

## Appendix D

### National Type Evaluation Program (NTEP) Measuring Sector Meeting Summary

Annual Meeting  
September 15-16, 2015  
Denver, Colorado

#### INTRODUCTION

The charge of the NTEP Measuring Sector (herein after referred to as “Sector”) is to provide appropriate type evaluation criteria based on specifications, tolerances and technical requirements of NIST Handbook 44, “Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices,” Sections 1.10. General Code and all portions of Section 3 including codes for Liquid Measuring Devices, Vehicle Tanks Meters, Liquid Petroleum Gas and Anhydrous Ammonia Measuring Devices, Cryogenic Liquid Measuring Devices, Milk Meters, Water Meters, Mass Flow Meters, and Carbon Dioxide Liquid Measuring Devices. The Sector’s recommendations are presented to the National Type Evaluation Program (NTEP) Committee each January for approval and inclusion in NCWM Publication 14, “Technical Policy, Checklists, and Test Procedures” for national type evaluation.

The Sector is also called upon occasionally for technical expertise in addressing difficult NIST Handbook 44 issues on the agenda of National Conference on Weights and Measures (NCWM) Specifications and Tolerances (S&T) Committee. Sector membership includes industry, NTEP laboratory representatives, technical advisors, and the NTEP Administrator. Meetings are held annually, or as needed and are open to all NCWM members and other registered parties.

Proposed revisions to the handbook(s) are shown as follows: 1) deleted language is indicated with a **bold face font using strikeouts** (e.g., ~~this report~~), 2) proposed new language is indicated with an **underscored bold faced font** (e.g., new items), and 3) nonretroactive items are identified in *italics*. There are instances where the Sector will use **red** text and/or **highlighted** text to bring emphasis to text that requires additional attention. When used in this report, the term “weight” means “mass.”

**Note:** It is policy to use metric units of measurement in publications; however, recommendations received by NCWM technical committees and regional weights and measures associations have been printed in this publication as submitted. Therefore, the report may contain references to inch-pound units.

**Table A**  
**Table of Contents**

Reference Key	NTEP Page D
<b>INTRODUCTION</b> .....	<b>1</b>
<b>CARRY-OVER ITEMS:</b> .....	<b>4</b>
1. Identification of Certified Software .....	4
2. Software Protection/Security .....	6
3. Software Maintenance and Reconfiguration.....	7
4. Transfer Standards Testing – NIST Handbook 44 Section 3.32. LPG and NH <sub>3</sub> Liquid-Measuring Devices Code and Section 3.37. Mass Flow Meters Code.....	8
<b>NEW ITEMS:</b> .....	<b>12</b>
5. Recommendations to Update NCWM Publication 14 to Reflect Changes to NIST Handbook 44.....	12
6. G-S.8.1. Multiple Weighing or Measuring Devices that Share a Common Provision for Sealing, Update to NCWM Publication 14 Liquid-Measuring Devices (LMD) Checklist. ....	16
7. Vehicle-Tank Meters – Corrections to ATC Tolerances in NCWM Publication 14.....	17
8. NCWM Publication 14, Technical Policy P. Turbine Meters with Both Vertical and Horizontal Orientation. ....	18
P. Turbine Meters with Both Vertical and Horizontal Orientation. ....	19
9. Expansion of NCWM Publication 14 LMD Technical Policy A, Test Location and CC Information. ....	20
10. Time-Out on Card-Operated Retail Motor-Fuel Dispensers.....	21
11. NIST Handbook 44, Appendix D – Definitions; Remote Configuration Capability. ....	23
12. Test Methods for Metering Systems Measuring “Natural Gasoline” and Other Products with Special Characteristics. ....	25
<b>ADDITIONAL ITEMS AS TIME ALLOWS:</b> .....	<b>27</b>
13. Multi-Point Calibration – NIST Handbook 44 LMD Code – Wholesale Meters.....	27
14. Multi-Point Calibration – NIST Handbook 44 Vehicle-Tank Meters Code. ....	31
15. NIST Handbook 44 Section 3.32. LPG and NH <sub>3</sub> Code – Revisions to Address LPG RMFDs. ....	32
16. Equivalent Units for Natural Gas.....	33
<b>ADDITIONAL ITEM ADDED AT MEETING:</b> .....	<b>36</b>
17. Next Sector Meeting .....	36
<hr/>	
<b>APPENDICES</b>	
<hr/>	
A Excerpt – 2014 Software Sector (SS) Summary – SW Protection/Security – Measuring Sector Item 2 ..	A1
B Excerpt – 2014 SS Summary – SW Maintenance and Reconfiguration – Measuring Sector Item 3 .....	B1
C Proposed Revisions to LPG and NH <sub>3</sub> Code – Measuring Sector Item 15.....	C1
D Measuring Sector Attendee List, September 15 - 16, 2015, Denver, Colorado .....	D1

**Table B**  
**Glossary of Acronyms**

CC	Certificate of Conformance	OIML	International Organization of Legal Metrology
DMS	Division of Measurement Standards	OWM	Office of Weights and Measures (NIST)
ECR	Electronic Cash Register	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
NTETC	National Type Evaluation Technical Committee		

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.

---

**Details of All Items**  
*(In order by Reference Key)*

---

**Carry-over Items:**

**1. Identification of Certified Software**

**Source:**

NTEP Software Sector; [2014 NCWM S&T Item 310-1 (D)]

**Recommendation:**

The Measuring Sector and the Software Sector conducted a joint meeting on September 16, 2015, and were asked to discuss this item that appears as NCWM S&T Item 310-1.

The Measuring Sector was asked to review and provide input on the following proposed changes to G-S.1. Identification that were developed by the Weighing Sector and Software Sector during a joint meeting in August 2014. The Measuring Sector reviewed this item at its 2014 and suggested that it be maintained as an Information item on the S&T Committee’s agenda to allow additional time for input. Sector members were asked to be prepared to provide input to the Software Sector at the joint September 2015 meeting.

**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, 2020;**

*[Nonretroactive as of January 1, 2004]*

(Added 2003) (**Amended 20XX**)

(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 20XX)**

- ii. **directly linked to the software itself; and**

**[Nonretroactive as of January 1, 2020]**

**(Added 20XX)**

- iii. **continuously displayed or be accessible via the display. Instructions for displaying the version or revision identifier shall be described in the CC. As an exception, permanently marking the version or revision identifier shall be acceptable providing the device does not have an integral interface to communicate the version or revision identifier.**

**[Nonretroactive as of January 1, 2020]**

**(Added 20XX)**

- (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)

- (e) 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 201X**)

### **Background:**

This item originated as an attempt to answer the question “How does the field inspector know that the software running in a software-based weighing or measuring device is the same software evaluated and approved during an NTEP evaluation?”

The Measuring Sector discussed this issue at its 2013 and 2014 meetings and considered several proposals to amend paragraphs “G-S.1. Identification” and “G-S.1.1. Location of Marking Information for Not-Built-for-Purpose, Software-Based Devices.” At its 2014 meeting, the Measuring Sector reviewed the proposal shown in the Recommendation above that was developed at a joint August 2014 meeting of the Software and Weighing Sectors. After very thorough discussion of this item, the Sector agreed to forward a recommendation to the SWMA and the NCWM S&T Committees that the proposal to modify G-S.1. remain an Informational item. The Sector agreed with the general direction of the proposal, but believes that additional work is needed before recommending the item for a vote.

See the Sector’s 2013 and 2014 meeting summaries for additional details.

At the 2015 Interim Meeting, the S&T Committee agreed to keep the item on its agenda as a Developing item in recognition of the progress that was reported and the planned future joint meeting of the Measuring and Software Sectors. However, because this item has remained on S&T’s agenda for several years, the Committee also agreed it would Withdraw the item if a proposal that can be presented for vote is not received before the 2016 NCWM Interim Meeting. At the 2015 NCWM Annual Meeting, testimony heard for this item (which was presented as S&T Agenda Item 310-1) supported continued work on it by the joint Measuring/Software Sector in September 2015. The S&T Committee again emphasized that continued progress on the item is needed to maintain it on the agenda.

**Note:** A copy of the August 2014 Software Sector Meeting Summary is available from the NCWM website at:

[http://www.ncwm.net/resources/dyn/files/1296056z19618afb/\\_fn/14\\_Software\\_Final\\_Meeting\\_Summary.pdf](http://www.ncwm.net/resources/dyn/files/1296056z19618afb/_fn/14_Software_Final_Meeting_Summary.pdf)

**Discussion and Decision:** The Measuring Sector deferred discussion of this item to a joint meeting with the Software Sector on the second day of its meeting. The discussion and conclusions for this item are found in the summary of the Software Sector.

## 2. Software Protection/Security

### Source:

NTEP Software Sector

**Recommendation:** The Measuring Sector was asked to discuss and provide input on the following recommendation (developed during an August 2014 Software Sector and Weighing Sector meeting). The Measuring Sector had considered this recommendation at the 2014 Measuring Sector meeting, but did not reach a consensus on the proposal. At that meeting, the Measuring Sector stated that it believes this item needs additional work and clarity on how it would be applied and asked that this comment be passed onto the Software Sector and the S&T Committee for further review and development.

The Measuring and the Software Sectors conducted a joint meeting on September 16, 2015. The Measuring Sector was given the opportunity to more fully discuss the proposed changes in this joint meeting.

Add the following new paragraph to Section 1.10. General Code of NIST Handbook 44:

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

**[Nonretroactive as of January 2, 20XX]**

**(Added 20XX)**

### Background:

A draft checklist was proposed for NCWM Publication 14 to evaluate the protection and security of software. At the 2013 Measuring Sector meeting, the proposal was thoroughly discussed and debated. The Sector rejected the proposal; however, manufacturers committed to studying the issue and bringing back alternative(s) to consider at the 2014 Sector Meeting. (See the 2013 NTEP Measuring Sector Meeting Summary for details.)

The Software Sector and the Weighing Sector discussed this item in a joint meeting on August 27, 2014. In September 2014, Mr. Truex forwarded a recommendation from the joint Software Sector/Weighing Sector meeting to add a new section to NIST Handbook 44 as shown in the “Recommendation” above.

At its 2014 meeting, the NTEP Measuring Sector heard many comments on this proposed amendment to add a new paragraph G-S.9. to NIST Handbook 44. Much of the discussion was on the checklist that had been reviewed and rejected by the Measuring Sector at their 2013 meeting. Several Sector members stated they support the proposed amendment. Mr. Keilty stated that he would like to see sealable parameters added to the measuring device portion of NCWM Publication 14 and to recommend the same thing to the other NTEP Sectors. After much discussion and vigorous debate on this proposed new paragraph, there was not agreement on what change constitutes a “metrologically significant change to the software” and what change was simply an update. It was not clear how this proposal would apply to software that does not currently separate metrologically significant and non-metrologically significant portions within itself. The Measuring Sector also discussed that this be added to the list of sealable parameters, but was advised that the Software Sector does not view a software update as a sealable “parameter” or a “feature.” The Measuring Sector is amenable to adding this to the table, but recognized concerns about the terminology. (See the Measuring Sector’s 2014 meeting summary for additional details.)

An excerpt from the Software Sector’s 2014 Meeting Summary, Item 3 Software Protection/Security is included in **Appendix A**; a complete copy of that summary is available from the NCWM website at:

[http://www.ncwm.net/resources/dyn/files/1296056z19618afb/\\_fn/14\\_Software\\_Final\\_Meeting\\_Summary.pdf](http://www.ncwm.net/resources/dyn/files/1296056z19618afb/_fn/14_Software_Final_Meeting_Summary.pdf)

**Discussion and Decision:**

The Measuring Sector deferred discussion of this item to a joint meeting with the Software Sector on the second day of its meeting, September 16, 2015. The discussion and conclusions for this item are found in the summary of the Software Sector.

### **3. Software Maintenance and Reconfiguration**

**Source:**

NTEP Software Sector

**Recommendation:**

The Measuring and the Software Sectors conducted a joint meeting on September 16, 2015. The Measuring Sector was asked to revisit this issue and discuss any alternative proposal(s) from manufacturers to add language into NCWM Publication 14 on how to secure their software. No specific recommendations were provided by Measuring Sector members or the Software Sector prior to this joint meeting.

**Background:**

The Software Sector posed the following question to the Measuring Sector in 2013, “After the software is completed, what do the manufacturers use to secure their software?” At the 2013 Measuring Sector meeting, proposals were discussed and debated to address this issue. The Sector rejected the proposals; however, manufacturers committed to studying the issue and bringing back alternative(s) to the 2014 Sector meeting. See the 2013 NTEP Measuring Sector meeting summary for additional details.

**2014 Software Sector:**

Following a joint meeting of the Weighing and Software Sectors in August 2014, the Software Sector discussed the issue of “Software Maintenance and Reconfiguration” and revised the wording of a proposed paragraph G-S.9. to reflect concerns raised by other Sectors and interested parties. (Note that, at its 2014 meeting, the Measuring Sector discussed the proposed new paragraph G-S.9. in conjunction with the agenda item titled “Software Protection/Security.” See Agenda Item 2 above for comments and discussion on this proposal.)

The Software Sector proposed the following paragraph be added to the General Code of NIST Handbook 44:

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

At its 2014 meeting, the Software Sector stated it felt that explicitly requiring the metrologically significant software to be given at least the same level of protection as metrologically significant parameters is the best approach. The Software Sector looks forward to feedback from the S&T Committee and other Sectors on this proposed change. The Software Sector still would like to consider the issue of audit trail protection; there is some doubt as to whether the existing language is sufficient as it does not address the integrity of the audit trail during a software update, etc.

***2014 Measuring Sector:***

At its 2014 meeting, the Measuring Sector was asked to discuss any alternative proposal(s) from manufacturers to add language into NCWM Publication 14 on how to secure their software. The Measuring Sector discussed this item and reviewed Appendix B; *NTEP Measuring Sector 2014 Agenda, Software Maintenance and Reconfiguration, Excerpts from 2013 Measuring Sector Summary*. However, no alternatives were brought forth, nor were there any alternatives provided by the Software Sector. (See the Sector’s 2014 Meeting Summary for details.)

An excerpt from the Software Sector’s 2014 Meeting Summary, Item 4 Software Maintenance and Reconfiguration is included in **Appendix B**; a complete copy of that summary is available from the NCWM website at:

[http://www.ncwm.net/resources/dyn/files/1296056z19618afb/\\_fn/14\\_Software\\_Final\\_Meeting\\_Summary.pdf](http://www.ncwm.net/resources/dyn/files/1296056z19618afb/_fn/14_Software_Final_Meeting_Summary.pdf)

**Discussion and Decision:**

The Measuring Sector deferred discussion of this item to a joint meeting with the Software Sector on the second day of its meeting, September 16, 2015. The discussion and conclusions for this item are found in the summary of the Software Sector.

**4. Transfer Standards Testing – NIST Handbook 44 Section 3.32. LPG and 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)]

**Recommendation:**

The Sector was asked to provide input on two proposals being developed by Mr. Michael Keilty (Endress + Hauser Flowtec AG). These items appeared on the 2014 NCWM S&T Agenda as Items 332-3 and 337-3 and have been carried over on the S&T Committee’s agenda as “Developing” items. These proposals recognize the use of “transfer standards” in field testing of LPG & NH<sub>3</sub> Liquid-Measuring Devices and Mass Flow Meters.

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 two 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 the fall of 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 devices 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 2015 NCWM Interim and Annual Meetings, the S&T Committee discussed both 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.

At the 2015 NCWM Annual Meeting, the Committee noted that with regard to the relative accuracy of a particular test standard, the Fundamental Considerations in NIST Handbook 44 Section 3.2. Tolerances for Standards specify that when a standard is used without correction its combined error and uncertainty must be less than one-third of the applicable tolerance. Some of the other factors include demonstrated reliability of the device over time; device repeatability; how well it duplicates actual use; existence of documentary standards for the test equipment; availability of equipment and facilities within a state laboratory to test the equipment; and whether training has been provided for the laboratory staff, field officials, and users of the equipment. These and other factors were raised by others during the Committee’s open hearings.

NIST OWM established a U.S. National Work Group (USNWG) to examine alternative test methods. A subgroup within that USNWG is presently working to establish uncertainties for selected different test methods. OWM has circulated a draft document with guidelines for collecting test data within this subgroup; once finalized, this document might be useful in collecting such data on the use of other types of standards. Currently, there are no representatives

on the subcommittee to review factors that affect the uncertainties of measurements using master meters. However, several members of the larger work group have expressed interest in developing standards and test procedures for master meters in some applications. Should industry want to pursue recognition of master meters, test data may be needed to determine whether this is a viable method and the OWM guidelines might be used for this purpose. Collecting data to assess the test uncertainties associated with using master meters would provide useful information on the potential use of transfer standard meters (master meters) for field testing.

Regarding the specific language in the proposed new paragraph N.3.2. Transfer Standard Test, the Developer may wish to consider eliminating the phrase “test draft” and replacing it with the phrase “delivered quantity” as shown in the alternative version below. This change would be consistent with changes made in 1996 to LMD Code requirements for test drafts to better allow for the use of alternative test methods such as small volume provers.

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

Ms. Kristin Macey (California) commented that if the proposal were adopted, it would allow use of a transfer standard and California would not be able to fully support it. She noted that the State of California had completed some comparison testing using the following different test methods: “pressure volume temperature,” “gravimetric,” and “master meter.” Of the three methods compared, the master meter performed worst.

Several regulatory officials and one industry representative commented in support of the continued development of the two items. That industry representative also noted that the NIST Handbook 44 definition of “transfer standard” needs to be expanded.

Mr. Keilty, in response to Mrs. Butcher’s and Mr. Oppermann’s comments, stated that he agreed completely. Adding the paragraph to these two codes is a step towards allowing the use of transfer standards and it’s understood that there’s a number of things that would need to be in place in order that they be considered suitable for use in testing. He further noted that a change to the tolerances in these two codes is not being proposed.

The Committee agreed this item has merit and recommends the submitter of these items work with OWM by providing data for the WG to consider in determining the suitability of the master meter transfer standard as a standard in testing another device.

See the S&T Committee’s 2015 Interim and Final Reports for additional details and regional association comments.

**Discussion:**

Technical Advisor, Ms. Tina Butcher, introduced the item, noting that it appears on the NCWM S&T Committee’s agenda as a Developing Item. The submitter, Mr. Keilty, is looking for additional input to assist in the item’s development. Mr. Keilty noted that transfer standards are addressed in some NIST Handbook 44 measuring codes such as the Cryogenic LMD Code, but not in the LPG and NH<sub>3</sub> Code or Mass Flow Meters Code. Providing recognition of this testing method in those two codes would assist manufacturers and jurisdictions who might want to use these types of test methods to facilitate testing. He noted that there has been a significant increase in the interest of using “master meters” as transfer standards for testing devices such as CNG metering systems.

Mr. Randy Moses (Wayne Refueling) noted that procuring appropriate test equipment when type evaluating or field testing CNG metering systems can be challenging. It is difficult to find a scale with an appropriate capacity and division size and the environmental conditions (wind and vibrations) make it difficult to test systems gravimetrically in the field. Additionally, venting of a test tank during CNG testing poses its own problems with regard to safety and environmental issues. The use of master meters is particularly appealing in these applications. Sector members noted that testing of hydrogen metering systems gravimetrically is even more challenging given the extremely light net loads involved.

Mr. Keilty inquired whether or not Measurement Canada has considered the use of master meters. Mr. Luciano Burtini (Measurement Canada) noted that they have the same concerns and the department that addresses CNG metering in

Canada has been approached with similar requests to use master meters. Measurement Canada doesn't typically allow master meters in conventional applications, but they may be allowed in special cases where there are special challenges such as accessibility or high flow rates.

Mrs. Butcher reiterated points made during the 2014 Sector meeting and noted that these same points were raised during NCWM meetings by her and others. She noted that the use of master meters is a topic of great interest to many weights and measures jurisdictions and industry, particularly in applications where the product is caustic or corrosive or poses safety concerns; flow rate is such that conventional proving may not be practical or even available; environmental factors such as wind and vibration make other methods difficult; etc. Mr. Keilty concurred with these comments and acknowledged that there are many provisions that need to be in place to recognize such standards, but he also noted that one of the necessary components is to ensure that NIST Handbook 44 would support these devices once the other provisions have been addressed.

One question raised during the discussion was the origin/purpose of the two-minute minimum specified in the proposed paragraph titled "Transfer Standard Test." Mr. Keilty noted that the two-minute reference mirrors similar language in existing NIST Handbook 44 paragraphs that reference transfer standards and may also mirror an OIML recommendation, but he has no objection to a proposal to modify this value if appropriate. Several Sector members discussed specific procedures used for testing CNG Metering systems and noted that the NIST Examination Procedure Outline specifies specific sizes of test drafts duplicating a fill starting with cylinders filled to one-third, two-thirds, and full capacity.

Mr. Dmitri Karimov (LC) questioned whether there was an intent to limit requirements for CNG metering to the Mass Flow Meters Code, to which Mr. Keilty responded there was no intent to impose such a limitation. Mr. Karimov noted that it seems a bit unbalanced to address this only in select codes and suggested consideration be given as to whether or not similar language would be appropriate for other codes such as the VTM Code.

While resources are extremely limited with OWM's Legal Metrology Devices Program, Mrs. Butcher noted that NIST, OWM hopes to assist jurisdictions in assessing the appropriateness of alternative methods of testing metering systems. Some work is being done through the NIST USNWG on Alternative Test Methods, including the development of guidelines that could be used by a jurisdiction assessing the suitability of a given test method and in ensuring that provisions needed to ensure NIST traceability have been addressed. Mrs. Butcher noted that another aspect of assessing a given test method is to ensure that its combined error and uncertainty are less than one-third of the applicable tolerance (in addition to other provisions outlined in NIST Handbook 44 Appendix A Fundamental Considerations). She also noted that in the Carbon Dioxide Liquid-Measuring Devices Code, a larger tolerance is allowed for tests using a transfer standard. This recognizes that, if the test method is contributing additional error and/or uncertainty to the process, this should not detract from the tolerance permitted for the metering system under test. Thus, another component of assessing the suitability of a given test method is an uncertainty analysis.

The NTEP Laboratories noted that they are often faced with the question of whether or not a test method proposed by a manufacturer for use during type evaluation is appropriate. Mr. Roach stated that there need to be some kind of guidelines for transfer standards and what additional provisions would be required in order to ensure traceability to NIST. Several Sector members expressed interest in working together to identify such guidelines for review by the Sector. Mr. Buttler developed some criteria that might be used as a starting point and offered to work with others who are interested.

Mr. Keilty expressed appreciation to the Sector for the discussion on this issue and the comments shared. He indicated he believes this discussion is a good start to further work to develop this issue and looks forward to working with others who may want to develop proposed guidelines for selecting test methods during NTEP testing.

**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, including 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 NCWM 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 NIST Handbook 44 item or as a separate item for type evaluation criteria.

### **New Items:**

#### **5. Recommendations to Update NCWM Publication 14 to Reflect Changes to NIST Handbook 44.**

**Source:**

NCWM S&T Committee

**Background:**

At its 100<sup>th</sup> meeting, the National Conference on Weights and Measures (NCWM) adopted the following items that will be reflected in the 2016 Edition of NIST Handbook 44. These items were included on the Sector's agenda to inform the Measuring Sector of the NCWM actions and recommend corresponding changes to NCWM Publication 14.

**A. Section 3.30. Liquid-Measuring Devices Code, Table S.2.2. Categories of Device and Methods of Sealing**

**Background:**

At the 2015 NCWM Annual Meeting, the “Methods of Sealing” section for Category 3 devices in Table S.2.2. was modified as shown below:

<b>Table S.2.2. 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>[*Nonretroactive as of January 1, 1996]</p>
<p><b>Category 3:</b> Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>[Nonretroactive as of January 1, 1995]</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>[Nonretroactive as of January 1, 2001]</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>on demand</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. (Note: Does not require 1000 changes to be stored for each parameter.)</p>

[Nonretroactive as of January 1, 1995]

(Table Added 1993) (Amended 1995, 1998, 1999, ~~and~~ 2006, and 2015)

On a Category 3 device, the event log must be available through the device or through another device on site. The requirement to make this information available in printed or hard copy form has not changed. However, the language was refined to recognize that some systems may, in addition, be able to provide this information electronically. Some inspectors (or device owners) may find the electronic form to be a convenient way of receiving and viewing the information and, while a printed copy is still required to be made available at a minimum, this change recognizes that some systems may provide both forms.

**Recommendation:**

As a result of the changes to Table S.2.2., the Sector was asked to recommend the following changes to NCWM Publication 14. In the process of reviewing NCWM Publication 14 to identify necessary changes, several editorial changes to referenced appendices were also identified by the technical advisor.

Page LMD-42, Code Reference S.2.2.:

**9. Measuring Elements**

**Code Reference: S.2.2. Provision for Sealing**

Measuring elements shall be designed with adequate provisions to prevent changes from being made to the measuring element or the flow rate control (if the flow rate control affects the accuracy of deliveries) without evidence of the change being made. These provisions can be an approved means of security (e.g., data change audit trail) or physically applying a security seal which must be broken before adjustments can be made. When applicable, the adjusting mechanism shall be readily accessible for the purposes of affixing a security seal.

- 1.1. A measuring element shall have provisions for either:
  - 1.1.1. Applying a physical security seal. **OR**  Yes  No  N/A
  - 1.1.2. An approved means of security (e.g., data change audit trail) so that no changes may be made to its adjustable components.  Yes  No  N/A
- 1.2. Any adjustable element controlling the delivery rate shall provide for sealing or other approved means of security (e.g., data audit trail) if the flow rate affects the accuracy of deliveries.  Yes  No  N/A
- 1.3. When applicable, the adjusting mechanism shall be readily accessible for the purposes of affixing a security seal.  Yes  No  N/A
- 1.4. Audit trails shall use the format set forth in the Common and General Code Criteria section of this checklist (Code Reference G-S.8) and in Appendix A, ~~**Audit Trail Checklist for Liquid Measuring Devices**~~**Philosophy for Sealing, and Appendix B, Requirements for Metrological Audit Trails.**  Yes  No  N/A
- 1.5. Retail motor fuel dispensers with remote configuration capabilities shall be sealed according to Table S.2.2. in Appendix A, ~~**Philosophy for Sealing, and Appendix B, Minimum Requirements for Metrological Audit Trails for Liquid Measuring Devices**~~ and under the "Common and General Code Criteria" section of this checklist.  Yes  No  N/A

**Appendix B – Requirements for Metrological Audit Trails, Modify Category 3 requirements as follows:**

**Category 3.**

A device that allows virtually unrestricted access to configuration parameters or calibration parameters, or has remote configuration or calibration capability, must have an event logger as its minimum form of the audit trail. All devices with remote configuration capability manufactured after January 2005 must comply with the sealing requirements of Category 3.

An event logger contains detailed information on the parameters that have been changed and documents the new parameter values. An event logger requires a significant amount of memory;

however, it is anticipated that any device to which unrestricted access is given, will be part of sophisticated measurement process that will have considerable memory available. A centralized audit trail may be used, but additional criteria apply.

**Liquid Measuring Devices Code: S.2.2. Provision for Sealing**

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that no adjustment may be made of:

- a. Any measurement element. OR
- b. Any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries. When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.
- c. Audit trails shall use the format set forth in Table S.2.2.  
[Non-retroactive and enforceable as of January 1, 1995.]

(Amended 1991, 1993, ~~and~~ 1995, ~~and~~ 2015)

**Modify Category 3 of Table S.2.2. Categories of Device and Methods of Sealing in Appendix B as follows:**

<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.</p> <p><b>Note:</b> Does not require 1000 changes to be stored for each parameter.</p>
---	---

**Discussion:** The Sector reviewed this item, but there were no comments or discussion.

**Decision:** The Sector agreed to recommend to the NTEP Committee that the changes outlined in the Recommendation above be incorporated into the next edition of NCWM Publication 14.

**B. Appendix D – Definitions; Definition of “Point-of-Sale System.”**

**Background:** At the 2015 Annual Meeting, the NCWM adopted the following changes to the definition for “point-of-sale system.”

<p><b>point-of-sale system.</b> – An assembly of elements including a weighing or measuring element, an indicating element, and a recording element (and may also be equipped with a “scanner”) used to complete a direct sales transaction. <b><u>The system components, when operated together must be capable of the following:</u></b></p> <ol style="list-style-type: none"><li><b><u>1. determining the weight or measure of a product or service offered;</u></b></li><li><b><u>2. calculating a charge for the product or service based on the weight or measure and an established price/rate structure;</u></b></li></ol>
---

**3. determining a total cost that includes all associated charges involved with the transaction; and**  
**4. providing a sales receipt.**  
**(Amended 2015)**

There are multiple references to the term “point-of-sale system” in NCWM Publication 14 in both the LMD Checklist and the Retail Motor-Fuel Dispensers Interfaced with Electronic Cash Registers Checklist. However, the definition itself does not appear in these documents and the modifications to the definition outlined above do not appear to impact these checklist references.

**Recommendation:**

No action was requested of the Sector on this item. This item was included to update Sector members on changes to Handbook 44 and make them aware of changes that might affect how the term “point-of-sale system” is interpreted.

**Discussion:**

The Sector reviewed this item, but there were no comments or discussion.

**Decision:**

The Sector agreed to recommend to the NTEP Committee that the changes outlined in the Recommendation above be incorporated into the next edition of NCWM Publication 14.

**6. G-S.8.1. Multiple Weighing or Measuring Devices that Share a Common Provision for Sealing, Update to NCWM Publication 14 Liquid-Measuring Devices (LMD) Checklist.**

**Source:**

NTEP Measuring Sector Technical Advisor, Tina Butcher

**Background:**

Even before the adoption of paragraph G-S.8.1. in 2007, the Liquid-Measuring Devices (LMD) Code included a paragraph “S.2.2.1. Multiple Measuring Devices with a Single Provision for Sealing” that required changes to adjustments of any measuring element to be individually identified. When paragraph G-S.8.1. was added to the General Code as nonretroactive paragraph (effective 2010), a note was added to LMD Code paragraph S.2.2.1. indicating that paragraph S.2.2.1. would be deleted in 2010. Although LMD Code paragraph S.2.2.1. was removed from NIST Handbook 44 in 2010, the corresponding references in Publication 14 were not removed.

**Recommendation:**

The Sector was asked to recommend that NCWM Publication 14 Code Reference S.2.2.1 and its accompanying note be modified as follows. (See NCWM Publication 14 page LMD-42)

**Code Reference: ~~S.2.2.1. Multiple Measuring Devices with a Single Provision for Sealing~~ G-S.8.1 Multiple Weighing or Measuring Elements that Share a Common Provision for Sealing.**

9.6 A change to the adjustment of any measuring element shall be individually identified.  Yes  No  N/A

*Note: Examples of acceptable identification of a change to the adjustment of a measuring element include but are not limited to:*

a. A broken, missing, or replaced physical seal on an individual measuring element.



- b. A change in a calibration factor for each measuring element.
- c. Display of the date of or the number of days since the last calibration event for each measuring element.
- d. A counter indicating the number of calibration events per measuring element.

***Note: S.2.2.1. will be removed in the 2010 edition of NIST Handbook 44 when General Code paragraph G S.8.1. Multiple Weighing or Measuring Elements with a Single Provision for Sealing becomes effective.***

**Discussion:**

Technical Advisor, Ms. Tina Butcher, noted that this item is proposed to correct an apparent oversight in the LMD checklist in NCWM Publication 14. When paragraph S.2.2.1. Multiple Measuring Devices with a Single Provision for Sealing was removed from the NIST Handbook 44 LMD Code in 2010, the corresponding paragraph and note in the LMD checklist should have been deleted. There was limited discussion on this item. Several sector members commented that this is primarily a “housekeeping” item to correct an apparent oversight in the checklist.

**Decision:**

The Sector agreed to recommend to the NTEP Committee that the changes outlined in the Recommendation above be incorporated into the next edition of NCWM Publication 14.

**7. Vehicle-Tank Meters – Corrections to ATC Tolerances in NCWM Publication 14**

**Source:**

CDFA Division of Measurement Standards (DMS), Mr. John Roach and Mr. Dan Reiswig

**Recommendation:** Modify LMD Checklist Field Evaluation and Permanence Test Section C as follows:

**C. Field Evaluation and Permanence Test for Vehicle-Tank Meters- (Except for LPG, Cryogenic and CO2 Meters)**

The following tests are considered to be appropriate for vehicle-tank metering systems:

- Four test drafts at each of five flow rates.
- One vapor or air eliminator (product depletion) test.

**Note:** *The normal test of a measuring system shall be made at the maximum discharge rate that may be anticipated under the conditions of the installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests. (Code reference N.4.1.)*

Only one meter is required for the initial test, and after the test, the meter will be placed into service for the permanence test. The minimum throughput criterion for these meters is the maximum rated flow in units per minute × 2000.

Following the period of use, the tests listed above are to be repeated. All results within the range of flow rates to be included on the Certificate of Conformance (CC) must be within the applicable tolerances. Extended flow range testing performed at the manufacturer's discretion may be included on the CC provided the results are within the acceptable tolerances.

### **Tests of Automatic Temperature Compensating Systems (Code Reference T.2.1.)**

The difference between the meter error (expressed as a percentage) for results determined with and without the automatic temperature-compensating system activated shall not exceed:

- a. ~~0.4~~ 0.2 % for mechanical automatic temperature-compensating systems. **AND**
- b. ~~0.2~~ 0.1 % for electronic automatic temperature-compensating systems.

The delivered quantities for each test shall be approximately the same size. The results of each test shall be within the applicable acceptance or maintenance tolerance.

#### **Background:**

In 2010, the NCWM adopted changes to NIST Handbook 44, Section 3.31. Vehicle-Tank Meters Code to revise the tolerances applicable to tests of the automatic temperature compensating system. Changes were not made to corresponding references in the LMD Checklist and NCWM Publication 14 does not reflect the current tolerances specified in NIST Handbook 44. The changes proposed in the “Recommendation” above will align the tolerances in NCWM Publication 14 with those in NIST Handbook 44.

#### **Discussion:**

Technical Advisor, Ms. Tina Butcher, noted that this item is proposed by CDFA to correct an apparent oversight in the LMD checklist in NCWM Publication 14. When the tolerances for testing automatic temperature compensation systems on vehicle-tank meters was modified in the NIST Handbook 44 Vehicle-Tank Meters Code (2010 edition), the corresponding tolerance reference in the LMD checklist should have been deleted. There was limited discussion on this item. Several sector members commented that this is primarily a “housekeeping” item to correct an apparent oversight in the checklist.

#### **Decision:**

The Sector agreed to recommend to the NTEP Committee that the changes outlined in the Recommendation above be incorporated into the next edition of NCWM Publication 14.

### **8. NCWM Publication 14, Technical Policy P. Turbine Meters with Both Vertical and Horizontal Orientation.**

**Source:** CDFA Division of Measurement Standards (DMS)

**Recommendation:** The Sector was asked to consider the following changes to LMD Checklist Technical Policy Section P:

#### **P. Turbine Meters with both Vertical and Horizontal Orientation**

In addition to the Common General Code Criteria, Common Specific Code Criteria, and the Field Evaluation and Permanence Tests, the Committee noted that the following applies to tests of turbine meters, which can feature both vertical and horizontal orientation, and both directions of flow due to the effect on meter performance.

For NTEP testing, at least one meter must be tested in each direction (vertical and horizontal) of orientation. If the meter may be installed in this manner, it ~~must~~ may be tested in both directions and with the meter flow in both directions.

**Background:** Mr. John Roach (CDFA Division of Measurement Standards) questioned the language in NCWM NTEP Publication, Technical Policy P. Turbine Meters with both Vertical and Horizontal Orientation. He expressed concern that the way it is currently written, these meters are required to be tested in both vertical and horizontal orientations. Mr. Roach proposed the changes outlined in the “Recommendation” above to address these concerns.

**Discussion:** The Sector discussed ways in which meter orientation and direction of flow have the potential to affect measurement accuracy and performance for turbine meters. Mr. Roach summarized his concerns and the situation which gave rise to his concerns about the current language in NCWM Publication 14, Technical Policy P.

Technical Advisor, Ms. Tina Butcher (NIST, OWM), noted that this paragraph was added to NCWM Publication 14 following discussions at the Sector’s January 1989 meeting. At that meeting, the Sector agreed to the following:

The orientation of the meter in its installation and the direction of product flow can have an effect on meter performance. The effects of gravity can alter the meter’s ability to perform properly. The Committee recommends that a turbine meter be tested in both directions (vertical and horizontal) of installation if it may be installed in both directions and with meter flow in both directions if it is used in this manner. It is thought that the positions between the vertical and horizontal will not vary significantly from the results obtained in these two positions.

The Sector discussed aspects of meter installation, noting both meter “orientation” and “direction of product flow” can have an effect on meter performance for some designs of meters. The Sector acknowledged that not all meters are designed to be used in both horizontal and vertical orientations; likewise, not all meters are designed or intended to be used in multiple directions of flow. However, if a meter is intended to be used in more than one orientation and/or in more than one direction of flow, the Sector agreed that performance under those different conditions must be verified through testing during type evaluation. The Sector agreed that the Technical Policy in NCWM Publication 14 needs to be clarified to require testing to verify performance only in the orientation(s) and flow direction(s) intended by the manufacturer and to clarify that meter “orientation” is a separate variable from meter “direction of flow.”

Some Sector members felt that limitations of installation with regard to orientation or direction of flow should be marked on the meter and specific, corresponding marking requirements be added to NIST Handbook 44. However, the consensus was that including the information on the CC for the meter was sufficient and would be an effective way to address any limitations that must be addressed in specific installations.

**Decision:**

The Sector agreed to recommend that the following changes be made to Section P. of the Technical Policy in NCWM Publication 14.

**P. Turbine Meters with Both Vertical and Horizontal Orientation.**

In addition to the Common General Code Criteria, Common Specific Code Criteria, and the Field Evaluation and Permanence Tests, ~~the Committee noted that~~ the following applies to tests of turbine meters; ~~which feature designed for use in~~ both vertical and horizontal orientations; ~~and/or in~~ both directions of flow due to the effect on meter performance.

For NTEP testing, ~~at least one meter must be tested in each direction (vertical and horizontal) of orientation. If the of a meter that may be installed in multiple orientations (e.g., horizontal, vertical, or other), this manner, it at least one meter must be tested in both directions and with the meter flow in both directions each orientation. For meters that are designed as “bi-directional,” at least one meter must be tested in both directions of flow.~~

**Limitations in orientation or direction of flow must be addressed as follows:**

- **Direction of flow (e.g., bi-directional or uni-directional) must be marked on the meter as well as listed in the Certificate of Conformance.**
- **Limitations regarding the orientation (e.g., horizontal or vertical) must be specified in the Certificate of Conformance; however, these limitations are not required to be marked on the meter.**

- **In the case of a meter approved for use in other than a horizontal orientation, limitations regarding the upward/downward flow must be specified in the Certificate of Conformance; however, these limitations are not required to be marked on the meter.**

## **9. Expansion of NCWM Publication 14 LMD Technical Policy A, Test Location and CC Information.**

**Source:** NTEP and NTEP Laboratories

**Recommendation:** Modify LMD Checklist Technical Policy A as follows:

### **A. Type Evaluation Test Location, and Installations Criteria and Certificate of Conformance Information**

The manufacturer has the choice of submitting a meter or liquid measuring device to one of the following for National Type Evaluation Program (NTEP) evaluation:

- A government laboratory
- A field test
- A manufacturer's laboratory

A laboratory test alone may not be sufficient basis on which to issue a Certificate of Conformance (CC.) The policies on product families, meter sizes, and flow rates listed on a CC apply regardless of where the meter is tested. Additional testing may be required based on these policies.

#### **Site Requirements – General**

Site requirements for tests to add new sizes to an existing CC:

For tests of a meter size not previously covered on the CC (through testing or through the guidelines outlined for meter sizes paragraph E), the installation selected for test must achieve at least 80 % of the meter's rated maximum flow rate.

Site requirements to add new products to an existing CC:

2. If the size of meter selected for test was previously tested under the CC with another product, then there are no minimum requirements with respect to the flow rates to be achieved in the installation selected for testing.
3. If the size of meter selected for test was covered based on the guidelines outlined for meter sizes not previously tested under the CC with another product, then the installation selected for test must achieve at least 40% of the meter's rated maximum flow rate; otherwise, the site is inappropriate for type evaluation.

To recognize that the maximum discharge flow rate developed by the measuring system will vary with each system, NTEP accepts a maximum discharge rate developed by a system as low as 50 % of the rated maximum flow rate of the device. If the maximum flow rate achieved during and NTEP evaluation is less than 50 % of the maximum flow rate marked on the device, NTEP will limit the maximum flow rate listed on the CC to 200 % of the maximum flow rate achieved during the evaluation.

**The CC should include the following information:**

- **Approved ranges and parameters (flow rates, viscosity/specific gravity, product family or families, sizes of meter, minimum measured quantity)**
- **Accuracy Class**
- **Application (stationary, vehicle mounted, etc.)**
- **Multi-point calibration (if applicable)**
- **Special restrictions (if applicable)**
- **Operating instructions required to test or inspect the device**
- **Conditions of testing (lab, field, manufacturer facility, etc.), test equipment used and other devices used in the system under test**

**Background:**

During the spring 2015 NTEP Measuring Laboratories Meeting, NTEP Laboratory representatives reviewed the information needed on an NTEP Certificate of Conformance. NTEP Administration and NTEP evaluators agreed that it would be advisable to change NCWM Publication 14. The group reviewed a similar section in the weighing devices portion of NCWM Publication 14, Technical Policy A & B. The group proposes expanding Technical Policy A. in NCWM Publication 14 to include pertinent information that should be included on NTEP Certificates of Conformance for Liquid Measuring Devices as shown in the “Recommendation” above.

**Discussion:**

Mr. Truex related the discussions at the 2015 NTEP Laboratories Meeting and noted that the proposed changes are intended to help improve uniformity in CCs and help ensure that key information needed by the field official in verifying compliance of the device is readily available. This information will also help provide guidance to manufacturers regarding the minimum information that needs to be included on a CC. Additional information may be added to the CC at the discretion of the NTEP evaluator to help provide key information needed by field officials in inspecting and testing individual devices in the field.

**Decision:**

The Sector agreed to recommend that the changes outlined in the “Recommendation” above be made to Section A. of the Technical Policy in NCWM Publication 14.

**10. Time-Out on Card-Operated Retail Motor-Fuel Dispensers.**

**Source:**

North Carolina Department of Agriculture and Consumer Services, Allen Katalinic

**Recommendation:**

The Sector was asked to consider proposing the following paragraph for inclusion in NIST Handbook 44 (and to specify “timeout” limits in NCWM Publication 14). The proposed paragraph would limit the amount of time that a credit or debit card can remain authorized and help to avoid misuse by subsequent customers.

**S.X.X. Card-Operated Retail Motor Fuel Devices. – After accepting the card, if the device is not activated or there is no product flow within three minutes the transaction must be completed. Re-authorization of the device must be performed before any product can be dispensed. If the time limit to deactivate the dispenser is programmable, it shall not accept an entry greater than three minutes. The 3-minute timeout shall be a sealable feature.**

**Background:**

North Carolina reports a complaint in which an individual purchased fuel with a credit card and after the first customer drove away, the next vehicle received fuel on the first customer’s credit card. While paragraph G-S.2.2. Facilitation of Fraud might be used to address the operation of the dispenser; a more specific requirement is needed to enable NTEP evaluators and inspectors to consistently apply appropriate requirements to the system.

Section 39 of the “Additional Checklists and Test Procedures for Card-Activated Retail Motor-Fuel Dispensers” section of the NCWM Publication 14 LMD Checklist requires a dispenser that has been “authorized” with a credit or debit card to “de-authorize” if the dispenser has not been turned on after a period of three minutes. There are also provisions requiring “de-authorization” after the handle has been turned off after a delivery. There is no time limit for de-authorization of the dispenser if the handle remains “on” after authorization with a card or if no product flows after a certain period of time after authorization.

Several references to “time out” limits are found in measuring device codes in NIST Handbook 44. The addition of similar requirements to address the use of credit and debit cards on retail motor-fuel dispensers would help to limit misuse of cards. North Carolina proposes that the Sector consider proposing a paragraph for addition to NIST Handbook 44 and adding more specific requirements to NCWM Publication 14 to address these concerns.

**Discussion:**

Mr. Katalinic provided an overview of the complaint that prompted the proposal. The Sector discussed the proposal at some length. During the discussion, the Sector debated what terminology is most appropriate to use when referencing the process of authorizing a credit or debit card. For example, should the reference be to the “authorization” or “activation” of the dispenser? Likewise, is the key issue the activation of the dispenser or the authorization of the card.

Mr. Randy Moses (Wayne Fueling Systems) commented that these features are controlled through the point-of-sale (POS) system rather than the card reader in the dispenser. The RMFD sends a signal to the POS and, if there is no information provided within a specified period of time, the POS de-authorizes the sale. Mr. Moses also expressed concern about the maximum limit of three minutes, noting that for some applications such as filling of saddle tanks on large trucks, this limit may interfere with the transaction process.

Mr. Adam Oldham (Gilbarco, Inc.) concurred that the payment terminal in the dispenser is a “dumb” card-reading device similar to what you would see in many retail locations. The United States and Canada don’t presently have mandated pre-set minimum time limits for a “time-out” nor the provisions to seal or limit these settings. He expressed concerns about requiring this to be a sealable feature. Mr. Oldham also noted (and others agreed) that, if the time-out feature is programmable, it should not have to be “sealable” if the maximum amount for which it can be programmed is equal to the maximum permissible time limit (e.g., three minutes in the current proposal). One additional question that needs to be addressed is whether or not this proposed requirement would also apply to cash-activated dispensers.

Mr. Truex commented that the underlying issue for this proposal is that if a dispensing system allows a customer’s card to be authorized and that authorization is allowed to remain open for an indefinite period of time, this can facilitate fraud. Without a paragraph such as the one proposed, it would be covered under General Code paragraph G-S.2. Facilitation of Fraud. Mr. Truex noted that this may become an emotional issue and subject to considerable debate in the open hearings of the regional weights and measures associations and the NCWM.

After additional debate and proposed modifications to the proposed language, the Sector developed an alternative version of the proposal which members felt was more appropriate with regard to terminology.

**Decision:**

The Sector supports the submission of a proposal and agreed to recommend the following, modified version of the proposal **when this proposal is presented to the regional associations and national S&T (by North Carolina):**

**S.X.X. Card-Operated Retail Motor Fuel Devices. – Within three minutes after the card has been accepted and the device has been authorized, if the device is not activated or there is no initial product dispensed, the device must de-authorize. 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 three minutes.**

## 11. NIST Handbook 44 Appendix D – Definitions; Remote Configuration Capability.

### Source:

2015 NCWM S&T Committee (2012 Grain Sector; 2015 NIST OWM) [2014 S&T Item 360-2 (D)]

### Recommendation:

The Sector was asked to provide input on the development of requirements to address devices which are remotely configured using removable digital storage devices. This item is still under development. However, NIST, OWM is seeking preliminary feedback on a proposed addition to the General Code and accompanying requirements in the specific codes which would state that sealing requirements for such devices are as outlined in this new General Code paragraph. The proposed General Code paragraph appears below and is followed by an example (based on the Scales Code) of how this requirement might appear in the specific codes.

Add the following new paragraph to Section 1.10. General Code:

**G-S.8.2. Devices Adjusted Using Removable Digital Storage Device. – For devices in which the configuration or calibration parameters can be changed by use of a removable digital storage device, such as a secure digital (SD) card, USB flash drive, etc., security shall be provided by use of an event logger in the device. The event logger shall 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 on demand through the device or through another on-site device. In addition to providing a printed copy of the information, the information may be made available electronically. 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.)**

Modify the sealing requirements in Section 2.20. Scales Code as follows:

### *S.1.11. Provision for Sealing.*

**S.1.11.1 Devices Adjusted Using a Removable Digital Storage Device. – For those devices adjusted using a removable digital storage device, G-S.8.2. applies.**

**S.1.11.2 All Other Devices. – Except on Class I scales and devices specified in S.1.11.1. the following provisions for sealing applies:**

(a) *Provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of an electronic device.*

*[Nonretroactive as of January 1, 1979]*

(b) *A device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.*

*[Nonretroactive as of January 1, 1990]*

(c) *Audit trails shall use the format set forth in Table S.1.11.*

*[Nonretroactive as of January 1, 1995]*

A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

(Amended 1989, 1991, and 1993)

**Background:**

At its 2014 meeting, the Grain Analyzer Sector agreed to forward a proposal to amend the definition of “remote configuration capability” in NIST Handbook 44 to the S&T Committee for consideration. The following changes were proposed:

**remote configuration capability.** – The ability to adjust a weighing or measuring device or change its sealable parameters from or through some other device that ~~is not~~ **may or may not** itself **be** necessary to the operation of the weighing or measuring device or ~~is not~~ **may or may not be** a permanent part of that device.[2.20, 2.21, 2.24, 3.30, 3.37, 5.56(a)]

(Added 1993, **Amended 20XX**)

The SMA supported the Grain Analyzer Sector’s proposal. However, during subsequent NCWM meetings, the S&T Committee heard opposition to the proposed changes and also heard some suggested alternatives without being able to reach a consensus on proposed changes. Many acknowledged that technology exists to remotely configure some types of weighing and measuring equipment using removable media.

NIST, OWM commented that when the current requirements for sealing (including the criteria for various categories of devices and audit trails) were developed some years ago, no one had considered devices which could be configured in this manner. OWM suggested that it might be more appropriate to develop separate requirements to address new and future technologies which can be remotely configured with removable media rather than attempt to modify the current sealing requirements, which apply to other types of devices. If new requirements were developed, current sealing requirements could continue to apply to technology which cannot be adjusted using removable media.

At its 2013 meeting, the Weighing Sector asked its members to assist OWM in identifying the various types of removable storage media used in weighing equipment. This item was also discussed at the 2013 and 2014 Measuring Sector meetings, including the question of and whether or not additional guidance might be needed on what is covered by each sealing category. The Measuring Sector concluded that the definitions are adequate as currently written.

Since grain analyzers in the NTEP program are all already required to be sealed using an “event logger,” the Grain Analyzer Sector indicated no interest in continuing to develop this item. Based on input from the weights and measures community, OWM anticipates other device types with the capability to be configured with removable media will be (and in some cases, have already been) developed. NIST, OWM believes that further development of this item is required and needs to include other remote configuration technologies that may be used in other weighing and measuring devices. Consequently, OWM requested that the S&T Committee reassign this item to OWM as a “Developing” item and indicated it plans to develop draft language and request input from the various Sectors at their upcoming meetings.

At the 2015 NCWM Annual Meeting, NIST, OWM updated the S&T Committee on its work on this issue and requested feedback on suggested changes to the General Code that NIST OWM has developed. (These drafts are outlined in the “Recommendation” above.)

OWM also noted that it plans to propose corresponding changes to individual, specific codes to specify that sealing requirements for devices configured with removable media are found in the new, proposed General Code paragraph. An example drafted for possible inclusion in the Scales Code appears below. OWM plans to draft language for other specific codes prior to submitting any recommended changes to the S&T Committee under this item.

At that meeting, the S&T Committee also agreed to reassign this item to NIST, OWM for further development.

Additional background information on NCWM S&T Item 360-2 is contained in the S&T Committee’s 2014 Interim and Annual Reports.



**Discussion:**

Ms. Tina Butcher (NIST, OWM) explained that NIST would appreciate receiving feedback on the general direction for addressing devices configured with removable media that is outlined in the Recommendation above. She noted that the proposal is not yet ready to submit for NCWM action; NIST is still in the process of refining the proposal. The key issue is that some designs of devices that can be configured with removable media do not meet the definition of a remotely configurable device, yet the security concerns are similar. In the example of the grain moisture meter, the removable media must remain in place in order for the equipment to operate, but there is no control to ensure or track that the removable media is not replaced with media with different calibration/configuration values. Such devices weren't envisioned when the current criteria and requirements for sealing electronic devices was developed. Changing the definitions and requirements that are currently in place would impact existing equipment. OWM is attempting to find a solution that would be applied only to this category of device (that can be configured with removable media), but have a minimal impact on equipment that complies with the current sealing requirements.

Mr. Dmitri Karimov (LC) questioned how systems that are configured through wireless communication would be addressed and whether they would be addressed with this proposal. Mr. Luciano Burtini (Measurement Canada) also questioned how the configuration of a device by scanning a bar code would be addressed in the current sealing requirements and suggested that this variation needs to be considered. Several Sector members echoed these points, noting that any new criteria should consider wireless types of communication.

Mr. Marc Buttler (Emerson Process Management/Micro Motion) noted that another approach is for a device to be equipped with a physical switch which puts a USB port into and out of the configuration access mode. Thus, the USB port is not always activated with regard to calibration/configuration. A desired method of sealing would be for the switch to be able to be physically sealed or for the device to be equipped with two event counters. Mr. Truex noted that similar scenarios have been observed for shipping scales where shipping rates were downloaded via USB ports.

Mr. Rich Miller (FMC) noted that some of these scenarios are similar to that in which an EPROM is switched out. There should have been a method of protecting from this type of change. Mr. Buttler echoed that such a change is also modifying the software revisions.

**Decision:**

The Sector did not develop any conclusions or recommendations on this issue, but provided general comments to assist NIST, OWM in the further development of its proposals. The Sector agreed that variations such as those discussed by the Sector need to be considered either in OWM's new proposal or the current sealing requirements and looks forward to reviewing specific proposals when they are ready.

**12. Test Methods for Metering Systems Measuring “Natural Gasoline” and Other Products with Special Characteristics.**

**Source:**

Rich Miller (FMC) and NTEP

**Recommendation:**

The Sector was asked to provide input on several issues related to the measurement “Natural Gasoline.” The Sector is asked for input on the following points:

- What is the most appropriate test method(s) for testing metering systems used to measure “natural gasoline” during NTEP testing (and routine field testing)?
- Where should “natural gasoline” fall in the “Family of Products” table?
- Are additional provisions needed in NIST Handbook 44 to help ensure that metering systems used to measure natural gasoline (and other products with characteristics with low boiling points or other special challenges) remains in the liquid state during normal commercial metering?

- Might the Sector develop general guidelines to assist NTEP laboratories (and field officials) in selecting the most appropriate test methods for other products that may not remain in the liquid state in the range of typical ambient temperatures and pressures?

**Background:**

Mr. Rich Miller (FMC) brought an issue to NTEP’s attention regarding the measurement of “natural gasoline.” During the field inspection of a metering system measuring “natural gasoline” Mr. Miller raised concerns regarding the most appropriate test method for testing the metering system. Information provided to NTEP regarding the properties of natural gasoline seems to vary, with boiling points ranging from + °F to + 82 °F. For products with such a boiling point so close to common ambient temperatures, a concern is that during routine field testing, temperatures may exceed the boiling point of the product and tend to vaporize in an open neck-type prover.

Products with special characteristics such as this may pose a challenge, not only in selecting the most appropriate test methods, but in identifying the appropriate place to include them in the “Family of Products” table in the NCWM Publication 14 LMD Checklist Technical Policy section. Input is needed from the Sector regarding categorization of the product in the Family of Products Table.

NIST, OWM was asked to provide input regarding recommended test procedures for routine field inspections and also asked to revise EPO 25 Loading Rack meters to recognize testing with small volume provers. NIST, OWM noted that EPO 25 was developed based upon testing with a neck-type prover. The test procedure in EPO 25 includes specific procedures for testing with a neck type prover such as proper drain procedures, reading test errors, and other details; this EPO does not adequately address testing with other types of test methods. Alternate test procedures would need to be developed for testing conducted with other types of test methods such as small volume provers. NIST, OWM has no immediate plans to develop recommended minimum test procedures (in the form of an EPO) for testing with small volume provers; however, NIST, OWM will revise EPO 25 to include a statement clarifying that the test procedures in EPO 25 are for use with neck-type provers.

In addition to considering the appropriate test methods for metering systems for such products, consideration also needs to be given to whether or not additional NIST Handbook 44 requirements may be needed to help ensure that such products remain in the liquid state during commercial metering. For example, LPG measuring systems are required to have special features such as a differential pressure value to help ensure that the product remains in the liquid state during metering. The Sector may wish to provide input on this aspect of metering such products.

**Discussion:**

Mr. Miller provided a brief summary of the situation, which led to his initial request. He explained that in the scenario he encountered, a company was using natural gasoline to denature alcohol and, though this product is not always metered, it was being metered in this particular instance. Mr. Miller pointed out that this is not a metering issue; rather, it is a procedural issue. That is, the issue relates to the selection of a test method that is appropriate for the metering system and the product being measured. Mr. Miller noted he had contacted several other weights and measures jurisdictions regarding how they address testing of these meters and some, like Minnesota, indicated that they only test these systems (using a neck-type prover) in cooler weather. They don’t check these meters in hot weather.

Ms. Butcher questioned how we know for certain that this is not a metering issue, but rather a testing issue – or if the results were a result of both issues. In researching this issue, OWM and others questioned whether or not special provisions need to be included in the metering system to ensure that vaporization doesn’t occur during the metering process. For example, in an LPG metering system, a special component is required to maintain the product in a liquid state during the metering process. Mike Keilty (Endress + Hauser Flowtec AG, USA) also questioned whether the metering system might have created some of the problem. Mr. Marc Buttler (Emerson Process Management/Micro Motion), noted that natural gasoline is somewhere between gasoline and LPG in volatility.

Mr. Miller commented that the system requires that a constant back pressure be maintained upstream of the meter. Additionally, a relatively small amount is dispensed in normal deliveries, whereas a much larger quantity was dispensed during testing into an open prover; thus, vaporization during routine use doesn’t typically become an issue.

Ms. Butcher noted that finding authoritative information about the product and its characteristics proved difficult when preparing this issue. She commented that OWM would need additional information about the product in order to make specific recommendations about the best test method to be used or for where the product might fall within the Family of Products Table in NCWM Publication 14. However, as mentioned earlier, a note added to EPO 25 clarifying that the procedure is for use with a neck-type prover would be appropriate in the meantime. Additionally, a note could also be added to caution people to select a test method and to test under conditions that would minimize the effect of vaporization during testing. There is already a paragraph in the “Notes” section of most of the NIST Handbook 44 measuring devices codes that requires care be taken to minimize changes in volume of the test liquid due to temperature and evaporation issues. This “Notes” paragraph is already referenced in any of the measuring device EPOs that reference codes where such a paragraph is included.

**Decision:**

The Sector discussed and vetted this issue at length, but reached no solution or recommendation. The Sector agreed that the scenario sounded like the issue was more a question of selecting the most appropriate test method. If a more specific proposal including a recommendation for where “natural gasoline” would fall in the Family of Products Table is developed, the Sector is willing to readdress the issue at a future meeting. The NTEP laboratories indicated that they would consult with NIST regarding testing methods to be used for meters dispensing natural gasoline should the question arise during type evaluation. The labs and other Sector members agreed that it appears that a closed type of prover seems most appropriate for testing meters dispensing this product or other liquids that don’t remain in a liquid state during ambient temperatures and pressures.

**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.

**13. Multi-Point Calibration – NIST Handbook 44 LMD Code – Wholesale Meters.**

**Source:**

Minnesota Weights and Measures Division (2014); [2014 NCWM S&T Item 330-4 (D)]

**Recommendation:**

This item is included on the Sector’s agenda to make members aware of the continued development of a proposal to add new paragraphs to NIST Handbook 44, Liquid-Measuring Devices Code and to ask for input from the Sector on those recommended changes which are outlined below:

**N.4.5. Verification of Linearization Factors. All enabled linearization factors shall be verified when a device:**

- (a) is initially being put into commercial use;**
- (b) has been placed into service and is officially being tested for the first time;**
- (c) is being returned to commercial service following official rejection for failure to conform to performance requirements and is being officially tested for the first time after corrective service;**
- (d) is being officially tested for the first time after major reconditioning or overhaul; or**
- (e) at the discretion of the official with statutory authority.**

**The verification of enabled linearization factors may be done through physical testing or empirical analysis.**

**UR.4. Maintenance Requirements.**

**UR.4.1. Use of Adjustments. – Whenever devices are adjusted, all enabled linearization factors shall be verified through physical testing or empirical analysis to determine that the errors are in tolerance and any adjustments which are made, shall be made so as to bring performance errors as close as practicable to zero value.**

**Background:**

Wholesale metering systems are used to deliver product at many different flow rates. Many of these systems are equipped with features that allow different calibration factors to be programmed at those flow rates. Companies commonly set accuracy goals of  $\pm 0.05\%$  at normal and “fallback” delivery rates; however, they are often reluctant to spend time entering different calibration factors for the initial (“start-up”) and ending (“shut-down”) portions of the delivery. Spending time calibrating the metering system at normal and fallback delivery rates to such a high degree of accuracy is wasted if the error introduced into the measurement by the start-up and shut-down quantities is unknown. An additional concern is that an unscrupulous operator could use the error introduced by the start-up and shut-down portions of the delivery (if known) to adjust calibration at the normal delivery rate such that the overall error of a typical delivery is predominantly in the user’s favor. Officials should be aware that when delivered quantities are greater than the prover used at calibration, start-up and shutdown errors have a counter-intuitive effect. Underregistration errors (which are normally in the consumers’ favor) in the start-up and shut-down portions of the delivery may actually create shortages in the total delivery if calibration of the normal rate is adjusted to compensate for that underregistration. While these errors should be well within tolerance if the start-up and shut-down errors are in tolerance, an official who is trying to determine predominance of error should be aware of this effect and know how to determine the expected error in a typical delivery. Operators need to understand the importance of knowing and accounting for the effects of start-up and shut-down errors. Officials need to be aware of the potential for misusing that knowledge. Terminals and refineries want to maximize the accuracy of their liquid measuring devices by optimizing the calibration factors at typical delivery rates.

This proposal is not intended to have any effect on locations which do not use electronic calibration factors to optimize accuracy at every delivery rate. Even at locations which do use multiple calibration factors, no action is required unless the official notices that the error for the start-up and shut-down rates is predominantly in one direction. If the start-up and shut-down errors are predominantly in one direction, the official then needs to determine the size of a typical transaction and the likely predominance of the error. Device owners can easily ensure that they have no problems with this requirement by making sure that their devices are in tolerance at slow flow start-up and shut-down rates and that errors are not predominantly in one direction.

At its 2014 meeting, the Sector discussed four proposals submitted in relation to this general issue as a group (see the Sector’s 2014 Meeting Summary and the S&T Committee’s 2014 and 2015 Annual Reports for details).

Mr. Dmitri Karimov (Liquid Controls) provided a presentation developed by a group of individuals who have been working on this issue. Mr. Karimov noted that this presentation will also be given to all regional weights measures meetings. The purpose of the presentation was to explain the reasoning behind the proposal and to attempt to answer any questions or concerns. The primary objective of the proposal is to linearize the meter’s error across its operation, in other words, to flatten the typical error curve that is registered in a measuring device.

Significant discussion and vigorous debate ensued. Participants from the NTEP laboratories present at this meeting stated that nothing is changed to the applicable tolerances and this would only result in a great amount of additional testing with minimal improvement in the results. Other members asked questions about the minimum testing recommended for field inspections and Measurement Canada’s procedures were discussed. The Sector did not reach consensus on these proposals and no recommendation was presented from the Sector. Some Sector members stated that the existing NIST Handbook 44 Special Test reference in the Notes section of both the LMD and VTM codes currently allow for these additional tests at multiple calibration points to be conducted, thus, there is no need for this proposal. The Sector did not reach consensus on these items and no recommendation was presented from the Sector.

At the 2015 NCWM Annual Meeting, the S&T Committee grouped several agenda items related to this issue (Agenda Items 330-4 and 331-2) and addressed them simultaneously. During the open hearings, there was a recommendation

made by Ms. Julie Quinn (Minnesota), submitter of the two items, to replace the Item Under Consideration in both agenda items with new language. (*See the “Recommendation” above in the Sector’s agenda.*)

In providing justification for the recommendation, Ms. Quinn noted that she had conducted a meeting on Sunday, July 19, 2015, with a group that included several meter manufacturers to consider the proposal. It was during this meeting that the group developed proposed paragraphs N.4.5. and UR.4. and decided to recommend they replace the two paragraphs currently proposed. An industry representative, who is also a member of the group that helped develop the proposal voiced support of the changes proposed by Ms. Quinn.

Mr. Ross Andersen (New York, retired), in considering the new proposal recommended by Ms. Quinn, commented that only part (e) of proposed new paragraph N.4.5. Verification of Linearization Factors is needed. Officials must decide which factors are to be tested or what testing is needed.

Ms. Butcher acknowledged the progress made by the group working on the multi-point calibration issue. She indicated additional work is needed with respect to abbreviating the testing that’s needed to verify the performance of a meter with multi-point calibration. She also indicated that detailed procedures might be better suited in a NIST EPO, rather than NIST Handbook 44. In a written analysis of the item provided to the Committee, OWM reiterated the following points presented at the 2015 NCWM Interim Meeting:

- OWM acknowledges that to verify the performance of a meter with multi-point calibration completely, separate tests must be performed with each product that will be metered, and at all flow rates and every calibration factor that has been programmed into the system for those products. This makes obvious the need to perform many tests on a single meter in order to take into account the different factors, and combinations thereof, affecting performance.
- OWM questions however, whether it is reasonable to expect that all regulatory jurisdictions be equipped with the resources necessary to perform the extensive amount of testing required by this proposal. OWM believes that some jurisdictions are likely to consider this practice onerous, and consequently, may not be willing or capable of performing the amount of testing prescribed. OWM also questions whether device owners would be receptive to the amount of time a device would need to be taken out of service in order to complete the testing.
- In considering this item, OWM identified a number of issues that indicate additional work would be needed to further develop this proposal. The following issues were identified:
  - Why limit this concept of testing multi-point calibration devices to LMDs and to only those LMDs being used in a wholesale application? Other types of equipment, both wholesale and retail, including scales, vehicle tank meters, etc., have multi-point calibration. Perhaps there should be a General Code requirement that addresses this issue for all types of devices.
  - Did the multi-calibration group consider statistical sampling to reduce the number of tests required when developing this proposal? Might some form of statistical sampling plan be developed that provides an indication of the level (or amount) of testing required in a given population of devices?
  - Might such detailed procedures be better suited for inclusion in a NIST EPO?
  - It is not clear what is meant by “all products’ in the proposal. Is this to mean every grade of product? If the intent is to require every grade of every product, this would conflict with current NTEP evaluation policy.
  - If it is the intent of the multi-calibration work group to classify the testing to be performed on a device with multi-point calibration as “Normal” tests opposed to “Special” tests, which is OWM’s understanding, then positioning this new paragraph beneath N.4.2. Special Tests and assigning it the designation “N.4.2.5.” would be inappropriate.

- The title of the proposed paragraph, “Initial Verification,” conflicts with the following words contained in the first sentence of the paragraph: “or after being repaired or replaced.”
- What is meant by “repaired” in the first sentence? Did the multi-calibration group consider the definition of “repaired device” in NIST Handbook 44 or the examples of a “repaired device” that were developed by the NCWM Remanufactured Device Task Force in 2000 when using this term?
- How much testing would be required on a return (callback or reexamination) inspection if a device exceeded tolerance on only one of the initial tests (i.e., one product, flow rate, and calibration factor) when all other initial tests of the same meter (using same or different products at different flow rates and calibration factors) proved accurate? No guidance has been provided on how much testing would be needed on a callback or re-inspection visit (i.e., following repair).
- Should the word “and” replace the word “or” in the first sentence? OWM believes the testing described is intended to apply to equipment put into commercial service the first time, equipment that has been adjusted, and to equipment installed to replace another piece of equipment. If that’s the case, the word “and” should be used.

The Committee agreed to replace the Item Under Consideration with the changes proposed by Ms. Quinn and looks forward to future refinements of this item by the submitter.

**Discussion:**

The Sector briefly discussed this issue. There was general support for the work to develop clear guidelines for testing systems with multi-point calibration capability. The Sector acknowledged that several Sector members have participated in the group working to develop these proposals and several spoke to the proposals.

During discussion of this item, Mr. Allen Katalinic (North Carolina NTEP Laboratory) questioned the format of the language in the proposed paragraph N.4.5. Verification of Linearization Factors. He noted that the lead sentence doesn’t flow with the last subsection (e) and does not make sense as written. The Sector developed two alternative versions of the language to address this inconsistency. Prior to the end of the Sector meeting, Technical Advisor, Tina Butcher, contacted Ms. Julie Quinn (MN) who has been leading the work on these proposals. Ms. Quinn expressed appreciation to Mr. Katalinic and identified the option which best represents the intent of the group working on this issue.

**Decision:**

The Sector reviewed the most recent proposal presented by the group working on multi-point calibration issues. The Sector agreed to support the proposal, noting that several Sector members were part of the group that has been developing this issue. The Sector supports proposed paragraph UR.4. Maintenance Requirements as written. The Sector recommends the following version of the proposed paragraph (which proposed modifications to the beginning of each subsection), as confirmed by Ms. Quinn:

**N.4.5. Verification of Linearization Factors. – All enabled linearization factors shall be verified:**

- (a) **when a device is initially being put into commercial use;**
- (b) **when a device has been placed into service and is officially being tested for the first time;**
- (c) **when a device is being returned to commercial service following official rejection for failure to conform to performance requirements and is being officially tested for the first time after corrective service;**
- (d) **when a device is being officially tested for the first time after major reconditioning or overhaul; or**
- (e) **at the discretion of the official with statutory authority.**

**The verification of enabled linearization factors may be done through physical testing or empirical analysis.**

#### **14. Multi-Point Calibration – NIST Handbook 44 Vehicle-Tank Meters Code.**

**Source:**

Minnesota Weights and Measures Division (2014); [2014 NCWM S&T Item 331 2 (D)]

**Recommendation:**

This item is included on the Sector’s agenda to make members aware of the continued development of a proposal to add new paragraphs to NIST Handbook 44, Vehicle-Tank Meters code and to ask for input from the Sector on those recommended changes which are outlined below:

##### **N.4.6. Initial Verification.**

**A vehicle tank meter shall be tested at all flow rates and with all products for which a calibration factor has been electronically programmed prior to placing it into commercial service for the first time or after being repaired or replaced.**

**A vehicle tank meter not equipped with means to electronically program its flow rates and calibration factors shall be tested at a low and high flow rate with all products delivered prior to placing it into commercial service for the first time or after being repaired or replaced.**

**Example: A vehicle tank meter is electronically programmed to deliver regular and premium gasoline at a startup/shutdown flow rate of 20 gpm, a normal operating flow rate of 100 gpm, and an intermediate rate of 65 gpm. The meter is to be tested with regular gasoline at 20 gpm, 65 gpm, and 100 gpm; and with premium gasoline at 20 gpm, 65 gpm, and 100 gpm.**

**The official with statutory authority has the discretion to determine the flow rates and products at which a vehicle tank meter will be tested on subsequent verifications.**

##### **UR.1.5. Initial Verification Proving Reports.**

**Initial verification proving reports for vehicle tank meters equipped with means to electronically program flow rates shall be attached to and sent with placed-in-service reports when the regulatory agency with statutory authority requires placed-in-service reports.**

**Background/Discussion:**

Many terminals and refineries want to maximize the accuracy of their liquid-measuring devices by optimizing the calibration factors at typical delivery speeds and some bulk delivery companies are beginning to utilize the capabilities of electronic registers with multiple calibration factors to optimize their accuracy at flow rates that are customarily used. Just like registers on wholesale liquid measuring devices, these meters can be configured for a standard initial “start-up” and ending “shut-down” quantity delivered at a slower speed than is used for the remainder of the delivery. Service agents are expected to calibrate devices as close to zero as possible, but spending time calibrating normal delivery rates to a high degree of accuracy is wasted if the error introduced into the measurement by the start-up and shut-down quantities is unknown. On the other hand, an unscrupulous operator could also use the known error introduced by the start-up and shut-down errors to calibrate the normal delivery rates so that all the errors on typical deliveries work predominantly in the user’s favor. Officials should be aware that when delivered quantities are greater than the prover used at calibration, start-up and shut-down errors have a counter-intuitive effect. Underregistration, which normally operates in the consumers’ favor, may actually create shortages in the total delivery if calibration of the normal rate was adjusted to compensate for that underregistration. While these errors should be well within tolerance if the start-up and shut-down error are in tolerance, an official who is trying to determine predominance of error should be aware of this effect and know how to calculate the expected error in a typical delivery. Operators need to understand the importance of knowing and accounting for the effects of start-up and shut-down errors. Officials need to be aware of the potential for misusing that knowledge.

This proposal has no effect on locations which do not use electronic calibration factors to optimize accuracy at every delivery rate. Even at locations which do, no action is required unless the official notices that the error for the start-up and shut-down rates is predominantly in one direction. If the start-up and shut-down errors are predominantly in one direction, the official then needs to determine the size of a typical transaction and the likely predominance of the error. Device owners can easily ensure that they have no problems with this requirement by making sure that their devices are in tolerance at the slower start-up and shut-down flow rates and errors are not predominantly one way or the other.

At its 2014 meeting, the Sector discussed four proposals submitted in relation to this general issue as a group. See the Sector's 2014 Meeting Summary and the S&T Committee's 2014 and 2015 Annual Reports for details.

The proposals outlined in this item for inclusion in the Vehicle-Tank Meters Code were discussed in conjunction with the previous agenda item on this year's (2015) Sector Agenda. See that item for additional details and information.

**Discussion:**

The Sector briefly discussed this issue. There was general support for the work to develop clear guidelines for testing systems with multi-point calibration capability. The Sector acknowledged that several Sector members have participated in the group working to develop these proposals.

**Decision:**

The Sector reviewed the most recent proposal presented by the group working on multi-point calibration issues. The Sector agreed to support the language as written, noting that several Sector members were part of the group that has been developing this issue.

**15. NIST Handbook 44, Section 3.32. LPG and NH<sub>3</sub> Code – Revisions to Address LPG RMFDs.**

**Source:**

California Department of Food and Agriculture (CDFA), Division of Measurement Standards (DMS). [2014 NCWM S&T Item 332-1 (D)]

**Recommendation:**

The Sector was asked to provide input on proposed revisions to align the LPG and NH<sub>3</sub> Codes with respect to requirements for retail motor-fuel dispensing applications. Included in Appendix C for the Sector's review and comment are the most recent revisions proposed to the NCWM S&T Committee. This version includes input from WWMA's fall 2014 meeting; MMA; and NIST OWM along with additional suggestions from MMA and NIST, OWM made following the 2015 NCWM Annual Meeting.

**Background:**

The purpose of this item is to add Specifications and User Requirements to NIST Handbook 44 Section 3.32. Liquefied Petroleum Gas (LPG) and Anhydrous Liquid-Measuring Devices Code similar to those in Section 3.30. Liquid-Measuring Devices, Section 3.37. Mass flow Meters, and Section 3.39. Hydrogen-Gas Measuring Devices Tentative Code. The NCWM S&T Committee has received multiple comments on this item and has indicated it supports the objective of making changes to align the LPG and the LMD Code with respect to requirements for retail motor-fuel dispensing applications.

The Sector discussed this item at its 2014 meeting. The Sector heard many comments from meeting participants, and some noted there is an ever-increasing number of liquefied petroleum gas (LPG) dispensers being installed that are intended for and used in retail motor fueling applications. Mr. Roach (CDFA DMS) emphasized that this proposed language is needed because devices used to dispense LPG are specifically exempted from NIST Handbook 44, Section 3.30. Liquid-Measuring Devices, in A.2. Exceptions (b), and that Section 3.32. LPG and NH<sub>3</sub> does not have adequate requirements addressing retail motor fueling applications.

The Sector agreed to keep this item on its agenda for its 2015 meeting. The Sector noted that it supports the concept that LPG retail motor fuel dispenser (RMFD) requirements should be the same as those in NIST Handbook 44, Section 3.30. However, the Sector wishes to take time and carefully go through the proposal to make sure that there are no conflicts with other codes and to assure that it applies to RMFD only.



At the 2015 NCWM Annual Meeting, the S&T Committee reviewed another version of the proposal which included comments from the 2014 WWMA meeting, the MMA, and NIST, OWM. The Committee heard additional suggestions from MMA and OWM and indicated its continued support for this item. Following the Annual Meeting, Mr. Dmitri Karimov (Liquid Controls) and Ms. Tina Butcher (NIST, OWM) incorporated those additional changes and plans to submit the proposed revision to the regional associations in fall 2015. The Sector is asked to review and comment on this revised version as outlined in the “Recommendation” above.

See the 2014 and 2015 NCWM S&T Committee’s Interim and Annual Reports for additional details.

**Discussion:**

The Sector reviewed the latest proposed revisions from MMA and NIST which combine the 2014 WWMA proposal; MMA’s comments; and NIST OWM’s comments. This latest proposal was included as Appendix C in the Sector’s agenda. Ms. Butcher and Mr. Karimov noted that this version appears to address the comments and concerns that have been expressed and noted that these changes are needed to align the LMD and LPG and NH<sub>3</sub> codes with regard to requirements for retail motor-fuel applications. They also noted that modifications were made to the zero-set-back interlock requirement to restrict it to stationary retail devices because the paragraph was structured to address “dispensers.” Both Ms. Butcher and Mr. Karimov noted that a similar requirement is needed for vehicle-mounted application. They considered proposing that the requirement for zero-set-back interlock in the Vehicle-Tank Meters Code, paragraph S.2.4. be used as an example. However, paragraph S.2.4. in the VTM Code is in need of modifications (particularly with regard to how the time-out feature is to be applied) to clarify its application. Rather than delay the proposed adoption of the much-needed changes proposed in this item, Ms. Butcher and Mr. Karimov believe it would be better to develop a separate proposal for the addition of a new LPG and NH<sub>3</sub> Code paragraph for zero-set-back interlock requirements to be submitted in the 2016 - 2017 NCWM cycle

**Decision:**

The Sector supports this most recent version of the proposed revisions to the LPG and NH<sub>3</sub> code prepared by MMA and NIST. The Sector noted that the item proposing a “time-out” provision for card-activated RMFDs should be added to the LPG and MFM Codes at a future point when that item is ready for adoption. However, the Sector does not believe it should be added as part of this current proposal so as not to further delay these changes to the LPG and NH<sub>3</sub> Code.

## 16. Equivalent Units for Natural Gas.

**Source:**

NCWM S&T Committee; [2015 NCWM S&T Item 337-1 (I)]

**Recommendation:**

The NCWM S&T Committee continues deliberating on proposed changes to NIST Handbook 44 and NIST Handbook 130 to recognize “alternative units” for natural gas. The S&T Committee would value input from the Sector on this issue.

**Background:**

For the past several years, the NCWM has discussed multiple proposals to define “equivalent units” for compressed and liquefied natural gas (CNG and LNG). The item has been returned to the NCWM Standing Committees the past two years. The Sector was asked to provide thoughts and input on this issue.

The gasoline gallon equivalent (GGE) unit was defined by NCWM in 1994 to allow users of natural gas vehicles to compare costs and fuel economy of light-duty compressed natural gas vehicles with equivalent gasoline powered vehicles. More background on the efforts of NIST and NCWM is available in the Reports of the 78th and 79<sup>th</sup> NCWM in NIST Special Publication 854 and 870 (see pages 322 and 327, respectively). Natural gas is sold as a vehicle fuel as either Compressed Natural Gas (CNG) or Liquefied Natural Gas (LNG). For medium and heavy duty natural gas vehicles in widespread use today, there is a need to officially define a unit allowing a comparison of cost and fuel economy with diesel powered vehicles. The submitter stated that the official definition of a DLE and a DGE will likely provide justification for California, Wisconsin, and many other states to permit retail sales of CNG for heavy-duty vehicles in these convenient units. The submitter has provided a mathematical justification for the specific

quantity (mass) of compressed natural gas in a DLE and DGE which found in the S&T Committee’s 2014 Interim Report. Full details on this issue appears in the NCWM S&T and L&R Committee reports from 2014 - 2015.

At the 2015 Interim Meeting, the S&T Committee considered two proposals (summarized as follows):

**Proposal 1**, titled, *The Volume Equivalent Compromise Proposal*, in essence proposes amendments to NIST Handbook 44, MFM Code and NIST Handbook 130, MOS to: 1) recognize the indication of natural gas fuel sales in values of *either* volume equivalent units *or* mass units; 2) mandate labeling of the equivalent unit conversion factor on the dispenser; and 3) no longer recognize SI mass units in favor of U.S. customary mass units.

**Proposal 2**, titled, *The Mass Compromise Proposal*, in essence proposes: 1) keeping the *new* phase in period where mass indications for all sales of natural gas motor-fuel will be of a specific maximum value and required for all dispensers effective January 1, 2017; 2) continues recognition the *new* supplemental fuel information for value comparison and taxation purposes; and 3) recognizes the existing compressed natural gas motor-fuel application.

Comments in support of Proposal 1 were primarily heard from representatives of the gas industry, manufacturers of natural gas retail motor fuel dispensers, natural gas refueling station owners, fuel marketers, and other industry representatives. Two state weights and measures directors, Mr. Mahesh Albuquerque (Colorado) and Mr. Joe Gomez (New Mexico), also provided comments in support of Proposal 1. The following list includes the primary comments heard in support of Proposal 1 (this list is not all inclusive of every comment, but intended to capture the key points raised):

- Volume equivalent units recognize what’s already in the marketplace – acceptance would put all retailers on the same footing.
- The first proposal provides the best chance of having a national standard.
- The proposal was submitted because of LNG; not CNG. There is no MOS specified for LNG. LNG is a fuel that will mostly be used in trucks.
- The feedback we’re hearing from our customers is that they want to make value comparisons using gallon equivalent units.
- We can build dispensers that measure in mass. Providing both indications (mass and equivalent gallons) would be very expensive to build. Our customers like gallon equivalents. It would create confusion if you put two values there. These are two different units of measurement; unlike cash/credit pricing.
- It would be considered an unfair trade practice to advertise on the street in one unit of measure and dispense product in another unit of measure. The advertised unit price should match the unit price on the dispenser.
- We want to hear feedback from our customers. They value the comparison of LNG to diesel because it is a quick and easy determination. We talk to our customers. They want to make comparisons by using DGE.
- Universally, our customers want, ask, and purchase gallon equivalent units. We can provide an indication in mass units. Is it worth changing a twenty-year industry MOS to something industry doesn’t want? Our equipment measures in mass and indicates in gallon equivalents.
- Support gallon equivalent units for three reasons:
  - 1) uniformity,
  - 2) clarity in the marketplace (there have been no complaints...customers want it), and

3) verification for fairness – both will be verified in mass (not BTU).

Comments heard in support of Proposal 2 were predominantly made by weights and measures officials. The following list includes the primary comments heard in support of Proposal 2 (this list also is not all inclusive of every comment, but intended to capture the key points raised):

- We're a standards organization. Equivalent units are not a standard. This is a marketing tool. Allowing equivalent units would provide industry a competitive advantage.
- Equipment is capable of providing mass indications.
- There is a general lack of support for DGE and GGE units among regulators.
- Label equivalent units on the front of the dispenser and measure and indicate in mass.
- Which method would provide the most value comparison to the customer? Many products offered for sale provide supplemental information. Examples given: fertilizer sold by weight provides square footage coverage information; paint sold by gallon provides spread dimensions, etc.
- Need to sell by a quantifiable measurement – mass.
- Proliferation of “equivalent units” is a real concern.
- There are questions concerning the validity of the equivalent values being proposed. Natural gas composition fluctuates, as does the composition of gasoline. How accurate are the numbers? We're not comfortable that the study on BTU by the Energy Department provides accurate enough information. Industry reported specific gravities change by as much as 12 %.
- We stand to face the same mistake made 20 years ago. It was a mistake then and it would be a mistake now.
- There are new fuels coming onboard. The same argument can be made for equivalent units. How do you tell the next group “no?”
- Products need to be sold by a recognizable unit of measure.
- We are a standard organization – the best way to sell is the way it's actually measured.
- Consumers have purchased propane by weight for years and years. They've never asked how much they were receiving in gallon equivalent units.
- We are not the world. There are not liter equivalent units in Canada, Europe, or Japan.
- Consumers learn what the measurement is and then they do the calculations. Consumers will know before they purchase a vehicle what their cost per mile will be.
- On January 1, 2015, a California law added DGE and GGE. It is a very bad law. I urge the Conference not to follow that course. Support the second proposal.

The NCWM S&T Committee had to choose one of these proposals to recommend to the 2015 NCWM Annual Meeting for a Vote. The Committee chose Proposal 1 as shown below to put forward for a Vote at the 2015 NCWM Annual Meeting. See the NCWM S&T Committee's 2015 Interim Report for the specific proposal.

At the 2015 Annual Meeting, this item was again returned to the Committee for further consideration due to a Split Vote. The Sector is asked to provide input and suggestions for the S&T Committee to consider.

**Discussion:**

Chair Michael Keilty introduced this item and summarized its history. He noted that “Gasoline Equivalent Gallons (GGEs)” were established in 1994. The NCWM has been asked to consider establishing a similar equivalent unit for LNG, the “Diesel Gallon Equivalent (DGE).” The NCWM has reviewed several proposals, but the issue has stalled, with some weights and measures jurisdictions believing that all sales should be based on mass. The NCWM considered a proposal in July 2015 which would allow either mass or equivalent units as the basis for sale; however, that was returned to the S&T Committee as a result of a split vote.

Mr. Randy Moses (Wayne Fueling) noted that a lot of states are now requiring equivalent units and overriding what is currently in the code. He noted that they are unable to get an NTEP Certificate for devices delivering LNG indicating in DGE. (Note that multiple CCs have been issued for LNG dispensers indicating in mass units.) Mr. Moses noted that Wayne Fueling and Gilbarco can switch back to mass right now, but that doesn’t seem to be what industry wants. Mr. John Roach (CAFDA) pointed out that a manufacturer could get a California Type Evaluation Program Certificate (CTEP) for LNG devices indicating in equivalent units. For CNG, GGEs are presently permitted.

Mr. Keilty commented that the proposal is not to remove GGE, but rather to add a DGE for compressed gas. He also noted that his understanding is that, if NIST Handbook 44 is changed to permit the DGE, another NTEP evaluation would not be required, though it may be necessary to do some limited testing to demonstrate that the conversion is correct.

There was some additional discussion about how states are approaching this issue. Mr. Jim Truex (NTEP Director) noted that, when industry was not able to get the proposal accepted through the NCWM, they went around weights and measures agencies directly to state legislatures to push for recognition of the “equivalent units.” NTEP has issued CCs for a number of LNG dispenser in mass only. He confirmed Mr. Keilty’s comments that, should the NCWM recognize additional alternative units, some limited evaluation may be needed. Thus, an application and some evaluation may be needed, but there would only be limited testing.

Mr. Adam Oldham (Gilbarco) commented that without nationally-recognized requirements, there is nothing to keep the factors/conversion values uniform. Mr. Keilty noted that some states have already adopted different numbers than are in the proposal. As a dispenser manufacturer, you would not know how your customer is going to use the dispenser. Mr. Moses commented that, prior to shipping a dispenser, the manufacturer knows the intended unit and the setup of the value could be a sealable feature.

Mr. Marc Buttler (Emerson Process Management, MicroMotion) commented that in light of the current circumstances, there appears to be multiple different units in use. Thus, it will be necessary for inspectors and NTEP evaluators to be able to view the conversion factor values for every device. He also noted that some have debated the need to mark the value of the equivalent unit relate to mass. Some believe this marking is essential. Manufacturers noted that marking can be handled with an “orderable” graphic and someone in the field with expertise to make changes would need to be sure the proper conversion factor is included.

**Decision:**

The Sector reached no conclusion on this issue nor did it provide any specific recommendations to the NCWM on this issue. The Sector recognized the challenges faced by industry, manufacturers, and regulators in attempting to find a solution to this issue while maintaining integrity of the measurement process.

**Additional Item Added at Meeting:**

**17. Next Sector Meeting**

**Background:**

Several Sector members asked to discuss the location and general timing of the next Sector meeting. The Sector discussed the benefits of holding the meeting in association with a regional weights and measures association, noting that the Sector has met in conjunction with the Southern Weights and Measures Association, and the Western Weights and Measures Association. While there are benefits to holding the meeting in conjunction with these associations and the Sector has appreciated this in the past, this can create a very long week for those attending both meetings. The

NTEP Director reported that a location in a large airport hotel is sometimes costly, but this location proved reasonable. Holding the meeting in conjunction with the WWMA in 2016 was not seen as a viable option because of its location in Hawaii and the difficulty people may have in getting travel approval. Several sector members expressed satisfaction with the Denver location. Additionally, several members requested that the meeting not be scheduled over a weekend.

**Decision:**

The Sector acknowledged that the decision is ultimately up to the NCWM Board of Directors. The Sector agreed to ask that the NTEP Director to explore the possibility of holding the meeting in Denver, Colorado, in late September or with the SWMA (once the SWMA has selected a date and location) and make a recommendation for one of these options to the BOD.

THIS PAGE INTENTIONALLY LEFT BLANK

## **Appendix A**

### **Excerpt from 2014 Software Sector Meeting Summary**

#### **Software Sector Item 3, Software Protection/Security**

### **3. Software Protection/Security**

**Source:**

NTEP Software Sector

**Background:**

The Sector agreed that NIST Handbook 44 already has audit trail and physical seal, but these may need to be enhanced.

*From the WELMEC Document:*

**Protection against accidental or unintentional changes**

Metrologically significant software and measurement data shall be protected against accidental or unintentional changes.

**Specifying Notes:**

Possible reasons for accidental changes and faults are: unpredictable physical influences, effects caused by user functions and residual defects of the software even though state of the art of development techniques have been applied.

This requirement includes consideration of:

- a) Physical influences: Stored measurement data shall be protected against corruption or deletion when a fault occurs or, alternatively, the fault shall be detectable.
- b) User functions: Confirmation shall be demanded before deleting or changing data.
- c) Software defects: Appropriate measures shall be taken to protect data from unintentional changes that could occur through incorrect program design or programming errors (e.g., plausibility checks).

**Required Documentation:**

The documentation should show the measures that have been taken to protect the software and data against unintentional changes.

**Example of an Acceptable Solution:**

- The accidental modification of software and measurement data may be checked by calculating a checksum over the relevant parts, comparing it with the nominal value and stopping if anything has been modified.
- Measurement data are not deleted without prior authorization (e.g., a dialogue statement or window asking for confirmation of deletion).
- For fault detection, see also Extension I.

The Sector continued to develop a proposed checklist for NCWM Publication 14. The numbering will still need to be added. This is based roughly on R 76-2 checklist and discussions beginning as early as the October 2007 NTETC Software Sector Meeting. The information requested by this checklist is currently voluntary; however, it is recommended that applicants comply with these requests or provide specific information as to why they may not be able to comply. Based on this information, the checklist may be amended to better fit with NTEP's need for information and the applicant's ability to comply.

The California, Maryland, and Ohio laboratories agreed to use this checklist on one of the next devices they have in the lab and report back to the Sector on what the problems may be. In February 2011, the North Carolina laboratory was also given a copy of the check list to try.

The Maryland Laboratory had particular questions regarding 3.1 and 5.1. The information for 3.1 could be acquired from an operator's manual, a training video, or in-person training. The items in 5.1 were confusing to the evaluators. The terminology is familiar to software developers, but not necessarily others. It was indicated that manufacturers were typically quick to return the filled-out questionnaire, but he didn't know how his laboratory was supposed to verify it was true. Generally, the laboratories wouldn't be expected to verify things to that level. For example, if the manufacturer states that a checksum is used to ensure integrity, the laboratories wouldn't be expected to evaluate the algorithm used.

The intent was to see whether the manufacturer had at least considered these issues, not for evaluators to become software engineers. Perhaps a glossary or descriptive paragraphs might be added to assist the evaluators for if the manufacturer has questions for the evaluators.

OIML makes use of supplementary documents to explain the checklist they use. Below are links:

<http://www.oiml.org/publications/D/D031-e08.pdf>

<http://www.welmec.org/latest/guides/72.html>

[http://www.welmec.org/fileadmin/user\\_files/publications/2-3.pdf](http://www.welmec.org/fileadmin/user_files/publications/2-3.pdf)

WELMEC document 2.3 is the original source for our checklist, but it's been significantly revised and simplified. Mr Payne, Maryland Department of Agriculture, is going to review the other documents and come up with some suggestions for the checklist. Mr. Roach, California Division of Measurement Standards, is going to begin using the checklist. The international viewpoint is that any device running an operating system is considered to be Type U. Mr. Roach mentioned that they're having lots of problems with "skimmers" stealing PINs. Is there some way they can detect this?

Mr. Lewis, Rice Lake Weighing Systems, Inc., mentioned that he liked Measurement Canada's website. When answering similar questions, different pages would appear, based on answers to those questions:  
<http://www.ic.gc.ca/eic/site/mc-mc.nsf/eng/lm00573.html>.

At the 2011 NTETC Software Sector Meeting, the laboratories were polled to obtain any feedback on the use of the checklist. Maryland attempted to use this checklist a few times. They had some difficulty obtaining answers from the manufacturers because the individual(s) interacting with the Maryland evaluator didn't always have the required information on hand. More experience in using the checklist will help determine what needs to be revised.

It was suggested that the checklist could be sent to manufacturers for their feedback as well, with the stipulation that it a completely voluntary exercise and purely informational at this point. The laboratories will coordinate with willing manufacturers to obtain feedback.

At the 2013 meeting, it was reported by the labs that attempts to use the current checklist did not meet with many difficulties. The checklists were given to the manufacturers to fill out, and that seemed to work rather well. Minor modifications were made to clarify certain confusing areas or eliminate redundancy. (Note the text above includes the updates made in 2013.)

#### **Discussion:**

The labs using this checklist on a trial basis indicated that there was some confusion as to versions/wording. There may be more than one version in circulation. The version shown in this Summary shall be used henceforth.

During the discussion, Mr. Ed Payne (NTEP lab, Maryland) said his impression is that this is at least making some of the manufacturers think about security, which they hadn't necessarily done in the past.



Appendix A – Excerpt from 2014 Software Sector Summary - Item 3 Software Protection/Security

It was indicated that some more or better examples may be helpful to manufacturers, and that more guidance is needed. Clearer instructions could be part of the checklist, or it could be a separate document. The Sector would like additional feedback specifically regarding what portions of it are causing confusion.

Due to proprietary issues, the labs can't simply give us direct feedback from the companies they interact with. Mr. Darrell Flocken volunteered to obtain information from the labs, aggregate it, and remove any potential proprietary information issues.

The checklist as updated during the 2014 meeting:

## 2. Devices with Software

- 2.1. Declaration of the manufacturer that the software is used in a fixed hardware and software environment. **The manufacturer should indicate whether it's solely software or includes hardware in the system. Can the software be changed after the system has been shipped without breaking a seal? AND**  Yes  No  N/A
- 2.2. Cannot be modified or uploaded by any means after securing/verification. **With the seal intact, can you change the software?**  Yes  No  N/A

*Note: It is acceptable to break the "seal" and load new software, audit trail is also a sufficient seal.*

- 2.3. The software documentation contains:
- 2.3.1. Description of all functions, designating those that are considered metrologically significant.  Yes  No  N/A
- 2.3.2. Description of the securing means (evidence of an intervention).  Yes  No  N/A
- 2.3.3. Software Identification, including version/revision. **It may also include things like name, part number, CRC, etc.**  Yes  No  N/A
- 2.3.4. Description how to check the actual software identification.  Yes  No  N/A
- 2.4. The software identification is:
- 2.4.1. Clearly assigned to the metrologically significant software and functions.  Yes  No  N/A
- 2.4.2. Provided by the device as documented.  Yes  No  N/A
- 2.4.3. Directly linked to the software itself. **This means that you can't easily change the software without changing the software identifier. For example, the version identifier can't be in a text file that's easily editable, or in a variable that the user can edit.**  Yes  No  N/A

## 3. Programmable or Loadable Metrologically Significant Software

- 3.5. The metrologically significant software is:
- 3.5.1. Documented with all relevant (see below for list of documents) information. *The list of docs referred to exists in agenda item 5.*  Yes  No  N/A
- 3.5.2. Protected against accidental or intentional changes.  Yes  No  N/A
- 3.6. Evidence of intervention (such as, changes, uploads, circumvention) is available until the next verification / inspection (e.g., physical seal, Checksum, Cyclical Redundancy Check (CRC), audit trail, etc. means of security).  Yes  No  N/A

**4. Software with no access to the operating system and/or programs possible for the user. This section and section 4 are intended to be mutually exclusive. Complete this section only if you replied Yes to 1.1.**

- 4.7. Check whether there is a complete set of commands (e.g., function keys or commands via external interfaces) supplied and accompanied by short descriptions.  Yes  No  N/A
- 4.8. Check whether the manufacturer has submitted a written declaration of the completeness of the set of commands.  Yes  No  N/A

**5. Operating System and / or Program(s) Accessible for the User. Complete this section only if you replied No to 1.1.**

- 5.9. Check whether a checksum or equivalent signature is generated over the machine code of the metrologically significant software (program module(s) subject to legal control Weights and Measures jurisdiction and type-specific parameters). This is a declaration or explanation by the manufacturer.  Yes  No  N/A
- 5.10. Check whether the metrologically significant software will detect and act upon any unauthorized alteration of the metrologically significant software using simple software tools (e.g., text editor). This is a declaration or explanation by the manufacturer.  Yes  No  N/A

**6. Software Interface(s)**

6.11. Verify the manufacturer has documented:

- 6.11.1. If software separation is employed, the program modules of the metrologically significant software are defined and separated.  Yes  No  N/A
- 6.11.2. For software that can access the operating system or if the program is accessible to the user, the protective software interface itself is part of the metrologically significant software.  Yes  No  N/A
- 6.11.3. The functions of the metrologically significant software that can be accessed ~~via the protective software interface~~.  Yes  No  N/A
- 6.11.4. The metrologically significant parameters that may be exchanged ~~via the protective software interface~~ are defined.  Yes  No  N/A
- 6.11.5. The description of the functions and parameters are conclusive and complete.  Yes  No  N/A
- 6.11.6. There are software interface instructions for the third party (external) application programmer.  Yes  No  N/A

**Conclusion:**

The Sector discussed examples, such as the upgrade of application programs and how these changes would affect audit trails and version numbers. It should be clear that if the upgraded software doesn't affect anything metrologically significant, then it's irrelevant for the purposes of this checklist. On the other hand, if it does affect metrologically significant functions or parameters, it should be tracked and/or identified somehow.

The revised checklist will be reviewed and further edited as required, and the updated version can be sent to the labs.

## Appendix B

### Excerpt from 2014 Software Sector Meeting Summary Software Sector Item 4, Software Maintenance & Reconfiguration

#### 4. Software Maintenance and Reconfiguration

**Source:**

NTEP Software Sector

**Background:**

After the software is completed, what do the manufacturers use to secure their software? The following items were reviewed by the sector. *Note that agenda Item 3 also contains information on Verified and Traced updates and Software Log.*

1. Verify that the update process is documented. (OK)
2. For traced updates, installed Software is authenticated and checked for integrity.

Technical means shall be employed to guarantee the authenticity of the loaded software (i.e., it originates from the owner of the type approval certificate). This can be accomplished (e.g., by cryptographic means like signing). The signature is checked during loading. If the loaded software fails this test, the instrument shall discard it and either use the previous version of the software **or become inoperative**.

Technical means shall be employed to guarantee the integrity of the loaded software (i.e., it has not been inadmissibly changed before loading). This can be accomplished (e.g., by adding a checksum or hash code of the loaded software and verifying it during the loading procedure). If the loaded software fails this test, the instrument shall discard it and either use the previous version of the software **or become inoperative**.

Examples are not limiting or exclusive.

3. Verify that the sealing requirements are met.

The sector asked, “What sealing requirements are we talking about?”

This item is **only** addressing the **software update**, it can be either verified or traced. It is possible that there are two different security means, one for protecting software updates (software log) and one for protecting the other metrological parameters (Category I, II, or III method of sealing). Some examples provided by the Sector members include but are not limited to:

Physical Seal, software log.

Category III method of sealing can contain both means of security.

4. Verify that if the upgrade process fails, the device is inoperable or the original software is restored.

The question before the group is, “Can this be made mandatory?”

The manufacturer shall ensure by appropriate technical means (e.g., an audit trail) that traced updates of metrologically significant software are adequately traceable within the instrument for subsequent verification and surveillance or inspection. This requirement enables inspection authorities, which are responsible for the metrological surveillance of legally controlled instruments, to back-trace traced updates of metrologically

significant software over an adequate period of time (that depends on national legislation). The statement in italics will need to be reworded to comply with U.S. weights and measures requirements.

The Sector **agreed** that the two definitions below for Verified update and Traced update were acceptable.

**Verified Update**

A verified update is the process of installing new software where the security is broken and the device must be re-verified. Checking for authenticity and integrity is the responsibility of the owner/user.

**Traced Update**

A traced update is the process of installing new software where the software is automatically checked for authenticity and integrity, and the update is recorded in a software update log or audit trail.

*Note: It's possible that the Philosophy of Sealing section of NCWM Publication 14 may already address the above IF the definitions of Verified and Traced Updates (and the statement below) were to be added. The contrary argument was that it may be better to be explicit).*

**Use of a Category 3 audit trail is required for a Traced Update. A log entry representing a traced software update shall include the software identification of the newly installed version.**

The Sector recommended consolidating the definitions with the above statement thus:

**Verified Update**

A verified update is the process of installing new software where the security is broken and the device must be re-verified. Checking for authenticity and integrity is the responsibility of the owner/user.

**Traced Update**

A traced update is the process of installing new software where the software is automatically checked for authenticity and integrity, and the update is recorded in a ~~software update log or~~ Category 3 audit trail. The audit trail entry shall include the software identification of the newly installed version.

The Sector recommended that as a first step, the following be added to NCWM Publication 14:

**The updating of metrologically significant software, including software that checks the authenticity and integrity of the updates, shall be considered a sealable event.**

Mr. Truex, NTEP Administrator, believes the above sentence is unnecessary since it's self-evident. It was agreed to ask the other Sectors for feedback on the value of this addition.

Though the Sector is currently recommending only the single sentence be incorporated into NCWM Publication 14 for the time being, ultimately, the Sector may wish to advance the remaining language of the original item submission.

At the 2013 meeting, the Sector had no information indicating that the other Sectors had yet been approached for feedback on the value of the addition of the proposed sentence. This Sector would still like the other Sectors to evaluate this for inclusion in NCWM Publication 14. We'd also like to include some description indicating that an existing audit trail should be protected during a software update, though that may already be a requirement. This does appear to be addressed in the Requirements for Metrological Audit Trails Appendices in NIST Publication 14.

**Discussion:**

In 2010 the Software Sector had considered the following:

**G-S.9. Metrologically Significant Software Updates – The updating of metrologically significant software shall be considered a sealable event.**

**Metrologically significant software that does not conform to the approved type is not allowed for use.**

Appendix B – Excerpt from 2014 Software Sector Summary - Item 4 Software Maintenance & Reconfiguration

Dr. Ambler Thompson suggested that the notes under G-S.8. could be amended to include software updates as a new example. Mr. Rick Harshman recommended having it as a stand-alone item, such as discussed in 2010.

This could possibly be tied back to G-S.2.

What is the sealable parameter? Is it the software version/revision? Currently, all the parameters are user-selectable, which would make this unique.

If the general code in NIST Handbook 44 is amended to include this in some form, it applies to everything. The various Sectors don't need to add to their specific sections of NIST Handbook 44.

Mr. Darrell Flocken suggested that we try to come up with a declaration of intent and see how the Sectors respond. Mr. Doug Bliss will add it to the existing presentation. Mr. Truex thought it might be valuable to obtain the opinion of the S&T Committee. The Legal Metrology group should be asked, "Is a software change that updates metrologically significant software a sealable event?" Mr. Harshman can obtain an answer from them.

Dr. Thompson raised a concern about the fact that at this point none of the suggested wording requires that the software identifier be unique (i.e., a change to the metrologically significant software should require a change to the software identifier). You could perhaps infer it from the requirement that it be inextricably linked to the software, but this isn't clear. Mr. Truex thinks this will eventually need to be addressed, but not right now.

We reviewed the presentation that Mr. Bliss had revised and tweaked it a bit. This sparked more discussion about the difficulty of convincing NIST. There seems to be a fundamental difference in how they understand changes of parameters and/or software. People don't seem to understand the difference between software and data. Adding a slide that explains the difference may help.

Last year's Weighing Sector feedback (Mr. Truex will provide their wording) – they were opposed because:

1. It would change the methods of sealing (category 1, 2, and 3 audit trails) and require a change to NIST Handbook 44.
2. It's not clear that the requirement for authenticity and integrity of the updates is limited to metrologically significant software.

The other Sectors were concerned about this as well.

Legacy equipment that's still being manufactured might need to be changed to meet this obligation since their audit trails would not necessarily indicate that the software has been updated.

Reference G-S.8., which is rather loose. NCWM Publication 14 goes into much more detail about what is metrologically significant.

Mr. Darrell Flocken referred to NIST Handbook 44, the Scales code – the event logger category 3 – the software is not a parameter. It's not so much that the software would be tracked, as the fact it has not been in the list of sealable parameters is the concern. It sounds like this may be a procedural issue – sections of NIST Handbook 44 may need to be altered before the Sectors can add this suggestion to NCWM Publication 14.

**Conclusion:**

After the discussion during the 2014 joint meeting, we revised the wording of the proposed G-S.9. to reflect some of the concerns heard from the other Sectors and interested parties:

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

The Sector still feels that explicitly requiring the metrologically significant software to be given at least the same level of protection as metrologically significant parameters is the best approach. We look forward to feedback from the S&T Committee and other Sectors on this proposed change. The Software Sector still would like to consider the issue of audit trail protection; there is some doubt as to whether the existing language is sufficient as it does not address the integrity of the audit trail during a software update, etc.

## Appendix C

### Proposed Revisions to NIST Handbook 44 LPG & NH<sub>3</sub> Code From MMA & NIST OWM – August 2015

*The following proposes revisions to align the LPG and NH<sub>3</sub> Codes with respect to requirements for retail motor-fuel dispensing applications. These proposed revisions include input from WWMA's fall 2014 meeting; MMA; and NIST, OWM along with additional suggestions from MMA and NIST, OWM made following the 2015 NCWM Annual Meeting.*

#### S.1.4. For Retail Devices Only.

**S.1.4.1 Indication of Delivery.** – A retail device shall be constructed to show automatically **show** on its **face** ~~the~~ initial zero condition and the ~~amounts~~ **quantity** delivered up to the nominal capacity of the device. **However, the following requirements shall apply:**

**For electronic devices manufactured prior to January 1, 2006, the first 0.03 L (or 0.009 gal) of a delivery and its associated total sales price need not be indicated.**

**For electronic devices manufactured on or after January 1, 2006, 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.**

**[Nonretroactive as of January 1, 2006]**

**(Amended 2014)**

#### S.1.5. For Stationary Retail Devices Only.

**S.1.5.1. Display of Unit Price and Product Identity.** – ~~In a~~ **A** device of the computing type, ~~means~~ shall be ~~provided for~~ displaying on each face of the device the unit price at which the device is set to compute or to deliver ~~as the case may be~~, and there shall be conspicuously displayed on each side of the device the identity of the product that is being dispensed. ~~If a device is so designed as to dispense more than one grade, brand, blend, or mixture of product, the identity of the grade, brand, blend, or mixture being dispensed shall also be displayed on each face of the device.~~

**Except for dispensers used 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.**

**[Nonretroactive as of January 1, 201X]**

**(Added 201X)**

~~S.1.5.3. — Recorded Representations, Point-of-Sale Systems. — Except for fleet sales and other price contract sales, a printed receipt providing the following information shall be 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:~~

- ~~(a) the total volume of the delivery;~~
- ~~(b) the unit price;~~
- ~~(c) the total computed price; and~~
- ~~(d) the product identity by name, symbol, abbreviation, or code number.~~

~~(Added 2014)~~

S.1.5.3. Agreement Between Indications.

*(a) When a quantity value indicated or recorded by an auxiliary element is a derived or computed value based on data received from a device, the value may differ from the quantity value displayed on the dispenser, provided that the following conditions are met:*

- (1) all total values for an individual sale that are indicated or recorded by the system agree, and*
- (2) within each element, the values indicated or recorded meet the formula (quantity × unit price = total sales price) to the closest cent.*

*(b) 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.*

*[Nonretroactive as of January 1, 201X]*

(Added 201X)

S.1.5.4. Recorded Representations. – Except for fleet sales and other price contract sales and for transactions where a post-delivery discount is provided, a receipt providing the following information shall be 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:

- (a) the total volume of the delivery;
- (b) the unit price;
- (c) the total computed price; and
- (d) the product identity by name, symbol, abbreviation, or code number.

(Added 2016)

S.1.5.5. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided. – Except for fleet sales and other price contract sales, a printed receipt providing the following information shall be available through a built-in or separate recording element that is part of the system for transactions involving a post-delivery discount:

- (a) the product identity by name, symbol, abbreviation, or code number;
- (b) transaction information as shown on the dispenser at the end of the delivery and prior to any post-delivery discount(s), including the:



- (1) total volume of the delivery;
- (2) unit price; and
- (3) total computed price of the fuel sale.

(c) an itemization of the post-delivery discounts to the unit price; and

(d) the final total price of the fuel sale after all post-delivery discounts are applied.

(Added 201X)

S.1.5.6. Transaction Information, Power Loss. In the event of a power loss, the information needed to complete any transaction in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable for at least 15 minutes at the device or other onsite device accessible to the customer.

[Nonretroactive as of January 1, 201X]

(Added 201X)

S.1.5.7. Totalizers for Retail Motor-Fuel Dispensers. – Retail motor-fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through the metering device.

[Nonretroactive as of January 1, 201X]

(Added 201X)

## S.2. Design of Measuring Elements.

...

S.2.5. Zero-Set-Back Interlock for Stationary Retail Motor-Fuel Devices – A device shall be constructed so that:

- (a) after a delivery cycle has been completed by moving the starting lever to any position that shuts off the device, an automatic interlock prevents a subsequent delivery until the indicating elements, and recording elements if the device is equipped and activated to record, have been returned to their zero positions;
- (b) the discharge nozzle cannot 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) until the starting lever is in its designed shut-off position and the zero-set-back interlock has been engaged; and
- (c) in a system with more than one dispenser supplied by a single pump, an effective automatic control valve in each dispenser prevents product from being delivered until the indicating elements on that dispenser are in a correct zero position.

[Nonretroactive as of January 1, 201X]

(Added 201X)

S.2.6. S.2.5. Thermometer Well. – For test purposes, means shall be provided to determine the temperature of the liquid either:

- (a) in the liquid chamber of the meter; or
- (b) in the meter inlet or discharge line and immediately adjacent to the meter.

(Amended 1987)

~~S.2.7.S.2.6.~~ **Automatic Temperature Compensation.** – A device may be equipped with an adjustable automatic means for adjusting the indication and registration of the measured volume of product to the volume at 15 °C (60 °F).

~~S.2.7.1S.2.6.1.~~ **Provision for Deactivating.** – On a device equipped with an automatic temperature-compensating mechanism that will indicate or record only in terms of liters or gallons adjusted to 1 °C (60 °F), provision shall be made to facilitate the deactivation of the automatic temperature-compensating mechanism so that the meter may indicate, and record if it is equipped to record, in terms of the uncompensated volume.

(Amended 1972)

~~S.2.7.2.S.2.6.2.~~ **Provision for Sealing.** – Provision shall be made for applying security seals in such a manner that an automatic temperature-compensating system cannot be disconnected and that no adjustment may be made to the system.

## UR.2. Use Requirements.

...

### UR.2.7. For Stationary Retail Computing Type Systems Only, Installed After January 1, 201X.

#### UR.2.7.1. Unit Price and Product Identity.

- (a) The following information shall be conspicuously displayed or posted on the face of a retail dispenser used in direct sale:
- (1) except for unit prices resulting from any post-delivery discount and dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), all of the unit prices at which the product is offered for sale; and
  - (2) in the case of a computing type device or money-operated type device, the unit price at which the dispenser is set to compute.

Provided that the dispenser complies with S.1.5.1. Display of Unit Price and Product Identity, it is not necessary that all the unit prices be simultaneously displayed or posted.

- (b) The following information shall be conspicuously displayed or posted on each side of a retail dispenser used in direct sale:
- (1) the identity of the product in descriptive commercial terms; and
  - (2) the identity of the grade, brand, blend, or mixture that a multi-product dispenser is set to deliver.

(Added 201X)

UR.2.7.2. Computing Device. – Any computing device used in an application where a product or grade is offered for sale at one or more unit prices shall be used only for sales for which the device computes and displays the sales price for the selected transaction.

The following exceptions apply:

- (a) Fleet sales and other price contract sales are exempt from this requirement.

**(b) A truck stop dispenser used exclusively for refueling trucks is exempt from this requirement provided that:**

- (1) all purchases of fuel are accompanied by a printed receipt of the transaction containing the applicable price per unit of measure, the total quantity delivered, and the total price of the sale; and**
- (2) unless a dispenser complies with S.1.5.1. Display of Unit Price, the price posted on the dispenser and the price at which the dispenser is set to compute shall be the highest price for any transaction which may be conducted.**

**(c) A dispenser used in an application where a price per unit discount is offered following the delivery is exempt from this requirement, provided the following conditions are satisfied:**

- (1) the unit price posted on the dispenser and the unit price at which the dispenser is set to compute shall be the highest unit price for any transaction;**
- (2) all purchases of fuel are accompanied by a receipt recorded by the system for the transaction containing:**
  - a. the product identity by name, symbol, abbreviation, or code number;**
  - b. transaction information as shown on the dispenser at the end of the delivery and prior to any post-delivery discount including the:**
    - 1. total volume of the delivery;**
    - 2. unit price; and**
    - 3. total computed price of the fuel sale prior to post-delivery discounts being applied.**
  - c. an itemization of the post-delivery discounts to the unit price; and**
  - d. the final total price of the fuel sale after all post-delivery discounts are applied.**

**(Added 201X)**

THIS PAGE INTENTIONALLY LEFT BLANK

## Appendix D

### 2015 Measuring Sector Meeting Summary

National Conference on Weights and Measures/National Type Evaluation Program



### Measuring Sector Attendee List Final September 15-16, 2015/Denver, Colorado

**Luciano Burtini**

Measurement Canada  
2008 Matera Avenue  
Kelowna, BC V1V 1W9  
P. (250) 862-6557  
E. luciano.burtini@ic.gc.ca

**Tina Butcher**

NIST, Office of Weights and Measures  
100 Bureau Drive, MS 2600  
Gaithersburg, MD 20899  
P. (301) 975-2196  
E. tina.butcher@nist.gov

**Marc Buttler**

Emerson Process Management / Micro Motion  
7070 Winchester Circle  
Boulder, CO 80301  
P. (303) 581-1970  
F. (303) 530-8459  
E. marc.buttler@emerson.com

**Rodney Cooper**

Tuthill Transfer Systems  
8825 Aviation Drive  
Fort Wayne, IN 46809  
P. (260) 755-7552  
E. rcooper@tuthill.com

**Mario Dupuis**

Measurement Canada  
151 Tunney's Pasture Driveway  
Ottawa, ON K1A 0C9  
P. (613) 948-5009  
E. mario.dupuis@ic.gc.ca

**Joe Eccleston**

Maryland Department of Agriculture  
50 Harry S. Truman Parkway  
Annapolis, MD 21401  
P. (410) 841-5790  
E. joseph.eccleston@maryland.gov

**Ronnell Gallon**

Zenner Performance Meters, Inc.  
1910 East Westward Avenue  
Banning, CA 92220  
P. (951) 849-8822  
F. (951) 922-2395  
E. rgallon@zennerusa.com

**Paul Glowacki**

Murray Equipment, Inc.  
2515 Charleston Place  
Fort Wayne, IN 46808  
P. (260) 480-1352  
E. pglowacki@murrayequipment.com

**Dmitri Karimov**

Liquid Controls, LLC  
105 Albrecht Drive  
Lake Bluff, IL 60044  
P. (847) 283-8317  
E. dkarimov@idexcorp.com

**Allen Katalinic**

North Carolina Department of Agriculture  
2 West Edenton Street  
Raleigh, NC 27601  
P. (919) 707-3230 F. (919) 715-0524  
E. allen.katalinic@ncagr.gov

**Michael Keilty**

Endress + Hauser Flowtec AG, USA  
2441 Arapaho Road  
Estes Park, CO 80517  
P. (970) 586-2122  
E. michael.keilty@us.endress.com

**Peter Kucmas**

Krohne Inc.  
7 Dearborn Road  
Peabody, MA 01960  
P. (603) 497-7200  
E. p.kucmas@krohne.com

NTEP Committee 2016 Final Report  
Appendix D – Measuring Sector Meeting Summary  
Appendix D – Measuring Sector Attendee List

**Douglas Long**

RDM Industrial Electronics  
850 Harmony Grove Road  
Nebo, NC 28761  
P. (828) 652-8346  
F. (828) 652-2697  
E. doug@rdm.net

**Jim Truex**

National Conference on Weights and Measures  
1135 M Street, Suite 110  
Lincoln, NE 68508  
P. (740) 919-4350  
E. jim.truex@ncwm.net

**Josh Long**

RDM Industrial Electronics  
850 Harmony Grove Road  
Nebo, NC 28761  
P. (828) 652-8346  
F. (828) 652-2697  
E. josh@rdm.net

**Rich Miller**

FMC Technologies Measurement Solutions, Inc.  
1602 Wagner Avenue  
P.O. Box 10428  
Erie, PA 16510  
P. (814) 898-5286  
E. rich.miller@fmcti.com

**Randy Moses**

Wayne Fueling Systems  
Heritage Campus, Suite 404  
1000 E. Walnut St.  
Perkasie, PA 18944  
P. (215) 257-2759  
E. randy.moses@wayne.com

**Christopher (Adam) Oldham**

Gilbarco, Inc.  
7300 West Friendly Avenue  
High Point, NC 27420  
P. (336) 547-5952  
E. adam.oldham@gilbarco.com

**John Roach**

California Division of Measurement Standards  
6790 Florin Perkins Road, Suite 100  
Sacramento, CA 95828  
P. (916) 229-3456  
E. john.roach@cdfa.ca.gov

**Steve Sharp**

Liquid Controls, LLC  
105 Albrecht Drive  
Lake Bluff, IL 60044  
P. (847) 283-8330  
E. ssharp@idexcorp.com