall be verified. The verification of enabled linearization factors shall be done through physical testing, or a combination of physical testing and empirical analysis at the discretion of the official with statutory authority.

### VTM Code:

**N.4.6. Verification of Linearization Factors.** - All enabled linearization factors shall be verified. The verification of enabled linearization factors shall be done through physical testing, or a combination of physical testing and empirical analysis, at the discretion of the official with statutory authority.

The submitter of these items also worked with a group of experts in the community to develop a document providing guidance on conducting an empirical analysis and presented the document to the S&T Committee for consideration. A copy of this document is included in Appendix C to this meeting summary and is titled "Guidance on Empirical Analysis." Comments received suggested getting additional input from the community on the guidance document, including input from the Measuring Sector, and providing the final document to NIST for incorporation in metering Examination Procedure Outlines as appropriate.

**Recommendation:** The Sector is asked to discuss whether or not additional criteria is needed for addition to Pub 14 with regard to the evaluation of systems including linearization factors, possibly in the Field Evaluation and Permanence Testing for Metering Sections of the LMD Checklist. Presently the only references in the checklist with regard to linearization are a reference to the inclusion of multi-point calibration capability as a feature on a CC where applicable (See Technical Policy Section A. Type Evaluation Test Location, Installations Criteria, and Certificate of Conformance) and Technical Policy Section G. Range of Data Points (see below).

## G. Range of Data Points

The number and types of tests to be run on devices covered under this checklist are specified in the Checklist and Test Procedures section and the Field Evaluation and Permanence Tests for Metering Systems section of this checklist. However, if the NTEP laboratory feels that there is a performance or other *NIST Handbook 44* related problem and provides reasons to support this belief, the laboratory is given the latitude to require additional testing.

A measuring element may use factory-established linearization curves to establish the minimum flow range (5:1, 10:1, or as required), providing the linearization programming is installed during manufacturing and the programming cannot be altered after leaving the factory.

Auxiliary equipment (e.g., indicator or register) with programmable multi-point calibration that alters the output signal from the measuring element to extend the flow range of the system beyond the measuring element's required minimum flow range may be used and the auxiliary device's multi-point calibration will be noted on the Certificate of Conformance and must be marked on the meter.

The Sector is also asked to review the guidance document “Guidance on Empirical Analysis” and provide input on its contents.

**Discussion:** Technical Advisor, Tina Butcher, suggested that the Sector consider whether or not additional guidance is needed in Publication 14 to address controllers with multi-point calibration. Dmitri Karimov (LC), Rich Miller (FMC), and others noted that the guidelines weren’t intended for type evaluation and suggested that the guidelines be ignored for type evaluation. John Roach (CA) concurred and noted that they test at all points across the range of the meter. Allen Katalinic (NC) noted he is uncomfortable simply eliminating testing based on data alone. Mrs. Butcher noted that, during the discussions of this issue within the NCWM, NIST OWM suggested that it be included as part of the NIST EPO and also suggested that additional input on the guidelines be sought from others in the community as well as the Measuring Sector, the Meter Manufacturers Association (noting that many of its members were part of the group that developed the guidelines), and others who may have an interest. She also suggested that a clear explanation of how to translate a meter factor into a meter error so that officials are able to appropriately assess the result of different meter factors through the flow range of a system.

In discussing the item, the Sector initially agreed that the criteria provided in the guidance document is unnecessary during type evaluation. During type evaluation, the evaluating laboratories conduct physical testing on all linearization factors programmed into a metering system. The Sector also suggested that additional explanation be provided in the guidance document regarding how to compare meter factors. Individual Sector members are also encouraged to provide comments on the guidance document to the Technical Advisor and to the Chairman of the Work Group that developed the document.

After considering the criteria overnight, the Sector renewed its discussion of the item. Several NTEP Laboratory representatives commented that it would be beneficial to have something in Publication 14 to describe how to handle multi-point calibration capability during type evaluation. Several Sector members noted that there are differences in how various systems and technologies handle linearization. Rich Miller (FMC) shared a copy of Measurement Canada’s Approval Procedure for Linearization Functions Incorporated in Measuring Instruments and suggested that the Sector consider this in its assessment. He expressed concern about how poor performance of a particular meter could reflect negatively on the performance of an indicator. Mrs. Butcher noted that there are two issues for the Sector to consider: (1) The group that developed the guidance document *for use in routine field testing* submitted to the NCWM in July 2016 would appreciate feedback from people with expertise in metering systems, particularly the Measuring Sector members; and (2) There appears to be a need to further define/document how linearization capability is addressed in type evaluation with regard to how the feature will be evaluated so that there is consistency among type evaluations.

**Decision:** Sector members are asked to review the guidelines presented by the small working group that presented the draft guidelines to the NCWM and provide input as it applies to field testing.

**The Sector agreed that more definitive criteria is needed in Publication 14 to define how linearization factors are to be addressed during type evaluation. The labs currently address this feature in the same way, but agree it needs to be documented.**

**The Sector acknowledged that there is a document from Measurement Canada that could form the basis for this criteria. The Sector also noted that there is a draft checklist for indicators that is close to completion and that this type of criteria might be included in that document. Several members volunteered to work on finalizing this checklist and including criteria for evaluating indicators with linearization features.**

**The following members agreed to work on this project:**

- Rich Miller (FMC)
- Allen Katalinic (NC)

- **Joe Eccleston (MD)**

**Allen and Rich agreed to co-chair the group. Others who are interested in working on this are encouraged to contact Allen.**

**The Sector agreed that this item should be included as a carryover item and that this group will work on finalizing the electronic indicators checklist, including additional guidance on linearization features.**

**F. Table S.2.2. Categories of Sealing and Methods of Sealing (S&T 331-2; 332-4; 334-1; 335-1; 337-1; 338-1; 339-1) – VTM, LPG, Cryogenic LMD, Milk Meters, MFM, CO<sub>2</sub>, and Hydrogen Gas Metering Codes**

**Background:** At the 2016 NCWM Annual Meeting, the NCWM adopted changes to the requirements for event loggers in the VTM, LPG, Cryogenic LMD, Milk Meters, MFM, CO<sub>2</sub>, and Hydrogen Gas Metering Codes. For systems requiring the use of an event logger, the system may offer an electronic copy of the log in addition to the required hard copy. This does not replace the need for such systems to provide for a hard copy, but recognizes that an electronic copy may also be provided.

The following shows the changes that were adopted to Tables S.2.2. of the VTM Code. Similar changes were made to the other codes referenced; in the interest of brevity, these changes are not shown below, but can be viewed in the Committee's 2016 Interim Report found in NCWM Publication 16.

**Recommendation:** The Sector is asked recommend changes to the LMD Checklist in Publication 14 checklists as outlined in the tables below to reflect the new paragraph:

<b>Table S.2.2.</b> <b>Categories of Device and Methods of Sealing</b>	
<b>Categories of Device</b>	<b>Methods of Sealing</b>
<p><b>Category 1:</b> No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p><b>Category 2:</b> Remote configuration capability, but access is controlled by physical hardware.</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in 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.</p>
<p><b>Category 3:</b> Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available <b><u>on demand</u></b> through the device or through another on-site device. <b><u>The information may also be available electronically.</u></b> The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (<b>Note:</b> Does not require 1000 changes to be stored for each parameter.)</p>

[Nonretroactive as of January 1, 1995]  
(Table Added 2006) (**Amended 20XX**)

**Recommendation:** As a result of the changes outlined above, the Sector is asked recommend changes to the following NCWM Publication 14 checklists as outlined in the tables below:

- Liquid-Measuring Devices Checklist;
- Hydrocarbon Gas-Vapor Measuring Devices Checklist;
- Cryogenic Liquid-Measuring Devices Checklist;

**Liquid-Measuring Devices Checklist:**

**Page LMD-28:** Modify Code Reference G-S.8. as follows:

**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.

- 2.36. For devices manufactured after January 1, 2001, the device must either:
  - 2.36.1. Clearly indicate when it is in the remote configuration mode. **OR**  Yes  No  N/A
  - 2.36.2. The device shall not operate while in the remote configuration mode.  Yes  No  N/A
- 2.37. The device is equipped with an event logger.  Yes  No  N/A
- 2.38. 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
- 2.39. Event counters are non-resettable and have a capacity of at least 000 to 999.  Yes  No  N/A
- 2.40. The system is designed to attach a printer, which can print the contents of the audit trail.  Yes  No  N/A  
**In addition to the hard copy, the information may also be made available electronically.**
- 2.41. The audit trail information must be capable of being retained in memory for at least 30 days while the device is without power or must be retained in nonvolatile memory.  Yes  No  N/A
- 2.42. 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
- 2.43. The event logger drops the oldest event when the memory capacity is full and a new entry is saved.  Yes  No  N/A
- 2.44. Describe the method used to seal the device or access the audit trail information:  
 \_\_\_\_\_  
 \_\_\_\_\_

**Page LMD-128:** Modify Table S.2.2. as follows:

**Table S.2.2. Categories of Device and Methods of Sealing**

Categories of Device	Method of Sealing
Category 1: No remote configuration capability.	Seal by physical seal or two event counters; one for calibration parameters and one for configuration parameters.
Category 2: Remote configuration capability, but access is controlled by physical hardware.  Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.	[The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in 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.] [Non-retroactive as of January 1, 1996.]
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password.)	<i>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available <b>on demand</b></i>

<p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p><i>through the device or through another on-site device. <b><u>The information may also be available electronically.</u></b> The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</i></p>
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**Hydrocarbon Gas-Vapor Measuring Devices Checklist:**

**Page HGVM-8:** Modify Section 5.27. as follows:

**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.

...

- 5.27. The system is designed to attach a printer, which can print the contents of the audit trail.  Yes  No  N/A  
**In addition to the hard copy, the information may also be made available electronically.**

...

**Cryogenic Liquid-Measuring Devices Checklist:**

**Page CLMD-8:** Modify Section 2.43. as follows:

**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.

...

- 2.4.3. The system is designed to attach a printer, which can print the contents of the audit trail.  Yes  No  N/A  
**In addition to the hard copy, the information may also be made available electronically.**

...

**Discussion:** Mr. Keilty reviewed the changes made at the July 2016 NCWM Annual Meeting relative to sealing. There was some discussion regarding the use of a flash drive to transfer event logger information to another on-site device for the purposes of printing a hard copy of the event log. While this approach wasn't part of the original discussion of audit trail criteria, some were amenable to permitting this method of printing the event logger information.

**Decision:** The Sector agreed to recommend the changes proposed to the checklist to reflect the changes adopted at the 2016 NCWM Annual Meeting.

### G. LPG Code Updates - S.1.4.3. Power Loss, etc. (S&T 332-2)

**Background:** At the 2016 NCWM Annual Meeting, the NCWM adopted numerous changes to the LPG & NH<sub>3</sub> Code to align requirements for retail motor-fuel applications with those in the LMD Code. In the interest of brevity, the Sector is referred to the S&T Committee's Interim Report beginning on page S&T-28.

**Recommendation:** The Sector is asked to consider recommending the following changes to the LMD Checklist to reflect the changes to the LPG & NH<sub>3</sub> Code outlined in the Background above.

#### LMD Checklist, Checklist and Test Procedures for LPG LMDs:

**Page LMD-64:** Modify Code Reference S.14.1. Indication of Delivery as follows.

**Code Reference: S.1.4.1. Indication of Delivery**

- 27.12. A retail device shall automatically show on its face the its initial zero condition and the ~~amount~~quantity delivered up to normal capacity of the device.  Yes  No  N/A
- 27.13. The measurement, indication of delivered quantity, and the indication of total sales price shall be inhibited until the fueling position reaches conditions necessary to ensure that the delivery starts at zero.  Yes  No  N/A

#### LMD Checklist, Checklist and Test Procedures for LPG LMDs:

**Page LMD-65:** Modify Code Reference S.1.5.1. Display of Unit Price and Product Identity.

**Code Reference: S.1.5.1. Display of Unit Price and Product Identity**

A computing or money-operated device shall ~~have a means for~~ displaying on ~~it~~each face the unit price at which it is set to compute or deliver, expressed as a decimal value in dollars. Means shall be provided to display on each side of the device ~~post~~ the identity of the product grade, blend, or mixture of product being dispensed.

Except for dispensers intended to be limited for use exclusively for fleet sales and other price contract sales, all of the unit prices at which that product is offered for sale shall meet the following conditions:

- (1) For a system that applies a discount prior to the delivery, all unit prices shall be displayed or shall be capable of being displayed on the dispenser through a deliberate action of the purchaser prior to the delivery of the product. It is not necessary that all of the unit prices be simultaneously displayed prior to the delivery of the product.
- (2) For a system that offers post-delivery discounts on fuel sales, display of pre-delivery unit price information is exempt from (1) above, provided the system complies with S.1.5.5. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided.

Note: When a product is offered at more than one unit price, display of the unit price information may be through the deliberate action of the customer: 1) using controls on the device; 2) through the customer's use of personal or vehicle-mounted electronic equipment communicating with the system; or 3) verbal instructions by the customer.

- 28.1. Means shall be provided to display the unit price on ~~the~~each face of the device.  Yes  No  N/A
- 28.2. The unit price shall be expressed in dollars and decimals of dollars using a dollar sign. A common fraction shall not appear in the unit price, (e.g., \$1.299 not \$1.29 9/10.)  Yes  No  N/A
- 28.3. The unit price cannot be changed while the dispenser is activated.  Yes  No  N/A



<p>28.4. Means shall be provided to <b>postdisplay</b> on <b>each</b> the side of the device the product identity, grade, brand, blend, or mixture of product being dispensed.</p> <p>28.5. <b><u>If a grade, brand, blend, or mixture is offered for sale at more than one unit price from a device, then all of the unit prices at which that product is offered for sale:</u></b></p> <p>28.5.1. <b><u>Shall be displayed prior to the delivery of the product. OR</u></b></p> <p>28.5.2. <b><u>Shall be capable of being displayed on the dispenser through the deliberate action of the purchaser using: 1) controls on the device; 2) personal or vehicle mounted electronic equipment communicating with the system; or 3) verbal instructions</u></b></p> <p style="text-align: center;">.</p> <p><i><u>Note: It is not necessary to simultaneously display all of the unit prices for all grades, brands, blends, or mixtures provided the dispenser complies with this section, S.1.5.1.</u></i></p> <p><i><u>Note: For a system that offers post-delivery discounts on fuel sales, display of pre-delivery unit price information is exempt from 28.5, provided the system complies with S.1.5.5. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided.</u></i></p> <p>28.6. <b><u>The unit prices for each product and price level may be:</u></b></p> <p>28.6.1. <b><u>Displayed simultaneously for all products.</u></b></p> <p>28.6.2. <b><u>Displayed simultaneously for each product separately.; or</u></b></p> <p>28.6.3. <b><u>Displayed individually in a unit-price display only if controls permit the customer to sequence the display through the unit prices for each and every product.</u></b></p> <p><i><u>Note: Section 28.5 shall not apply to fleet sales, other contract sales, or truck refueling sales (e.g. sales from dispensers used to refuel trucks.)</u></i></p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A</p>
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**LMD Checklist, Checklist and Test Procedures for LPG LMDs:**

**Page LMD-63:** Modify Code Reference G-S.5.2.2. Digital Indications and Representations to reference new LPG & NH3 Code Paragraph S.1.5.3. Agreement Between Indications. Note that this language is based on that in the LMD Checklist beginning on page LMD-33.

**Code References:** G-S.5.2.2. Digital Indication and Representation; S.1.5.3. Agreement Between Indications

**Basic operating requirements for devices are that:**

- **All digital values of like value in a system shall agree.**
- **A digital value shall agree with its analog representation to the nearest minimum graduation.**
- **Digital values shall round off to the nearest digital division that can be indicated or recorded.**
- **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.**

**Due to limitations of some of the technologies used to transmit information from dispensers to service station consoles, some exceptions to these rules have been given to the indications on retail motor fuel dispensers and service station consoles. Exact agreement of digital quantity values is not required if only total price information is sent from the dispenser to the console. In these cases, the console calculates the quantity from the unit price set in the console. Consequently, the quantity indicated on the console may not agree exactly with the quantity indicated on the dispenser. However, if the console prints a customer receipt, then the quantity times unit price must equal the total price on both the dispenser and the printed receipt. In 2016, provisions were added to the LPG & NH<sub>3</sub> Code to allow systems to apply post-delivery discounts. In cases where a system applies a post-delivery discount(s) to a fuel's unit price through an auxiliary element, the exception mentioned above does not apply and, therefore, the total volume quantity of the delivery shall be in agreement between all elements in the system. See LPG & NH<sub>3</sub> Code S.1.5.3. The money value indication prior to the**

**application of any post-delivery discount for dispensers and consoles must agree for all installations.**

**For those systems consisting of a console and dispensers and equipped with pre-set volume, the dispenser must deliver at least the pre-set volume; it cannot deliver less. For example, if the console sends only the money equivalent of the pre-set volume to the dispenser, the dispenser shall deliver at least the pre-set volume. It may not stop at the first quantity amount that results in mathematical agreement with the money value equivalent of the pre-set volume if the quantity indication is less than the pre-set volume. Similarly, if a money value is pre-set, the dispenser is not properly designed if it always stops at the lowest quantity value that provides mathematical agreement with the pre-set money value.**

**Tests for agreement of digital values shall be performed in the post pay, prepay money, and pre-set volume modes. Agreement should be checked at several unit prices including the maximum unit price and with the dispenser operating at its maximum flow rate.**

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

27.3. Basic operating requirements:

- ~~27.3.1. All digital values of like value in a system shall agree.~~  Yes  No  N/A
- ~~27.3.2. A digital value shall agree with its analog representation to the nearest minimum graduation.~~  Yes  No  N/A
- ~~27.3.3. Digital values shall round off to the nearest digital division that can be indicated or recorded.~~  Yes  No  N/A
- ~~27.3.4. 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  N/A

~~Agreement of indications shall be checked for several deliveries. Check the totalizer for accuracy and agreement with individual deliveries and with other totalizers in the system. Indications may disagree if digital indicators receive quantity pulses from a non-resettable pulsar.~~

- 27.43.1. All digital values of like values in a system agree with one another.  Yes  No  N/A
- 27.53.2. Digital values coincide with associated analog values to the nearest minimum graduation.  Yes  No  N/A
- 27.63.3. Digital values "round off" to the nearest minimum unit that can be indicated or recorded.  Yes  No  N/A
- 27.73.4. The device totalizer shall agree with the total of the individual deliveries and with other totalizers in the system.  Yes  No  N/A
- 27.3.5. **All total sale money value indications in a computing system are primary indications and must agree prior to the application of any post-delivery discount.**  Yes  No  N/A
- 27.3.6. **Digital volume indications in a non-computing system must agree or "round off" to the nearest minimum unit that can be indicated or recorded.**  Yes  No  N/A
- 27.3.7. **Manual quantity entries in invoice billing systems must be identified as such.**  Yes  No  N/A

**For stationary retail devices:**

- 27.4. **When delivery from a stationary retail computing device is based upon a pre-set volume, the quantity indicated on the dispenser and any auxiliary device must be equal to or greater than the pre-set volume and the dispenser and remote console must comply with G-S.5.5. Money Values, Mathematical Agreement.**  Yes  No  N/A

27.5.	<u>The quantity, unit price, and total price indications on the console shall be in mathematical agreement prior to the application of any post-delivery discount.</u>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
27.6.	<u>The following applies when a quantity value indicated or recorded by an auxiliary element such as a console, ticket printer, or remote customer display, is a derived or computed value based on data received from a retail motor fuel dispenser. When a system applies a post-delivery discount(s) to a fuel's unit price through an auxiliary element, the total volume of the delivery shall be in agreement between all elements in the system.</u>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
27.11.1.	<u>In systems that do not apply a post-delivery discount the quantity values indicated or recorded on a console, electronic cash register, or other auxiliary indicating or recording element may differ, however, for all systems:</u>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
27.11.1.1.	<u>All indicated or recorded total money values for an individual sale shall agree. AND</u>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
27.11.1.2.	<u>The indicated or recorded quantity, unit price, and total sales price values shall be in mathematical agreement to the closest cent (e.g., within each element, the values indicated or recorded must meet the formula [quantity x unit price = total sales price] to the closest cent.)</u> <u>Examples: \$1.5549 rounds to \$1.55</u> <u>\$1.5551 rounds to \$1.56</u> <u>\$1.5550 rounds to either \$1.55 or \$1.56</u>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
27.7.	<u>The printed ticket and dispenser must comply with G.S.5.5. Money Values, Mathematical Agreement to the nearest cent (unit price x volume = total sale ± 0.5 cent.)</u>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
27.8.	<u>Digital values agree with their associated analog value to the nearest minimum graduation.</u>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A

**Page LMD-66:** Modify Code Reference S.1.5.3. Recorded Representations, Point of Sale Systems and add a new paragraph reference as follows to reflect new paragraphs S.1.5.4. Recorded Representations and S.1.5.5. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided.

**Code Reference: S.1.5.3. Recorded Representations, Point of Sale Systems**

- |  |   |
|--|---|
| <del>28.13. A printed receipt providing the following information is available through a built-in or separate recording element for all transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash. This does not apply to fleet sales and other price contract sales.</del> | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| <del>28.13.1. The total volume of the delivery printed.</del>  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| <del>28.13.2. The unit price printed.</del>  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| <del>28.13.3. The total computed price printed.</del>  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| <del>28.13.4. The product identity by name, symbol, abbreviation, or code number.</del>  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |

**Code References: S.1.5.4. Recorded Representations; and S.1.5.5. Recorded Representations for Transaction Where a Post-Delivery Discount(s) is Provided.**

**Except for fleet sales and other price contract sales, for transactions conducted with point-of-sale systems or devices**

**activated by credit cards, debit cards, or cash, a printed receipt containing information about the transaction shall be available to the customer as outlined in the following items. A printed receipt must always be available to the customer upon request and printing of the receipt may be initiated at the option of the customer. In addition, some systems may be equipped with the capability to issue an electronic receipt; for those systems, the customer may be given the option to receive the receipt electronically (e.g., via cell phone, computer, etc.). See also NCWM Publication 14, Code Reference: G-S.5.6. Recorded Representations.**

Device capabilities:       Printed Receipt                       Electronic Receipt

**28.13. The system must provide a receipt to be made available to the customer at the completion of the transaction through either:**

**28.13.1. a built-in recording element OR**                       Yes  No  N/A

**28.13.2. a separate recording element that is part of the system**                       Yes  No  N/A

**28.14. Except for transactions where a post-delivery discount is provided, the customer receipt must contain the following information:**                       Yes  No  N/A

**28.14.1. The total volume of the delivery;**                       Yes  No  N/A

**28.14.2. The unit price;**                       Yes  No  N/A

**28.14.3. The total computed price; and**                       Yes  No  N/A

**28.14.4. The product identity by name, symbol, abbreviation, or code number.**                       Yes  No  N/A

**28.15. Where a post-delivery discount(s) is applied, the sales receipt must provide:**                       Yes  No  N/A

**28.15.1. the product identity by name, symbol, abbreviation, or code number;**                       Yes  No  N/A

**28.15.1 the total quantity, unit price, and total computed price that were displayed on the dispenser at the end of the delivery prior to any post-delivery discount(s);**                       Yes  No  N/A

**28.15.1. an itemization of the post-delivery discounts to the unit price; and**                       Yes  No  N/A

**28.15.1. the final total price of each fuel sale after all post-delivery discounts are applied.**                       Yes  No  N/A

**LMD Checklist, Checklist and Test Procedures for LPG LMDs:**

Add new code references to include a provision for new LPG & NH3 Code Paragraphs S.1.5.6. Transaction Information, Power Loss and S.1.5.7. Totalizers for Retail Motor-Fuel Dispensers.

Code Reference: S.1.5.6. Provisions for Power Loss

**Even if power fails during a delivery, it is still necessary to correctly complete all transactions in progress at the time of the power failure. Quantity and total sales price information shall be recallable for at least 15 minutes after the power failure. The information may be recalled at the dispenser or at the console if the console indications are accessible to the customer. Operator information, such as fuel and money value totals, shall be retained in memory during a power failure. The operator information is not required to be recallable during the power failure, but shall be recallable after power is restored. Test to determine if the indications are accurate when the delivery is continued after a power failure.**

**Note: For remote controllers (e.g., cash register, console, etc.) which have the capability to retain information pertaining to a transaction (e.g., stacked completed sales.) If the information cannot be recalled at the dispenser following a power outage, means (e.g., uninterruptible power supply or other means) must be provided to enable the transaction information to be recalled and verified**

for at least 15 minutes following a power outage.

- 28.16. The quantity and total sales price shall be recallable for 15 minutes after the power failure.  Yes  No  N/A
- 28.17. The quantity and total sales price values shall be correct if the power fails between deliveries.  Yes  No  N/A
- 28.18. The quantity and total sales price values shall be correct if the delivery is continued after a power failure.  Yes  No  N/A
- 28.19. The operator's information shall be retained in memory during a power failure.  Yes  No  N/A
- 28.120 Remote controllers which stack completed sales must have a means to enable the transaction information to be recalled and verified for at least 15 minutes.  Yes  No  N/A

**In addition to the above criteria for power, loss, the following applies to evaluations of Cash-Activated LPG Retail Motor-Fuel Dispensers:**

**In addition to the above checklist complete those portions of Section 15. of LMD Checklist, Checklists and Test Procedures for Cash-Activated Retail Motor-Fuel Dispensers which relate to provisions for power loss.**

**Code Reference: S.1.5.7. Totalizers for Retail Motor-Fuel Dispensers.**

- 28.21. Retail motor fuel dispensers shall be equipped with a non-resettable totalizer for the quantity delivered through the metering device.  Yes  No  N/A

Renumber subsequent checklist items under existing Code Reference S.1.6.1 accordingly.

**LMD Checklist, Checklist and Test Procedures for LPG LMDs:**

Add a new code reference to reflect the addition of new paragraph S.2.5. Zero-Set-Back Interlock for Stationary Retail Motor-Fuel Devices. Renumber subsequent code references to reflect corresponding changes to those paragraphs in Handbook 44.

**Code Reference: S.2.5. Zero-Set-Back Interlock**

**The zero-set-back interlock on a dispenser is critical to prevent fraudulent practices. A retail motor fuel device shall have an effective automatic interlock such that once the dispenser shuts off, it cannot be restarted without resetting the indicating element to zero. This requirement also applies to the recording element if one is present. The dispenser shall be designed so that the starting lever must be in the shut-off position and the interlock engaged before the discharge nozzle can be returned to its designed hanging position. If a single pump supplies more than one dispenser, then each dispenser shall have an automatic control valve that prevents product from being delivered by a dispenser until its indications have been set to zero.**

- 29.5. After the device is turned off by moving the lever that stops the flow, a subsequent delivery shall be prevented until the indicators (and recording element if present) have returned to their correct zero positions.  Yes  No  N/A
- 29.6. The starting lever shall be in shut off position and zero-set-back interlock engaged before the nozzle can be returned to its designed hanging position. That is any position where the tip of the nozzle is placed in its designed receptacle and the lock can be inserted.  Yes  No  N/A

- 29.7. If more than one dispenser is connected to a single pump, an automatic control valve shall prevent fuel from being delivered until the indicating elements have been returned to their correct zero position and engaged.  Yes  No  N/A
- 29.8. The use of the interlock shall be effective under all conditions when any control on the console, except a system emergency shut-off, is operating and after any momentary power failure.  Yes  No  N/A

Renumber existing code references as follows:

**Code Reference: S.2.56. Thermometer Well**

- 29.5.9. For test purposes, means shall be provided for inserting a thermometer in the meter chamber or immediately adjacent to the meter.

**Code Reference: S.2.67. Automatic Temperature Compensator**

- 29.6.10. An Liquefied Petroleum Gas meter may be equipped with an automatic temperature compensator. If so equipped, the meter shall be provided with a means for automatically adjusting the indication and registration of the measured volume of the product to the volume at 15 °C (60 °F.)

**Code Reference: S.2.67.1. Provision for Deactivation**

- 29.7.11. If a device is equipped with only a net indicating and/or recording element (volume compensated to 15 °C (60 °F)) provisions must be made to facilitate the deactivation of the automatic temperature-compensating mechanism so that the meter will indicate and/or record the uncompensated volume.

**Code Reference: S.2.67.2. Provision for Sealing**

- 29.8.12. Automatic temperature compensators must provide for applying security seals to prevent undetected adjustment or disconnection of the compensating system.

**Discussion:** The Sector acknowledged the changes proposed in the “Recommendation” above are to reflect the changes made by the NCWM at its July 2016 Annual Meeting. These changes are intended to align the LPG & NH<sub>3</sub> Code with the LMD and other measuring codes.

During discussion of the proposed changes, a question was raised regarding the requirements for including temperature compensating mechanisms in an LPG metering system. Technical Advisor, Tina Butcher, noted that NIST Handbook 130 states that the method of sale for LPG is the volume corrected/adjusted to the volume at 60 degrees Fahrenheit. If the LPG is being metered using a system with a maximum flow rate above 20 gpm, the system is required to make the corrections automatically via an automatic temperature compensating mechanism or system. For other metering systems operating at flow rates below this rate, the correction is not required to be made automatically; it can be accomplished manually. She also noted that NIST Handbook 44 is silent as to the method of sale for LPG; Handbook 44 only includes requirements that apply in those instances where automatic temperature compensation is being used. There was some discussion about how to align requirements across the LPG and MFM codes; however, no specific proposal was suggested nor pursued.

**Decision:** The Sector agreed to recommend the changes to the checklist proposed in the “Recommendation” above. Sector members agreed that it was a bit difficult to consider changes without having a device in front of them to consider; however, they acknowledged that, should the laboratories and manufacturers feel additional changes are needed once they begin applying the revised checklist, additional changes can be proposed at a that time.

## H. LPG Code – S.2.1. Vapor Elimination (S&T 332-3)

**Background:** At the 2016 NCWM Annual Meeting, the NCWM adopted the following changes to the requirements for vent lines on vapor eliminators in the LPG & NH<sub>3</sub> Code (and also adopted similar changes in the CO<sub>2</sub> LMD Code) which emphasizes the need for the lines to be made of material that is “non-collapsible.”

### S.2.1. Vapor Elimination. –

- (a) A device shall be equipped with an effective ~~automatic vapor eliminator or other effective~~ means to prevent the passage of vapor through the meter.
- (b) Vent lines from the vapor eliminator shall be made of appropriate non-collapsible material.

#### (Amended 20XX)

**Recommendation:** The Sector is asked to consider recommending the following changes to Code Reference 2.21. of the Pub 14 LMD Checklist which references vapor eliminator vent lines for LPG & NH<sub>3</sub> LMDs. Note that the checklist does not currently include specific requirements for CO<sub>2</sub> LMDs. Additionally, the current text refers to the vent line as a “vapor return line,” which generally connotes a different type of line; consequently, the recommendation includes proposed changes to correct this reference.

Since there seems to be general agreement on the criteria for a suitable vent line, the Sector may wish to consider modifying this reference to make a more generic reference to requirements for vent lines on vapor eliminators rather than for LPG & NH<sub>3</sub> systems only. This would eliminate the need to include specific requirements in multiple places in the various measuring checklists. For example, although similar changes were made to a corresponding paragraph in the CO<sub>2</sub> code, the current LMD checklist includes no reference to this requirement. Additionally, there are other sections of the checklist (such as VTMs and Loading-Rack Meters) where similar requirements appear, but the language doesn’t currently align with this language.

### LMD Checklist:

Page LMD-32, 2016 Edition: Modify Code Reference S.2.1. as follows:

#### 27.8.1. Measuring Elements

##### **Code Reference: S.2.1. Vapor Elimination (LPG S.2.1.)**

If air enters through a metering system or the product changes into vapor as it passes through the system, then it must be equipped with a vapor eliminator to remove the air or vapor before it passes through the meter. To prevent the ~~vapor return~~ vapor eliminator vent lines from being pinched closed and re-opened without being detected, the vent lines shall be made of metal tubing or other ~~rigid material~~ appropriate non-collapsible material. If the system is designed such that air or vapor will not enter the system, then a 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. Code Reference: S.1.5.1. Symmetry

- 6.1. The metering system is equipped with an effective vapor eliminator.  Yes  No  N/A
- 6.2. The vent lines are made of metal tubing or some other ~~rigid material~~ appropriate non-collapsible material.  Yes  No  N/A

**Discussion:** The Sector Chairman and Technical Advisor described the proposed changes to the checklist and their origin, noting that the intent of the changes was to align the requirements for vapor elimination with those in other measuring codes. They also noted that the Meter Manufacturers Association had questioned the use of the term “rigid,” citing concerns that rigid material is not typically used on vehicle-mounted systems; the term “non-collapsible” material will accomplish the same goal without being overly restrictive.

**Decision:** The Sector agreed to recommend the proposed changes to the checklist as shown in the “Recommendation” above.

## I. MFM Code – Natural Gas (S&T 337-2)

**Background:** At the 2016 NCWM Annual Meeting, the NCWM adopted multiple changes to the Mass Flow Meters Code to recognize the sale of liquefied natural gas through retail metering systems. Those changes are outlined in the table below.

Amend NIST Handbook 44 Appendix D to include the following new definition:

**diesel gallon equivalent (DGE). – Diesel gallon equivalent (DGE) means 6.384 pounds of compressed natural gas or 6.059 pounds of liquefied natural gas. [3.37] (Added 2016)**

Amend NIST Handbook 44 Appendix D definitions as follows:

**gasoline gallon equivalent (GGE).** – Gasoline gallon equivalent (GGE) means 5.660 pounds of **compressed** natural gas. [3.37] (Added 1994) **(Amended 2016)**

Delete the following NIST Handbook 44 Appendix D definition as shown:

~~**gasoline liter equivalent (GLE).** – Gasoline liter equivalent (GLE) means 0.678 kilograms of natural gas. [3.37] (Added 1994)~~

Amend NIST Handbook 44 Mass Flow Meters Code paragraphs S.1.2., S.1.3.1.1., S.5.2., and UR.3.8. and add new paragraphs S.1.3.1.2., S.5.3., UR.3.1.1. and UR.3.1.2. as follows:

**S.1.2. Compressed Natural Gas and Liquefied Natural Gas Dispensers.** – Except for fleet sales and other price contract sales, a compressed **or liquefied** natural gas dispenser used to refuel vehicles shall be of the computing type and shall indicate the quantity, the unit price, and the total price of each delivery. The dispenser shall display the mass measured for each transaction either continuously on an external or internal display accessible during the inspection and test of the dispenser, or display the quantity in mass units by using controls on the device. (Added 1994) **(Amended 2016)**

### **S.1.3. Units.**

**S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel.** – When compressed natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated in ~~“gasoline liter equivalent (GLE) units”~~ **or “gasoline gallon equivalent (GGE) units” or diesel gallon equivalent units (DGE), or in mass.** (Also see Appendix D definitions.) (Added 1994) **(Amended 2016)**



**S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel. – When liquefied natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated in diesel gallon equivalent units (DGE) or in mass. (Also see definitions.) (Added 2016)**

**S.5.2. Marking of Gasoline Volume Equivalent Conversion Factors for Compressed Natural Gas.** – A device dispensing compressed natural gas shall have either the statement “~~1 Gasoline Liter Equivalent (GLE) is Equal to 0.678 kg of Natural Gas~~” or “1 Gasoline Gallon Equivalent (GGE) is Equal **means** 5.660 lb of **Compressed** Natural Gas” or “**1 Diesel Gallon Equivalent (DGE) means 6.384 lb of Compressed Natural Gas**” permanently and conspicuously marked on the face of the dispenser according to the method of sale used. (Added 1994)(**Amended 2016**)

**S.5.3. Marking of Equivalent Conversion Factors for Liquefied Natural Gas. – A device dispensing liquefied natural gas shall have the statement “1 Diesel Gallon Equivalent (DGE) means 6.059 lb of Liquefied Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used. (Amended 2016)**

**S.6. Printer.** – When an assembly is equipped with means for printing the measured quantity, the following conditions apply:

- (a) the scale interval shall be the same as that of the indicator;
- (b) the value of the printed quantity shall be the same value as the indicated quantity;
- (c) ***the printed quantity shall also include mass value if mass is not the indicated quantity; [Nonretroactive as of January 1, 2021]***
- (~~e~~ **d**) a quantity for a delivery (other than an initial reference value) cannot be recorded until the measurement and delivery has been completed;
- (~~d~~ **e**) the printer is returned to zero when the resettable indicator is returned to zero; and
- (~~e~~ **f**) the printed values shall meet the requirements applicable to the indicated values.

**(Amended 2016)**

**UR.3.1.1. Marking of Equivalent Conversion Factors for Compressed Natural Gas. – A device dispensing compressed natural gas shall have either the statement “1 Gasoline Gallon Equivalent (GGE) means 5.660 lb of Compressed Natural Gas” or “1 Diesel Gallon Equivalent (DGE) means 6.384 lb of Compressed Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used. (Added 2016)**

**UR.3.1.2. Marking of Equivalent Conversion Factors for Liquefied Natural Gas. – A device dispensing liquefied natural gas shall have the statement “1 Diesel Gallon Equivalent (DGE) means 6.059 lb of Liquefied Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used. (Added 2016)**

**UR.3.8. Return of Product to Storage, Retail Compressed and Liquefied Natural Gas Dispensers.** – Provisions at the site shall be made for returning product to storage or disposing of the product in a safe and timely manner during or following testing operations. Such provisions may include return lines, or cylinders adequate in size and number to permit this

procedure.  
(Added 1998) **(Amended 2016)**

**Recommendation:** The Sector is asked to consider recommending the following changes to the Pub 14 LMD Checklist to reflect the changes to the Mass Flow Meters Code outlined in the Background above.

**LMD Checklist, Checklists and Test Procedures for Mass Flow Meters:**

**Page LMD-71:** Modify Code References S.1.2. and S.1.3.1.1. and add new code reference S.1.3.1.2. as follows:

**Code Reference: S.1.2. Compressed Natural Gas and Liquefied Natural Gas Dispensers – Mass Flow Meters**

**32.19.** Except for fleet sales and other price contract sales, a compressed or liquefied natural gas dispenser used to refuel vehicles shall be of the computing type and shall indicate the quantity, the unit price, and the total price of each delivery.  Yes  No  N/A

**32.20.** The mass measured for each transaction shall be displayed on the dispenser, either continuously on an external display or on an internal display accessible during the inspection and test of the dispenser, or it shall display the quantity in mass units by using controls on the device.  Yes  No  N/A

**Code Reference: S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel - Mass Flow Meters**

**32.21.** When compressed natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated in "~~gasoline liter equivalent (GLE) units~~" or "gasoline gallon equivalent units (GGE)" or "diesel gallon equivalent units (DGE)," or in mass. See NIST Handbook 44 definitions below.  Yes  No  N/A

**Code Reference: S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel - Mass Flow Meters**

**32.22.** When liquefied natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated in diesel gallon equivalent units (DGE) or in mass. See NIST Handbook 44 definitions below.  Yes  No  N/A

**Diesel Gallon Equivalent (DGE). – Diesel gallon equivalent (DGE) means 6.384 pounds of compressed natural gas or 6.059 pounds of liquefied natural gas. [3.37] (Added 2016)**

**Gasoline Gallon Equivalent (GGE)  
Gasoline gallon equivalent (GGE) means 5.660 pounds of compressed natural gas. [3.37] (Added 1994)**

~~**Gasoline Liter Equivalent (GLE)  
Gasoline liter equivalent (GLE) means 0.678 kilograms of natural gas. [3.37] (Added 1994)**~~

**LMD Checklist, Checklists and Test Procedures for Mass Flow Meters:**

**Page LMD-77:** Modify Code References S.5.2. and add new code references S.5.3. Marking and S.6. Printer as follows.

**Code Reference: S.5.2. Marking of ~~Gasoline Volume~~ Equivalent Conversion Factors for Compressed Natural Gas**

**36.3.** A device dispensing compressed natural gas shall have either the statement ~~"1 Gasoline Liter Equivalent (GLE) is Equal to 0.678 kg of Natural Gas" or "1 Gasoline Gallon Equivalent (GGE) is Equal to means 5.660 lb of Compressed Natural Gas"~~ or **"1 Diesel Gallon Equivalent (DGE) means 6.384 lb of Compressed Natural Gas"** permanently and conspicuously marked on the face of the dispenser according to the method of sale used.  Yes  No  N/A

**Code Reference: S.5.3. Marking of Equivalent Conversion Factors for Liquefied Natural Gas**

**36.4.** A device dispensing liquefied natural gas shall have the statement "1 Diesel Gallon Equivalent (DGE) means 6.059 lb of Liquefied Natural Gas" permanently and conspicuously marked on the face of the dispenser according to the method of sale used.  Yes  No  N/A

**Code Reference: S.6. Printer**

**36.5.** When an assembly is equipped with means for printing the measured quantity, the following conditions apply:

(a) the scale interval shall be the same as that of the indicator;  Yes  No  N/A

(b) the value of the printed quantity shall be the same value as the indicated quantity, except that after January 1, 2021 the printed quantity shall also include mass value if mass is not the indicated quantity;  Yes  No  N/A

(c) a quantity for a delivery (other than an initial reference value) cannot be recorded until the measurement and delivery has been completed;  Yes  No  N/A

(d) the printer is returned to zero when the resettable indicator is returned to zero; and  Yes  No  N/A

(e) the printed values shall meet the requirements applicable to the indicated values.  Yes  No  N/A

**Discussion:** Sector Chairman, Mike Keilty, noted that the proposed changes are intended to reflect the changes made by the NCWM at its July 2016 Annual Meeting. There was some discussion regarding the reference to UR.3.1. since, as NTEP Director Jim Truex noted, NTEP doesn't generally reference or apply "User Requirements" during type evaluation. He noted that how the labs test and evaluated these systems won't change; they must simply continue to examine how the information is displayed and make sure it is appropriate. There was some additional discussion regarding whether the laboratories are to verify the conversion factor that is programmed into a system and what testing is required to add the new "DGE" term to a Certificate. The labs reported that they generally verify the factor mathematically. Randy Moses (Wayne) noted that some companies are able to modify the conversion factor and some cannot. NTEP Director, Jim Truex, noted that if a company wants to list the term on a CC, they must request an amendment to the CC; NTEP may or may not require additional testing, but they would look at the system (either physically or through photographs) to ensure displays are clear and understandable and examine the algorithms used.

**Decision:** The Sector agreed to recommend the proposed changes to the checklist as shown in the "Recommendation" above.

### 3. NCWM Publication 14, LMD Checklist, Laboratory/Field Evaluation and Permanence Tests for Metering Systems, Section B - Previously Evaluated Meters.

**Source:** Randy Moses, Wayne Fueling, LLC

**Recommendation:** The Sector is asked to consider recommending the following change to the Section B of the “Laboratory/Field Evaluation and Permanence Tests for Measuring Systems” of the Liquid-Measuring Devices Checklist in NCWM Publication 14.

#### Page LMD-108, 2016 Edition:

#### Liquid Measuring Devices – Laboratory / Field Evaluation and Permanence Tests for Metering Systems; Field Evaluation Test of Previously Evaluated Components in Retail Motor Fuel Dispensers Using Different Previously Evaluated Meters

##### Different Previously Evaluated Meter

Previously evaluated dispensers using a previously type evaluated meter and indicator (register) will normally be subject to an initial test at the discretion of the testing lab. Based on the test results of the initial test, National Type Evaluation Program (NTEP) may require a permanence test.

##### Non-metrological Changes

A technical administrative review shall be conducted to issue a new Certificate of Conformance (CC) or amend an existing CC for previously evaluated devices because of non metrological changes. Based on the results of the technical administrative review, NTEP may require additional tests.

**Background:** The proposed changes are recommended to allow the evaluating NTEP laboratory some discretion when looking at the approval requirements for adding tested meters to existing dispenser files. This refers to the requirement for an initial test as called out in Pub 14, Section B, on page LMD-108. In some cases, there may be no difference in model series of a manufacturer except for things like the sheet metal cabinet making such a test unnecessary.

**Discussion:** Randy Moses (Wayne Fueling) provided an overview of the proposal, noting that the goal of the proposed changes is to make the process easier for updating CCs when features or components are changed. Sometimes changes are non-metrological such as modifying the cabinet of an RMFD and sometimes they are more significant and require additional testing. At present, there is nothing in the policy that recognizes “mixing and matching” and this can result in the need for unnecessary testing when changes are not metrologically significant.

NTEP Director, Jim Truex, noted that “mixing and matching” of components has been widely accepted for scales for many years. Technical Advisor, Tina Butcher, concurred that moving in this direction makes sense, particularly since measuring systems are often times comprised of multiple elements. If we were to move in this direction and make corresponding changes to NIST Handbook 44 as has been done in the scales code, this would provide a great deal more flexibility for the type evaluation of measuring systems and allow for better tracking of main components such as the meters in retail motor-fuel dispensing systems. John Roach (CA) concurred with the concept, noting that presently he must take pictures of individual components in an RMFD and it would make the process easier for field inspections. Mario Dupuis (Measurement Canada) noted that, at times they have found changes in components to result in significant differences such as the way that pulse transmission is done and, in such cases, additional testing is warranted. Mr. Moses and other Sector members concurred that there are often instances where additional testing is needed. The Sector discussed various instances where additional testing would be warranted as well as instances where changes could be made to the system and CC without the need for additional testing.

Some manufacturers questioned whether or not the current policies are adequately clear to define when additional testing is needed. Until such time that more specific guidance and examples might be developed, Mrs. Butcher proposed at least adding a statement such as “If a meter and electronics have been evaluated together, additional testing

will not typically be required if it is put into a new cabinet. However, the final decision rests with NTEP regarding the need for additional testing, depending upon the specific situation.” The Sector discussed the proposal; however, after considering the proposal, the NTEP laboratories and NTEP Director felt the current policy allows for sufficient flexibility in assessing the testing needed.

**Decision:** The Sector concurred that no changes are needed to the current policy. The policy currently allows NTEP the latitude to assess the amount and extent of testing required. Additional policies might be consulted and considered in making this assessment; however, no additional changes are needed to Publication 14 at the present time.

#### 4. Display of Unit Price in Tenths of a Cent.

**Source:** NTEP Measuring Labs via NTEP Director Jim Truex

**Recommendation:** The Sector is asked to consider the addition of a specific Handbook 44 code reference to the lead in paragraph to Pub 14, Liquid Measuring Device Checklist, Section 1.16. to read as follows:

“Code References: G-S.5.1. and G-S.5.2.2. Indicating and Recording Elements”

The Sector is also asked to consider recommending the addition of a new section 1.22. to read as follows:

**Page LMD-23, 2016 Edition:**

**Code References: G-S.5.1. and G-S.5.2.2. Indicating and Recording Elements**

Several requirements of a general nature 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. For example, retail fuel dispensers capable of indicating to 99.999 liters or gallons or \$99.99 are appropriate for automobiles at today's prices, but that are unsuitable for fueling trucks where deliveries may regularly exceed 100 liters or gallons and \$100. Metering devices must be capable of indicating the maximum quantity and money values that can normally be expected in a particular application.

- |   |   |
|---|---|
| 1.16. The maximum money value and quantity indications and unit prices are appropriate for the intended use.  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 1.16.1. The indications must be clear, definite, and accurate.  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 1.16.2. The indications must be easily read under normal operating conditions.  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 1.16.3. Totalizer values must be accurate to the nearest minimum interval with decimal points displayed or subordinate digits adequately differentiated from others, if applicable. | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 1.16.4. Symbols for decimal points shall clearly identify the decimal position. (Generally acceptable symbols are dots, small commas, or x.)  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 1.16.5. The zero indication must consist of at least the following minimum indications as appropriate:  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 1.16.6. One digit to the left and all digits to the right of a decimal point.   | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 1.16.7. If a decimal point is not used, at least one active decade plus any constant zeros.   | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 1.16.8. 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).*  | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
|   | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |

**1.16.9. Unit price values shall be displayed and recorded to the nearest 1 cent (\$0.01), except motor fuel dispensers which are permitted to display and record up to three decimal places to the right of the decimal point (\$0.001).**

\*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.

**Background:** During an NTEP evaluation the evaluator was asked to accept a recording element and receipt where the unit price was indicated and printed out to four decimal places (example: \$3.6990). The NTEP Labs acknowledge that it is customary for dispensers to indicate unit price values to three decimal places but do not think it is appropriate for other devices, such as POS systems, registers for meters). Total price values need to be rounded to the nearest cent. The NTEP labs propose the following amendments to Pub 14.

**Discussion:** Sector Chairman, Mike Keilty, reviewed the item and its source, noting that the goal is to add clarity and consistency to the requirements for displaying unit prices on RMFDs. NTEP Director, Jim Truex, and a number of others questioned the need for multiple places past the decimal point; since transactions are conducted based on whole cents, the need for even tenths of a cent seems inappropriate. However, the practice for expressing unit prices to a tenth of a cent is already ingrained in the system.

Sector Technical Advisor, Tina Butcher, commented that there are two different issues being discussed: (1) The value of the unit price is not sealable; and (2) The appropriate number of places past the decimal point for a unit price display. Mrs. Butcher also commented that it seems like the ability to make adjustments to the number of places past the decimal point should be a sealable feature; however, there was no additional discussion on this point. Mr. Truex and others agreed that the gap and lack of clarity around the appropriate number of places needs to be corrected and the Sector agreed that the proposed language will accomplish this.

Gordon Johnson (Gilbarco) expressed concerns that the change regarding the number of places past the decimal is not supported by a specific Handbook 44 reference. Others felt that the General Code adequately supported the change. The Sector discussed the idea of adding a reference to General Code Paragraph G-S.5.5. Money Values, Mathematical Agreement as well; however, there wasn't strong support to do this. Some manufacturers expressed concern about possible instances where they find that the additional places are legitimately needed, but couldn't provide examples at that point. The Sector agreed that there is always the option to bring the issue back at a future point should a specific need be identified.

**Decision:** The Sector agreed to recommend the proposed changes to the checklist. The Sector acknowledged that there are not specific references in Handbook 44 to reflect the proposed changes; however, there is a reference in the General Code under which the proposed changes clearly fall. Consequently, the Sector concurred that the proposed changes are supported by Handbook 44.

**5. NCWM Publication 14 Electronic Cash Registers Interfaced with Retail Motor-Fuel Dispensers Checklist – Change to Title.**

**Source:** NTEP Measuring Labs via NTEP Director Jim Truex

**Recommendation:** The Sector is asked to consider recommending the following change to the title of the checklist and subsequent references to the checklist to read:

**“Electronic Cash Register Interfaced with Retail Motor-Fuel Dispensers, Console Controller and Point-of-Sale System Software Checklists and Test Procedures”**

**Background:** NTEP evaluators routinely use the ECR checklist when evaluating console controllers and POS system software. The labs are recommending that the title of the ECR section in Pub 14 and subsequent references be changed to indicate inclusion of controllers and software.

**Discussion:** NTEP Director, Jim Truex, provided the Sector with a history of this item, noting that there are instances where companies don't realize that the laboratories are drawing from the Electronic Cash Registers checklist as well as the LMD Checklist. He noted that the purpose of the proposed changes is simply to clarify what the laboratories are already doing. There was no additional discussion on this issue.

**Decision:** The Sector agreed to recommend the proposed changes to the checklist.

## 6. Manual Volume Entries – Delete Entry in NCWM Publication 14 Electronic Cash Registers Interfaced with Retail Motor-Fuel Dispensers Checklist.

**Source:** NTEP Measuring Labs via NTEP Director Jim Truex

**Recommendation:** The Sector is asked to consider recommending that Section 2.3. in the Checklist on Electronic Cash Registers Interfaced with Retail Motor-Fuel Dispensers be deleted as follows:

~~2.3. Manual volume entries are permitted. They must be clearly identified on the receipt as a manual entry by the terms "Manual Fuel Sale."~~

~~Note: All uppercase or a combination of upper and lower case letters are permitted provided the evaluating laboratory finds the resulting text to be clear and legible.~~

**Background:** NIST Handbook 44 does not support the use of manual volume entries. Unless the Sector can provide a reason for the allowance in Pub 14, the NTEP laboratories recommend removal of this section.

**Discussion:** Sector Chairman, Mike Keilty, introduced the item. Gordon Johnson (Gilbarco) noted that Gilbarco does have this feature on their equipment; however, it isn't a feature that is routinely used. It is primarily included to enable an operator to go out to the dispenser and record information and enter it into the console in instances where communication between the console and the dispenser is malfunctioning. This enables the transaction to be processed and finalized. Additional situations where the feature might be used is in completing transactions for "standalone" dispensers such as those that dispense kerosene that are not interfaced with the console system. Randy Moses (Wayne Fueling) questioned whether removing the language may not prevent a manufacturer from still providing the option. John Roach (CA) commented that in the many years he has been evaluating systems, he has not used the provision. He recently reviewed similar requirements for weighing devices, but in that case, there are specific provisions in Handbook 44 that address the use of a manual entry feature. Sector Technical Advisor, Tina Butcher, noted that if there is a desire to use the feature, it would be best to propose adding provisions to Handbook 44 to address the feature in measuring systems. For weighing systems, where it is deemed a necessary feature, Handbook 44 includes very specific specifications and user requirements to ensure the feature is designed and used appropriately. For weighing devices, there was a particular concern to ensure that the system clearly indicates to the customer that the weight information was not generated through the weighing device in front of the customer. If the Sector wants to see more specific references, the Technical Advisor could develop a proposal and submit it through the NCWM process.

Joe Eccleston (MD) commented that, if we are going to leave the provision in Publication 14, additional language needs to be added to clarify that it is not allowed in other applications such as LPG metering systems and VTM systems. Mrs. Butcher noted that the Sector could also develop a list of applications where the feature is and is not appropriate to ensure consistent understanding and interpretation by manufacturers and laboratories. Some members expressed concern over whether or not the provision is adequately supported by Handbook 44; however, the General Code would address the use of the feature in a broad sense. The Sector discussed how the provision might be proposed for Handbook 44, either in the General Code and/or in specific codes. There was some concern that presenting specific language to the NCWM might also inadvertently lead to the omission of the feature altogether.

**Decision:** The Sector identified several instances where a manual fuel entry would be appropriate and felt that it should be allowed. However, the Sector acknowledged that the language in Pub 14 is not currently supported by H44. The Sector recognized that specific criteria is needed to ensure uniform interpretations and that there

should be specific references in Handbook 44 if criteria is to be included in Pub 14. However, the Sector was also concerned that, by presenting it to a larger audience, there may be unintentional consequences, including the removal of the provision in entirety.

The Sector considered several possible options such as leaving the language as it is currently written; included an additional code reference in the item; proposing a change to Handbook 44; and including additional guidance in Publication 14. The Sector was unable to reach a consensus on the options proposed. Consequently, the Sector agreed to take no action and to allow the use of manual entries in Pub 14 as is currently written.

### **Additional Items as Time Allows:**

If time permits, the NCWM S&T Committee and/or other groups would appreciate input from the Measuring Sector on the measuring-related issues that are outlined in the remaining agenda items below. A copy of any regional association modifications or positions will be provided to the Sector when these are made available by the regions.

## **7. S&T 2017 New Item – General Code - G-S.5.2.2. Digital Indication and Representation**

**Source:** Ross Andersen, Retired (2017)

**Purpose:** Address application of the code requirements across multiple devices.

**Item under Consideration:** Amend NIST Handbook 44 General Code as follows:

**G-S.5.2.2. Digital Indication and Representation.** – Digital elements shall be so designed that:

- (a) All digital values of like value in a system agree with one another.
- (b) A digital value coincides with its associated analog value to the nearest minimum graduation.
- (c) A digital value “rounds off” to the nearest minimum unit that can be indicated or recorded.
- (d) *A digital zero indication includes the display of a zero for all places that are displayed to the right of the decimal point and at least one place to the left. When no decimal values are displayed, a zero shall be displayed for each place of the displayed scale division.*

*[Nonretroactive as of January 1, 1986]*

**(e) A digital value that is electronically summed from the digital indications of multiple independent devices shall be mathematically correct.**

**[Nonretroactive as of January 1, 20XX]**

(Amended 1973, and 1985, **and 20XX**)

**Background:** See Appendix A, Page S&T-A5.

Additional letters, presentations and data may have been part of the committee’s consideration. Please refer to <http://www.ncwm.net/meetings/interim/publication-15> to review these documents.

**Discussion/Decision:** The Sector did not want to offer comments on this items without having a better understanding about background and history of the proposal than is provided in the S&T Committee’s report.



## 8. S&T 2017 New Item – General Code - G-UR.3.3. Position of Equipment

**Source:** Illinois (2017)

**Purpose:** Eliminate interpretation differences, while also demonstrating an apparent need for customer readability and giving the statutory authority permission to require visible indications for ease of test procedures.

**Item under Consideration:** Amend NIST Handbook 44 General Code as follows:

**G-UR.3.3. Position of Equipment.** – A device or system equipped with a primary indicating element and used in direct sales, except for prescription scales, shall be positioned so that its indications may be accurately read and the weighing or measuring operation may be observed from some reasonable “customer” and “operator” position. The permissible distance between the equipment and a reasonable customer and operator position shall be determined in each case **upon the basis of the individual circumstances by the official with statutory authority, who shall base the determination on “customer readability” and ease of testing procedures,** particularly the size, character, and **position** of the indicating element. **(e.g., A deli customer shall be able to read the indications from the patron side of the deli counter, whereas a truck driver shall be able to read the indications from the cab of the vehicle.) (Also see G-UR.4.4. Assistance in Testing Operations, and Appendix D. direct sales.)**

**Background:** See Appendix A, Page S&T-A9.

Additional letters, presentations and data may have been part of the committee’s consideration. Please refer to <http://www.ncwm.net/meetings/interim/publication-15> to review these documents.

**Discussion:** Sector Chairman, Mike Keilty, introduced the item. The Sector was asked to review and provide comments as appropriate to assist the S&T and the submitter with the proposed change to Handbook 44. Some Sector members shared instances where remote displays are required on weighing systems to ensure that customers are able to view the transaction information. Several Sector members commented that Handbook 44 isn’t the place to include examples.

**Decision:** The Sector had no comments on this item; however, did express concern that the examples may be misinterpreted as applying to measuring systems. Some Sector members suggested that the examples be removed and included in other documents such as EPOs and Pub 14.

## 9. S&T 2017 Carryover Item – LMD Code - Recognized the Use of Digital Density Meters

**Source:** Missouri (2016)

**Purpose:** Allow the use of digital density meters for inspections of meter for viscous fluids such as motor oils, diesel exhaust fluid (DEF) and antifreeze.

**Item under Discussion:** Amend NIST Handbook 44 Liquid Measuring Devices Code as follows:

Develop provisions in various LMD Codes of Handbook 44 that would recognize the use of digital density meters in lieu of volumetric provers, or the use of flasks and thermometers in the case of gravimetric testing) when testing meters used to dispense certain viscous fluids such as motor oil, DEF, antifreeze, syrups, etc..

*“Digital density meters may be a solution for testing motor oil, DEF and anti-freeze meters.”*

**Background/Discussion:** See Appendix A, Page S&T-A17.

Additional letters, presentations and data may have been part of the committee’s consideration. Please refer to <http://www.ncwm.net/meetings/interim/publication-15> to review these documents.

**Discussion:** Sector Chairman, Mike Keilty, introduced the item. The Sector was asked to review and provide comments as appropriate to assist the S&T and the submitter with developing the proposal. The Sector discussed the item, noting that there was little information provided about any ultimate proposal for Handbook 44. The Sector speculated that the intent is to use density meters in lieu of scales to determine the density of fluids when doing gravimetric testing of metering systems. Marc Buttler (Micro Motion) commented that the measurement of density is a component of a viable reference standard and that gravimetric testing makes sense, particularly in instances where there are safety issues related to the fluid being metered. He commented that there needs to be very clear accuracy and traceability requirements included in any recommendations and the Sector concurred.

**Decision:** The Sector briefly reviewed this item. Since there isn't a fully developed proposal for comment at this point, the Sector did not provide specific suggestions. However, Sector members provided some general comments including:

- Gravimetric testing provides a good option for testing measuring systems, particularly where safety or practicality of other types of testing are of concern.
- Density determination and associated equipment are a component of a viable reference standard, but additional criteria must be in place to ensure accuracy and suitability of the equipment and its use.
- Handbook 44 doesn't appear to be the right place to include such a proposal. Such provisions would seem to be more appropriate for a NIST EPO, NCWM Publication, or other guidance documents.
- There aren't enough specifics in the proposal to be able to provide any substantive technical comments at this point.

The Sector will be glad to provide additional input and comment as further development is made on the item.

## 10. S&T 2017 Carryover Item – VTM Code - S.3.7. Manifold Hose Flush System

**Source:** New York (2016)

**Purpose:** Recognize the use of hose flush systems in the HB 44 VTM code.

**Item under Consideration:** Amend NIST Handbook 44 Vehicle Tank Meter Code as follows:

**S.3.7. Manifold Hose Flush System. – A hose flush system to clear the hose of product may be installed in the manifold when multiple products are dispensed through a single meter and hose under the following conditions:**

**(a) the inlet valves for the system are conspicuously located above the bottom framework of the truck; and**

**(b) the inlet valves for the system are not connected to any hose or piping (dust covers are permitted) when not in use; and**

**(c) the discharge hose remains of the wet hose type; and**

**(d) the direction of flow for which the system may be set at any time is definitely and conspicuously indicated; and**

**(e) a recorded representation of each flush is maintained for inspection.**

**Background:** See Appendix A, Page S&T-A18.

Additional letters, presentations and data may have been part of the committee's consideration. Please refer to <http://www.ncwm.net/meetings/interim/publication-15> to review these documents.

**Discussion:** Sector Chairman, Mike Keilty, introduced the item. The Sector was asked to review and provide comments as appropriate to assist the S&T and the submitter with developing the proposal. Allen Katalinic (NC) acknowledged the benefits of such a system with regard to safety; however, noted that additional work is needed to address concerns regarding appropriate use of such a system. Tina Butcher (NIST OWM) noted that OWM provided a number of suggestions and extensive comments to the submitter to assist in the development of the proposal, including a suggestion to add a user requirement to the proposal regarding appropriate use of the system. Additionally, OWM believes there should be some sort of interlocks provided to prevent misuse. Several Sector members acknowledged the benefits of such a system in helping to prevent contamination and improving safety practice; however, noted that additional provisions are needed to deter misuse.

**Decision:** The Sector has no specific suggestions to offer the submitter on the proposed language. However, the Sector did identify some areas that should be considered and addressed:

- There is a significant potential to facilitate fraud if adequate safeguards are not provided to help ensure that these systems are being designed appropriately and used as intended.
- Additional work is needed to clarify appropriate operation of such a system.
- A user requirement would help to provide some minimum criteria regarding appropriate use such as hose capacity; the use of preset volumes for flushing; and setting of interlocks.
- The “diversion of product” provisions in the code are not sufficiently strong as currently written to address the concerns about the use of such systems in diverting measured product.
- Provisions are needed to prevent misuse, including incorporating features such as interlocks to help prevent indicated volumes from being inappropriately used.

## 11. S&T 2017 New Item – VTM Code - S.5.7. Meter Size

**Source:** City of Madison, Wisconsin (2017)

**Purpose:** Remove a marking requirement that is no longer necessary due to changes in the product depletion test tolerance.

**Item under Consideration:** Amend NIST Handbook 44 Vehicle Tank Meter Code as follows:

*S.5.7. — Meter Size. — Except for milk meters, if the meter model identifier does not provide a link to the meter size (in terms of pipe diameter) on an NTEP Certificate of Conformance, the meter shall be marked to show meter size.*

*[Nonretroactive as of January 1, 2009]*

*(Added 2008)*

**Background:** See Appendix A, Page S&T-A20.

Additional letters, presentations and data may have been part of the committee's consideration. Please refer to <http://www.ncwm.net/meetings/interim/publication-15> to review these documents.

**Discussion:** Sector Chairman, Mike Keilty, introduced the item. The Sector was asked to review and provide comments as appropriate to assist the S&T and the submitter with developing the proposal. Allen Katalinic (NC) commented that, when the NTEP Laboratories discussed this proposal, they felt that the issue is fairly straightforward. Joe Eccleston (MD) noted that not all states adopt the current edition of Handbook 44 and, therefore, some states are not currently enforcing provisions for marking meter size. Dmitri Karimov (LC) questioned whether or not there are instances where the marking of meter size is still beneficial; for example, in correlating a specific meter to an NTEP CC. Several Sector members concurred that meter size markings may assist field officials in assessing whether or not a particular meter is covered by an NTEP CC.

**Decision:** The Sector had few comments to offer. The NTEP Laboratories agreed that the requirement may no longer be needed. A comment was made that the meter size marking may still be useful to inspectors in determining whether a particular meter is covered by an NTEP CC since CCs typically list specific meter sizes.

## 12. S&T 2017 New Item – VTM Code - N.4.X. Automatic Stop Mechanism, T.X. Automatic Stop Mechanism and UR.2.6. Automatic Stop Mechanism

**Source:** City of Madison, Wisconsin (2017)

**Purpose:** Incorporate the automatic stop mechanism test requirement in NIST Handbook 112 EPO 23 Vehicle-Tank Meters, Power Operated into Handbook 44 so that it is enforceable.

**Item under Consideration:** Amend NIST Handbook 44 Vehicle Tank Meter Code as follows:

**N.4.X. Automatic Stop Mechanism. - The automatic stop mechanism shall stop the flow within one-half the minimum interval indicated.**

**T.X. Automatic Stop Mechanism. - The automatic stop mechanism shall stop the flow within one-half the minimum interval indicated.**

**U.R.2.6. Automatic Stop Mechanism. - The automatic stop mechanism shall stop the flow within one-half the minimum interval indicated.**

**Background:** See Appendix A, Page S&T-A43.

Additional letters, presentations and data may have been part of the committee's consideration. Please refer to <http://www.ncwm.net/meetings/interim/publication-15> to review these documents.

**Discussion:** Sector Chairman, Mike Keilty, introduced the item. The Sector was asked to review and provide comments as appropriate to assist the S&T and the submitter with developing the proposal. Some questioned whether or not the preset feature is a metrological component and if it would be covered by Handbook 44. The Sector Technical Advisor noted that many jurisdictions consider this part of the measuring system and appropriately require the components to function properly as required in the General Code Paragraph G-UR.4.1. Maintenance of Equipment. The NTEP Director and Sector Advisor and others commented that the proposed paragraph should be written as a specification rather than a user requirement. Rodney Cooper (Tuthill Transfer Systems) and several others expressed concern about the limits proposed, questioning whether or not some of the mechanical systems would have difficulty meeting the proposed requirement. Pressure changes and other system influences can sometimes affect how closely you stop relative to the preset amount.

**Decision:** The Sector had no specific recommendations to offer; however, noted that additional development is needed before the item is ready for consideration.

### 13. S&T 2017 Carryover Item – LPG & NH3 Code - N.4.2.3. For Wholesale Devices

**Source:** NIST Office of Weights and Measures (2016)

**Purpose:**

- 1) To specify the purpose of special tests conducted on Wholesale LPG and Anhydrous Ammonia Liquid-Measuring Devices;
- 2) To specify that the special tests are to be conducted at or slightly above the designated flow rates in the referenced paragraph; and
- 3) To specify that the special tests are not to be conducted below the device's marked minimum discharge rate.

**Item under Consideration:** Amend NIST Handbook 44, Liquefied Petroleum Gas and Anhydrous Liquid-Measuring Devices Code as follows:

**N.4.2.3. For Wholesale Devices. – ~~A wholesale device shall be so tested at a minimum discharge rate of:~~ “Special” tests shall be made to develop the operating characteristics of a measuring system and any special elements and accessories attached to or associated with the device. “Special” tests shall include a test at or slightly above the slower of the following rates:**

- (a) 40 L (10 gal) per minute for a device with a rated maximum discharge less than 180 L (50 gal) per minute;<sub>2</sub>
- (b) 20 % of the marked maximum discharge rate for a device with a rated maximum discharge of 180 L (50 gal) per minute or more;<sub>2</sub> or
- (c) the minimum discharge rate marked on the device, ~~whichever is least.~~

**In no case shall the test be performed at a flow rate less than the minimum discharge rate marked on the device.**

(Amended 1987 and 20XX)

**Background:** See Appendix A, Page S&T-A27.

Additional letters, presentations and data may have been part of the committee's consideration. Please refer to <http://www.ncwm.net/meetings/interim/publication-15> to review these documents.

**Discussion:** Sector Chairman, Mike Keilty, introduced the item. The Sector was asked to review and provide comments as appropriate to assist the S&T and the submitter with developing the proposal. Sector Advisor, Tina Butcher (OWM), noted that there was no opposition to the concept of modifying the paragraph to align it with similar requirements in the LMD Code; however, the MMA had suggested at the 2016 NCWM Annual Meeting that the item be held over to allow some additional work on the language. Members of the MMA commented that some of the provisions in the existing paragraph appear unnecessary and this might be an opportune time to fix them. She noted that OWM will be working with members of the MMA to propose additional revisions. Some of the MMA members present at the Sector meeting, including Marc Buttler (Micro Motion) and Dmitri Karimov (LC) concurred and committed to working with OWM.

**Decision:** Sector members are asked to review and comment on alternative language that will be presented by NIST. Some suggestions included eliminating all sections but the reference to the marked minimum discharge rate.

#### 14. S&T 2017 New Item – Appendix A – Fundamental Considerations: Section 4.4. General Considerations

**Source:** Ross Andersen, Retired (2017)

**Purpose:** Address the application of the code requirements across multiple devices.

**Item under Consideration:** Amend NIST Handbook 44, Appendix A – Fundamental Considerations as follows:

**4.4. General Considerations. – Code requirements are applied only to a single device or system, unless specifically stated in the code. The official may encounter equipment where the digital indications from more than one device are electronically summed. This may be done in multiple ways. Each device may have its own indicating element and the sum is indicated on a separate, associated indicator which is interfaced directly with each device (i.e. a computer or console via cable or even bluetooth wireless communication). The indicating elements of the individual devices may be enclosed in a single housing, with separate indicators for each device and a separate indicator for the electronic sum. An electronic sum of measured values from multiple devices is not subject to code requirements, except that it be mathematically correct, i.e. add up to the proper sum - See General Code G-S.5.2.2.(e).**

The simpler the commercial device, the fewer are the specification requirements affecting it, and the more easily and quickly can adequate inspection be made. As mechanical complexity increases, however, inspection becomes increasingly important and more time consuming, because the opportunities for the existence of faulty conditions are multiplied. It is on the relatively complex device, too, that the official must be on the alert to discover any modification that may have been made by an operator that might adversely affect the proper functioning of the device.

It is essential for the officials to familiarize themselves with the design and operating characteristics of the devices that he inspects and tests. Such knowledge can be obtained from the catalogs and advertising literature of device manufacturers, from trained service persons and plant engineers, from observation of the operations performed by service persons when reconditioning equipment in the field, and from a study of the devices themselves.

Inspection should include any auxiliary equipment and general conditions external to the device that may affect its performance characteristics. In order to prolong the life of the equipment and forestall rejection, inspection should also include observation of the general maintenance of the device and of the proper functioning of all required elements. The official should look for worn or weakened mechanical parts, leaks in volumetric equipment, or elements in need of cleaning.

**Background/Discussion:** See Appendix A, Page S&T-A33.

Additional letters, presentations and data may have been part of the committee's consideration. Please refer to <http://www.ncwm.net/meetings/interim/publication-15> to review these documents.

**Discussion/Decision:** The Sector briefly discussed this item and how it might apply to measuring systems in particular, acknowledging that the Fundamental Considerations applies all types of weighing and measuring equipment. The Sector had no comments to offer on the proposal.

## 15. S&T 2017 New Item – Vapor Elimination, Measuring Codes

**Source:** Dmitri Karimov (LC) and Tina Butcher (NIST OWM)

**Purpose:** To align other measuring device codes with the changes adopted in S&T LPG & NH<sub>3</sub> Code Item 332-3 (S.2.1. Vapor Elimination) in 2016.

**Item under Consideration:** Amend the requirements for vapor elimination in the following NIST Handbook 44 Sections and Paragraphs as outlined below:

- Section 3.30 Liquid-Measuring Devices Code (S.2.1);
- Section 3.31 Vehicle-Tank Meters Code (S.2.1);
- Section 3.35 Milk Meters Code (S.2.1);
- Section 3.36 Water Meters Code (S.2.2.1); and
- Section 3.37 Mass Flow Meters Code (S.3.3)

### 3.30. Liquid-Measuring Devices

#### S.2. Measuring Elements.

##### S.2.1. Vapor Elimination.

- (a) A liquid-measuring device shall be equipped with ~~an effective, a vapor or air eliminator or other~~ automatic means to prevent the passage of vapor and air through the meter.
- (b) Vent lines from the air or vapor eliminator shall be made of appropriate non-collapsible ~~metal tubing or other rigid~~ material.

(Amended 1975 and 2017)

##### S.2.1.1. Vapor Elimination on Loading Rack Metering Systems.

- (a) A loading rack metering system shall be equipped with ~~an effective, a vapor or air eliminator or other~~ automatic means to prevent the passage of vapor and air through the meter unless the system is designed or operationally controlled by a method, approved by the weights and measures jurisdiction having control over the device, such that air and/or vapor cannot enter the system.
- (b) Vent lines from the air or vapor eliminator (if present) shall be made of appropriate non-collapsible ~~metal tubing or other rigid~~ material.

(Added 1994)

(Amended 2017)

### 3.31. Vehicle-Tank Meters

#### S.2. Design of Measuring Elements.

##### S.2.1. Vapor Elimination.

- (a) A metering system shall be equipped with an effective vapor or air eliminator or other automatic means to prevent the passage of vapor and air through the meter.
- (b) Vent lines from the air or vapor eliminator shall be made of ~~metal tubing or some other suitable rigid material~~ appropriate non-collapsible material.

(Amended 1993)

(Amended 2017)

### 3.35. Milk Meters

#### S.2. Design of Measuring Elements.

##### S.2.1. Vapor Elimination.

- (a) A metering system shall be equipped with an effective, ~~vapor eliminator or other~~ automatic means ~~automatic in operation~~ to prevent the passage of vapor and air through the meter.
- (b) Vent lines from the air (or vapor) eliminator shall be made of ~~metal tubing or some other suitably rigid material~~ appropriate non-collapsible material.

(Amended 2017)



### 3.36. Water Meters

#### S.2.2. Batching Meters Only.

##### S.2.2.1. Air Elimination.

(a) Batching meters shall be equipped with an effective, ~~automatic means to prevent the passage of vapor and air through the meter air eliminator.~~

(b) Vent lines from the air or vapor eliminator shall be made of appropriate non-collapsible material. (Amended 2017)

### 3.37. Mass Flow Meters

#### S.3.3. Vapor Elimination.

(a) A liquid-measuring instrument or measuring system shall be equipped with an effective, ~~automatic vapor or air eliminator or other effective~~ means, ~~automatic in operation,~~ to prevent the measurement of vapor and air.

(b) Vent lines from the air or vapor eliminator ~~if present~~ shall be made of ~~metal tubing or some other suitable rigid material~~ appropriate non-collapsible material.

(Amended 1999 and 2017)

##### S.3.3.1. Vapor Elimination on Loading Rack Liquid Metering Systems.

(a) A loading rack liquid metering system shall be equipped with ~~a vapor or air eliminator or other an effective,~~ automatic means to prevent the passage of vapor and air through the meter. Such means might include, but is not limited to a ~~unless the~~ system ~~that is~~ is designed or operationally controlled by a method, approved by the weights and measures jurisdiction having statutory authority over the device, such that neither air nor vapor can enter the system.

(b) Vent lines from the air or vapor eliminator (if present) shall be made of ~~appropriate non-collapsible metal tubing or other rigid~~ material.

(Added 1995)

(Amended 2017)

**Background:** The NCWM adopted the following changes to the LPG and NH<sub>3</sub> code at its Annual Meeting in July 2016:

#### S.2.1. Vapor Elimination. –

(a) A device shall be equipped with an effective ~~automatic vapor eliminator or other effective~~ means to prevent the passage of vapor through the meter.

(b) Vent lines from the vapor eliminator shall be made of appropriate non-collapsible material.

(Amended 20XX)

The proposed changes will align other codes with the above changes to the LPG and NH<sub>3</sub> code and will help ensure consistency across the various measuring device codes in NIST Handbook 44. This would help ensure more uniform interpretation of the requirements and facilitate application by officials and industry.

The proposed changes make the requirement less design-specific and more focused on ensuring that the means for eliminating air or vapor are effective, including that the vent lines not be susceptible to restriction. The proposed changes also clarify that the provision for vapor elimination must be automatic in nature in order to be considered effective.

NIST OWM in its analysis of the 2016 S&T Agenda Item referenced above suggested that a similar change be proposed, where necessary, to corresponding requirements in other measuring codes and encouraged the Committee to consider including such an item on its agenda in the 2016-2017 NCWM cycle.

Note that the Mass Flow Meters Code states “means to prevent the measurement of vapor and air” while other codes state “means to prevent the passage of vapor and air through the meter,” but such distinction is probably justified. Consequently, no modifications are proposed to align this language with other codes.

Recommendation: The Sector is asked to review the proposed change and to provide input that would assist the submitters in refining the proposal as needed.

**Discussion:** Sector Chairman, Mike Keilty, introduced the item. The Sector was asked to review and provide comments as appropriate to assist the S&T and the submitter with developing the proposal. Sector Advisor, Tina Butcher (OWM) and Dmitri Karimov (LC) clarified that the proposal is to align the provisions for vapor elimination across all of these codes with what was adopted in the LPG & NH<sub>3</sub> code in July 2016. Marc Buttler (Micro Motion) commented that there is a difference in the language in the MFM Code and questioned if this means that something other than a vapor eliminator and vent line can be used in those systems as long as it is effective. Mrs. Butcher clarified that it is permissible to use other means provided the means can be demonstrated to be effective. There was some additional discussion about various methods used in systems to prevent vapor from being measured. Gordon Johnson (Gilbarco) acknowledged and concurred with the proposed reference to “non-collapsible,” but questioned why the reference to “metal” was eliminated, noting that any tube could be collapsed. Several noted that “metal” tubes are specifically not used on vehicle-mounted systems because of the effects of vibration and eventual breakage or loosening.

Mr. Johnson questioned the use of the word “device” rather than “system,” noting that we are talking about systems and that an actual “air eliminator” may not be used in the system if those other effective means are designed and incorporated into the system. Mrs. Butcher noted that there has been a separate, though related discussion of changing the references to “devices” and “meters” to systems throughout the measuring codes; reviewing and proposing such changes will prove to be a rather significant project to ensure use and application of the terms are still appropriate. With regard to this particular change, the Sector might consider providing feedback suggesting that the terminology be changed in this proposal. NTEP Director, Jim Truex, concurred, citing other terms such as “device,” “system,” “equipment,” and “meter” that are sometimes used interchangeably.

**Decision:** The Sector supports the proposed changes; however, suggests that the term “device” be changed “system” in the proposed change to the LMD Code and the Water Meters Code.

## **Additional Issues Added at the Sector Meeting:**

### **16. Categorization of DEF in Technical Policy C Product Categories and Families for Meters**

*Technical Advisor's Note: This item was submitted on 9/19/16, prior to the Sector meeting, but following publication of the Sector's agenda. The Sector agreed to address the item at the end of its meeting, as time permitted.*

**Source:** Marc Buttler (Micro Motion)

**Recommendation:** Change the value of the example density for Urea that is listed under mass meters in the Pub 14 LMD Product Table from 1.89 to 1.32. Add DEF to as a product under the Mass Meter "Test B" sub-heading with an SG value of 1.09 and a Product Category of "Chem."

**Background:** The following was provided by the submitter via an NCWM Form 15 for this item:

***Problem/Justification:*** In the LMD Product Table under the Product Category and Test Requirements for Mass Meters, the example density of Urea is incorrectly stated as 1.89 SG, while the more accurate density value available from NIST PML would be 1.32 SG. Furthermore, there is no listing for Diesel Exhaust Fluid (DEF) in the product table. Legal metrology devices are used increasingly to dispense and meter both DEF (which is a solution of 32.5% urea and 67.5% deionized water) and Urea. Inspectors and evaluators who are consulting NTEP CC's for master meters and consulting NCWM Publication 14 can be confused by the incorrect SG stated as an example value for urea and also need an example value for DEF to know if the density range stated in the NTEP CC includes DEF and/or urea.

***Alternative Considered:*** DEF could also be added under the headings of Magnetic Flow Meters, Positive Displacement Meters, and Turbine Meters. However, only Mass Meters are known to be used in DEF dispensers, so information related to the Conductivity, Dynamic Viscosity, and Kinematic Viscosity of DEF are not readily available. If meter manufacturers or others can provide example values for these properties, then DEF should be added as a product under these meter types, as well.

***Attachments and Additional Information:***

NIST PML source for Urea density of 1.32 SG: <http://physics.nist.gov/cgi-bin/Star/compos.pl?matno=273>

Example of DEF 1.09 SG as stated by one DEF manufacturer:

[http://blueskydefna.com/wp-content/uploads/2014/07/BlueSky32.5\\_datasheet.pdf](http://blueskydefna.com/wp-content/uploads/2014/07/BlueSky32.5_datasheet.pdf)

**Discussion:** Mr. Buttler introduced the item, noting that his goal is twofold: (1) to modify the reference for "Urea" in the Product Families Table from 1.89 to 1.32; and (2) to add "Diesel Exhaust Fluid (DEF)" to the tables along with "Urea" where the density would be recognized as 1.89. There was some discussion regarding the most appropriate place to include the reference to DEF. Some noted that the "FL&O" (Fuels, Lubricants, Industrial and Food Grade Liquid Oils) category might be considered because of how drivers are purchasing DEF during refueling; however, the product is not technically a fuel since it is added to the exhaust stream. With regard to categorization, however, it could fit within the FL&O category or in the "Chemicals" category. Dmitri Karimov (LC) commented that on LC's NTEP CCs, the meters include DEF under the category of "clear liquid fertilizers" and LC specifies the viscosity for the product. Rodney Cooper (Tuthill Transfer Systems) noted that there may be a different value specified for turbine meters.

Several Sector members commented that additional time is needed to study the issue and consider how different metering technologies might be impacted and where the most appropriate category would be to include the product. Sector Advisor, Tina Butcher, also noted that DEF is diluted with water, thus, it may be appropriate to consider a range so as not to penalize a manufacturer who may do a test with a particular supply of DEF. There were some

additional comments regarding the most appropriate value to assign for the density of the product, given various references found on line.

NTEP Director, Jim Truex, also commented that there may be other Sector members who are not present who would like an opportunity to weigh in on the discussion, so it would seem appropriate to hold the discussion over to the next meeting. Sector members agreed with the need to hold the item over, provided that a resolution can be reached in a timely manner.

**Decision:** The Sector agreed that the proposal to refine and include the values for DEF has merit and needs to be addressed. The submitter agreed to continue to refine the proposal and will appreciate input from others who are interested in the issue. The Sector agreed to include this as a “carryover item” for next year’s agenda and asks that the submitter provide an update proposal, including recommendations for the significant characteristics for various meter types, prior to the next Sector meeting.

## 17. Checklist for Electric Vehicle Fueling Systems

*Technical Advisor’s Note:* This item was submitted by CA DMS via the NTEP Director prior to the Sector meeting, but following publication of the Sector’s agenda. The NTEP Labs reviewed this issue during their meeting just prior to the Sector meeting and Sector agreed to address the item at the end of its agenda.

**Source:** Jim Truex, NTEP Director

**Background:** There is not a type evaluation checklist for Electric Vehicle Supply Equipment (EVSE). A Tentative Code in NIST Handbook 44, Section 3.40. Electric Vehicle Fueling Systems (EVFS) was added in 2015 that applies to EVSEs. EVSEs are being produced and installed in the marketplace across the nation for commercial use. However, there is not a type evaluation checklist for laboratories to follow to determine if the EVSEs comply with the EVFS NIST Handbook 44 code as there exists with other commercial weighing and measuring devices covered by NIST Handbook 44.

CDFR DMS developed a proposed type evaluation checklist for EVSEs that DMS requests the Measuring Sector to consider and recommend incorporating into NCWM Publication 14. This proposed EVSE checklist covers the specifications within NIST Handbook 44, Section 3.40. EVFS. If adopted, then NTEP laboratories and EVSE manufacturers would have specific guidelines to follow to assure the equipment does or does not comply with the NIST Handbook 44 EVFS code. A copy of this draft checklist is included in Appendix D to this Meeting Summary.

**Discussion:** NTEP Director, Jim Truex, provided a synopsis of the issue. He noted that he has been discussing the concept of type evaluation Electric Vehicle Fueling Systems with manufacturers, NTEP laboratories, NIST, and others for some time. CA DMS has been working on this issue under grants for alternative fuels as well. He noted that a tentative code has been adopted in Handbook 44 and the NIST USNWG on Electric Vehicle Fueling and Submetering has been working on requirements for test standards and test procedures. The next step is to develop criteria and documentation for type evaluation. CA DMS has submitted a draft checklist and has asked the Measuring Labs and

He reported that he asked the NTEP labs to review the draft checklist during the Measuring Lab meeting just prior to the Sector meeting. The NTEP labs felt that the draft checklist was more along the lines of an examination procedure outline (EPO), not an NTEP checklist. Thus, the laboratories felt that additional work is needed to develop a draft checklist. The NTEP Labs also suggested that the issue be presented to the NTEP Committee and the NCWM Board of Directors with a request that a Work Group comprised of evaluating laboratories, manufacturers, and others be established to develop type evaluation checklists and criteria. There are many people with experts who are already part of the USNWG who might provide the expertise needed for this work group. They also noted the need to establish traceability of the test standards and equipment.

Mr. Truex noted that he didn’t feel that it would be fair to turn this issue over to the Measuring Sector since its members may not feel comfortable with nor have the expertise in this field. Additionally, he noted that any checklist

developed by the proposed group should go straight to the NTEP Committee not via the Measuring Sector. This is the same approach that has been used by other devices such as the Taximeters Checklist and the Multiple Dimension Measuring Devices.

**Decision: The Measuring Sector agreed with the recommendations of the laboratories. The Measuring Sector appreciates the request to review the proposal, but doesn't have the expertise necessary to address these devices and recommends that the BOD/NTEP Committee establish a WG to address the checklist and draw from the expertise currently within the USNWG. This doesn't preclude members of the MS who have an interest in the work from participating in and/or providing input to the proposed WG.**

## **18. Discussion of Possible Meeting Location and Date:**

**Background/Discussion/Decision:** At the conclusion of its meeting, the Sector discussed potential locations and dates for the 2017 Sector meeting. The Sector asked the NCWM to look at Chicago, Atlanta, Denver, Houston, Dallas, Austin as possibilities, realizing that the location and timing will depend upon the availability of hotel and meeting space within cost constraints.

Possible dates to consider:

- September 25
- October 2
- October 3-4