

## Report of the Specifications and Tolerances (S&T) Committee

Mr. Mahesh Albuquerque, Committee Chair  
Colorado

### 300 INTRODUCTION

This is the final report of the Specifications and Tolerances (S&T) Committee (hereinafter referred to as the “Committee”) for the 100<sup>th</sup> Annual Meeting of the National Conference on Weights and Measures (NCWM). This report is based on the Interim Report offered in the NCWM Publication 16, “Committee Reports,” testimony at public hearings, comments received from the regional weights and measures associations and other parties, the addendum sheets issued at the Annual Meeting, and actions taken by the membership at the voting session of the Annual Meeting. The Informational items shown below were adopted as presented when this report was approved. This report contains those recommendations to amend National Institute of Standards and Technology (NIST) Handbook 44 (2015), “Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.”

Table A identifies the agenda and appendix items by reference key, title of item, page number, and the appendices by appendix designations. The acronyms for organizations and technical terms used throughout the agenda are identified in Table B. The first three digits of the Reference Key Numbers of the items are assigned from the Subject Series List. The status of each item contained in the report is designated as one of the following: **(D) Developing Item:** the Committee determined the item has merit; however, the item was returned to the submitter or other designated party for further development before any action can be taken at the national level; **(I) Informational Item:** the item is under consideration by the Committee but not proposed for Voting; **(V) Voting Item:** the Committee is making recommendations requiring a vote by the active members of NCWM; **(W) Withdrawn Item:** the item has been removed from consideration by the Committee.

Table C provides a summary of the results of the voting on the Committee’s items and the report in its entirety. Some Voting Items are considered individually; others may be grouped in a consent calendar. Consent calendar items are Voting Items that the Committee has assembled as a single Voting Item during their deliberation after the Open Hearings on the assumption that the items are without opposition and will not require discussion. The Voting Items that have been grouped into consent calendar items will be listed on the addendum sheets. Prior to adoption of the consent calendar, the Committee entertains any requests from the floor to remove specific items from the consent calendar to be discussed and voted upon individually.

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*. When used in this report, the term “weight” means “mass.”

**Note:** The policy of NIST and NCWM is to use metric units of measurement in all of their 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 U.S. customary units.

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**Table B**  
**Glossary of Acronyms and Terms**

<b>Acronym</b>	<b>Term</b>	<b>Acronym</b>	<b>Term</b>
API	American Petroleum Institute	NCWM	National Conference on Weights and Measures
CC	Certificate of Conformance	NEWMA	Northeastern Weights and Measures Association
CNG	Compressed Natural Gas	NIST	National Institute of Standards and Technology
CWMA	Central Weights and Measures Association	NGSC	NCWM Natural Gas Steering Committee
DGE	Diesel Gallon Equivalent	NTEP	National Type Evaluation Program
DLE	Diesel Liter Equivalent	OIML	International Organization of Legal Metrology
DOT	Department of Transportation	OWM	Office of Weights and Measures
FALS	Fuels and Lubricants Subcommittee	RMFD	Retail Motor Fuel Dispenser
FHWA	Federal Highway Administration	S&T	Specifications and Tolerances
FMCSA	Federal Motor Carrier Safety Administration	SD	Secure Digital
GGE	Gasoline Gallon Equivalent	SI	International System of Units
GLE	Gasoline Liter Equivalent	SMA	Scale Manufacturers Association
GMM	Grain Moisture Meter	SWMA	Southern Weights and Measures Association
GPS	Global Positioning System	SS	Software Sector
IEC	International Electrotechnical Commission	TC	Technical Committee
LMD	Liquid Measuring Devices	USNWG	U.S. National Work Group
LNG	Liquefied Natural Gas	WG	Work Group
LMDP	Legal Metrology Devices Program	WIM	Weigh-in-Motion
MMA	Meter Manufacturers Association	WWMA	Western Weights and Measures Association
MPCG	NCWM Multi-Point Calibration Group	WS	Weighing Sector
MS	Measuring Sector		

**Table C**  
**Summary of Voting Results**

<i>Reference Key Number</i>	<i>House of Senate Representatives</i>		<i>House of Delegates</i>		<i>Results</i>
	<i>Yeas</i>	<i>Nays</i>	<i>Yeas</i>	<i>Nays</i>	
Consent Calendar 320-2, 320-4, 321-1, 321-2, 321-3, 321-4, 321-5, 321-6, 321-7, 321-8, 354-3, 354-4, 354-5, 360-3, 360-5	40	0	70	0	Adopted
310-2 To hear amendment	Majority to hear				Amendment was heard
310-2 To amend the proposal	38	3	65	1	Amendment Accepted
310-2 As Amended	38	3	65	1	Adopted
*337-1	32	8	26	31	Returned to Committee
354-1	27	9	57	8	Adopted
354-2	No Vote				Committee Moved to Informational Status

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

### **310 HANDBOOK 44 - GENERAL CODE**

#### **310-1 D G-S.1. Identification. – (Software)**

**Source:**

This item originated from the NTEP Software Sector and first appeared on the Committee's 2007 Agenda as Developing Item Part 1, Item 1 and on its 2010 Agenda as Item 310-3.

**Purpose:**

Provide marking requirements that enable field verification of the appropriate version or revision for metrological software, including methods other than "permanently marked," for providing the required information.

**Item Under Consideration:**

Amend NIST Handbook 44 paragraph G-S.1. Identification as follows:

**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) a National Type Evaluation Program (NTEP) Certificate of Conformance (CC) number or a corresponding CC Addendum Number for devices that have a CC.

(1) The CC Number or a corresponding CC Addendum Number shall be prefaced by the terms “NTEP CC,” “CC,” or “Approval.” These terms may be followed by the word “Number” or an abbreviation of that word. The abbreviation for the word “Number” shall, as a minimum, begin with the letter “N” (e.g., No or No.)  
[Nonretroactive as of January 1, 2003]

The required information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.

(Amended 1985, 1991, 1999, 2000, 2001, 2003, ~~and~~, 2006 ~~and~~ 20XX)

#### **Background/Discussion:**

Among other tasks, the NTEP Software Sector (SS) was charged by the NCWM Board of Directors to recommend NIST Handbook 44 specifications and requirements for software incorporated into weighing and measuring devices and systems, which may include tools used for software identification. During its October 2007 meeting, the SS discussed the value and merits of required markings for software, including possible differences in some types of software-based devices and methods of marking requirements. After hearing several proposals, the Sector agreed to the following technical requirements applicable to the marking of software:

1. The NTEP CC Number must be continuously displayed or hard-marked;
2. The version must be software-generated and shall not be hard-marked;
3. The version is required for embedded (Type P) software;
4. Printing the required identification information can be an option;
5. Command or operator action can be considered as an option in lieu of a continuous display of the required information; and
6. Devices with Type P (embedded) software must display or hard-mark the device make, model, and serial number to comply with G S.I. Identification.



In 2008, the Software Sector developed and submitted a proposal to the NCWM S&T Committee to modify G-S.1. and associated paragraphs to reflect these technical requirements. Between 2008 and 2011, this item appeared on the S&T Committee's main agenda, and the Committee and the Sector received numerous comments and suggestions relative to the proposal. The Sector developed and presented several alternatives based on feedback from weights and measures officials and manufacturers. Among the key points and concerns raised during discussions over this period were how to address the following:

- (a) **Limited Character Sets and Space.** – How to address devices that have limited character sets or restricted space for marking.
- (b) **Built-for-Purpose vs. Not-Built-for-Purpose.** – Whether or not these should be treated differently.
- (c) **Ease of Access.** – Ease of accessing marking information in the field.
  - Complexity of locating the marking information
  - Use of menus for accessing the marking information electronically
  - Limits on the number of levels required to access information electronically
  - Possibility of single, uniform method of access
- (d) **Hard Marking vs. Electronic.** – Whether or not some information should be required to be hard marked on the device.
- (e) **Continuous Display.** – Whether or not required markings must be continuously displayed.
- (f) **Abbreviations and Icons.** – Establishment of unique abbreviations, identifiers, and icons and how to codify those.
- (g) **Certificate of Conformance Information.** – How to facilitate correlation of software version information to a CC, including the use of possible icons.

Further details on the alternatives considered can be found in the Committee's Final Reports from 2008 to 2014.

Prior to the 2014 NTEP Weighing Sector (WS) meeting, members of OWM's Legal Metrology Devices Program (LMDP) amended the proposal appearing on the Committee's Agenda in 2014; this after being asked by the NTEP SS to provide additional input and draft modifications to Paragraphs G-S.1. and G.S.1.1. in consideration of the goals of the SS and the comments provided during the 2014 Open Hearings of the S&T Committee relating to this item.

The following is a list of the goals provided by the SS in modifying G-S.1. and G.S.1.1. as communicated to the members of OWM's LMDP:

1. Remove the existing distinction between software identification requirements for built-for-purpose and not-built-for-purpose devices.
2. Require that all software-based devices have a software version or revision identifier for metrologically significant software.
3. Require that certified software versions or revision identifiers for metrologically significant software is recorded on the CC for access by inspectors.
4. Software itself does not require serial numbers.

5. Require that a software-based device's version or revision identifier shall be accessible via the display and user interface. Only if device's display is incapable of displaying the identifier or has no display and/or interface shall permanently mark the version or revision identifier be acceptable (e.g., digital load cell).
6. Nonretroactive as of January 1, 2016, if adopted by the NCWM in July 2015.

OWM's LMDP developed the following proposed draft alternative changes to G-S.1. based on the SS's request for additional input on how best to meet its goals and forwarded these changes to the Chairman of the SS for consideration at the 2014 WS/SS joint meeting:

Amend NIST Handbook 44: G-S.1. as follows:

**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 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 through December 31, 2015, and all software based devices or equipment manufactured as of January 1, 2016;**  
**[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)
- ii. ***directly linked to the software itself; and***  
***[Nonretroactive as of January 1, 2016]***  
***(Added 20XX)***
- iii. ***continuously displayed\* or be accessible via the display menus. 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, 2016]***  
***(Added 20XX)***

***\*The version or revision identifier shall be displayed continuously on software-based equipment with a digital display manufactured as of January 1, 20XX, and all software-based equipment with a digital display as of January 1, 20YY.***

- (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.).*  
[Nonretroactive as of January 1, 2007]

(Added 2006)

- (e) *a National Type Evaluation Program (NTEP) Certificate of Conformance (CC) number or a corresponding CC Addendum Number for devices that have a CC.*

- (1) *The CC Number or a corresponding CC Addendum Number shall be prefaced by the terms “NTEP CC,” “CC,” or “Approval.” These terms may be followed by the word “Number” or an abbreviation of that word. The abbreviation for the word “Number” shall, as a minimum, begin with the letter “N” (e.g., No or No.)*

[Nonretroactive as of January 1, 2003]

The required information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.

(Amended 1985, 1991, 1999, 2000, 2001, 2003, **and**, 2006 **and 20XX**)

OWM’s LMDP did not propose any changes to subparagraph G-S.1.1. since the SS had indicated earlier that it may be possible to eventually eliminate G-S.1.1. Additionally, the LMDP explained to the SS that the shaded portion of G-S.1.(d)(1)iii. of their draft alternative changes did not reflect any of the goals communicated by the SS and was being offered for consideration with the understanding that:

1. this change will make it easier in the future for inspectors to be able to identify software installed in equipment;
2. a reasonable amount of time for the changes to take effect can be specified; and

3. it is probable that improvements in technology over time will make it easier for equipment manufacturers to comply.

**NTEP Weighing and Software Sectors – Joint Meeting (August 2014):**

At its 2014 meeting, the Weighing Sector (WS) met jointly with the Software Sector (SS) to consider the proposal as amended by OWM's LMDP. After further amending it, the two Sectors agreed to submit the proposal as shown in the Item Under Consideration to the weights and measures regional associations for consideration, and requested its status be change from Developing to Informational. The Sectors also decided that no changes to G-S.1.1. were necessary since the two Sectors had agreed that the term “not-built-for-purpose software-based devices” in G-S.1.(d) would be retained in the proposal.

**2015 NCWM Interim Meeting:**

During the 2015 NCWM Interim Meeting, representatives speaking on behalf of the SMA, MMA, and OWM commented that they believed progress had been made on this item at the joint meeting of the SS and WS in August 2014. The SMA reported it continues to support the work of the SS and would like to see this item remain on the S&T Committee's Agenda. OWM noted that during the joint meeting members of both Sectors had agreed to a number of proposed amendments to G-S.1., which had been developed by OWM's LMDP. OWM encouraged the SS to continue working with the remaining NTEP Sectors to try and reach consensus on a proposal that provides the means for officials to easily determine whether or not software installed in a device is the same as that evaluated by NTEP. Mr. Michael Keilty (Endress Hauser Flowtec AG), Chairman of the Measuring Sector (MS), reported the Measuring Sector (MS) would be meeting with the SS next October (2015) to consider the proposal.

In recognition of the progress that was reported and the planned future joint meeting of the Measuring and Software Sectors, the Committee agreed to keep the item on its agenda as a Developing item. 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 next NCWM Interim Meeting.

**2015 NCWM Annual Meeting:**

At the 2015 NCWM Annual Meeting, Mr. Russ Vires (Mettler-Toledo, LLC), speaking on behalf of the SMA, commented that the SMA continues to support the work of the SS and looks forward to the outcome of their joint meeting with the MS.

Ms. Tina Butcher (OWM) reported that significant progress was made at last year's joint meeting of the SS and WS. OWM continues to support the efforts of the SS and looks forward to the outcome of their joint meeting with the MS in September 2015. She encouraged the SS to continue working with the remaining NTEP Sectors to try and reach consensus on a proposal, which provides the means for officials to be able to easily determine whether or not software installed in a device is the same as that evaluated by NTEP.

Committee member, Dr. Matthew Curran (Florida) asked if it was still the plan of the SS to have the proposal developed to the extent that it could be a Voting item during the 2016 NCWM cycle. Mr. Richard Harshman (OWM), Co-Technical Advisor to the Committee, responded that was still his understanding.

The Committee also noted again, due to the length of time the item has remained on the Committee's Agenda with no resolution (8 years), that if proposed language for voting status consideration could not be presented to the Committee by the 2016 Interim Meeting it would likely be withdrawn, but could be reintroduced when the Sectors were able to provide such language.

In consideration of the comments received in support of the item, which also acknowledged the recent significant progress to further develop it, the Committee agreed to maintain the item on its agenda in a Developing status. The Committee also agreed to replace the Item Under Consideration with the most recent proposal; which was agreed to by the SS and WS during their joint 2014 meeting and as now shown in Item Under Consideration.

**Regional Association Meetings:**

The CWMA recommended leaving this as a Developing item at its 2014 Interim Meeting due to the lack of new information from the SS. At its 2015 Annual Meeting, the CWMA again recommended the item move forward as Developing due to comments heard during the Open Hearing and the upcoming meeting between the SS and MS.

WWMA heard testimony in Open Hearings of the 2014 WWMA Annual Meeting in support of the work being done and the interested Sectors are meeting to continue the effort. WWMA agreed further work needs to be done with this item. WWMA recommended this item remain a Developing item.

At its 2014 Annual Meeting, the SWMA recommended this item remain Developing despite having indicated last year that if no progress had been made by the next NCWM cycle the item would be Withdrawn. While there were no specific updates provided, there were comments indicating progress has been made by the SS and WS. The Committee did not hear any comments in opposition to this item.

At its 2014 Interim Meeting, NEWMA recommended that the item be Withdrawn because no new information had been provided by the SS. It was noted that if the SS continues their work on this item and wants to bring this forward again with new information; the Committee could reconsider the item. At its 2015 Annual Meeting, NEWMA heard testimony indicating significant progress had been made on the item by the SS. A question was raised concerning whether or not the current proposal would exempt software from being required to have a serial number. The Committee reported it believes the current proposal would exempt software. NEWMA agreed to recommend the item move forward as Developing because of the ongoing work being done to further develop this item.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**310-2 V G-UR.4.1. Maintenance of Equipment.**

(This item was adopted.)

**Source:**

Florida Department of Agriculture and Consumer Services (2015)

**Purpose:**

To further clarify the applicability of the General Code to device types or flow rates at a single facility.

**Item Under Consideration:**

Amend NIST Handbook 44 General Code as follows:

**G-UR.4.1. Maintenance of Equipment.** – All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment in service at a single place of business ~~found to be in error predominantly in a direction favorable to the device user~~ (Also see the Introduction, Section Q) shall not be considered “maintained in a proper operating condition.” if:

(a) Predominantly, equipment of all types or applications are found to be in error in a direction favorable to the device user, or

(b) Predominantly, equipment of the same type or application is found to be in error in a direction favorable to the device user.

(Amended 1973, ~~and~~ 1991, and 2015)

**Background/Discussion:**

It is not uncommon for a single place of business to have in use different types of devices (or meters with different flow rates) at the same time. A truck stop may have retail meters for passenger vehicles and high-volume meters for commercial vehicles, both having different tolerances and essentially operating as separate sections at a single place of business. As this section is currently written, it would include both of these meter types under “equipment” and thus apply “predominantly in favor” across all meters, despite the fact that one group of these meters could be predominantly in favor of the vendor while the other is not, thus, leaving the weights and measures official without the ability to correct such a situation under the general code. Similar situations may exist with scales and other measuring devices. Further clarifying ‘equipment’ to apply to the same type or application use in this section would alleviate that potential. Consequently, the submitter of the item proposed the following amendments to paragraph G-UR.4.1.

**G-UR.4.1. Maintenance of Equipment** – All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment of the same type or application in service at a single place of business found to be in error predominantly in a direction favorable to the device user (See also Introduction, Section Q.) shall not be considered “maintained in a proper operating condition.”

**2015 NCWM Interim Meeting:**

At the 2015 NCWM Interim Meeting, there were a number of concerns raised during the S&T Committee Open Hearings regarding the impact this proposal might have on the application of the paragraph as it relates to predominance. There were also a number of state weights and measures officials who spoke in support of the proposed change. Ms. Tina Butcher (OWM) commented that OWM believes the current language in G-UR.4.1. is adequately broad to provide jurisdictions the flexibility of being able to establish policies and guidelines for assessing “predominance.” However, if the Committee believes that a change is needed to this paragraph to assist jurisdictions who are having difficulty enforcing the requirements; the current proposal might be too restrictive. The current language would limit how a jurisdiction can apply the requirement and would not enable other groupings or attributes to be considered. For example, if a gasoline station sets its most frequently used dispensers to operate in the station’s favor, the proposed language would not allow the jurisdiction to apply the requirement and consider this to be a scenario of “predominance.” OWM offered the following alternative language for consideration should the Committee decide changes were needed:

**G-UR.4.1. Maintenance of Equipment** – All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment in service at a single place of business found to be in error predominantly in a direction favorable to the device user (including, but not limited to, equipment of the same type or application) shall not be considered “maintained in a proper operating condition.” (~~see also Introduction, Section Q~~)

Ms. Butcher also noted that the reference to “Introduction, Section Q” should be deleted from the paragraph because the Introduction Section of NIST Handbook 44 was amended in 2013, resulting in Section M. being deleted and subsequent sections renumbered. Consequently, Section P. is now the correct reference, but referencing it in G-UR.4.1. is of no benefit in OWM’s view.

Dr. Matthew Curran (Florida), submitter of the item, reported that the marketplace has changed over the years, and today, many facilities are multi-dimensional with respect to commodities they sell (e.g., a business might sell gasoline out front along with diesel through high-flow meters in the back, while selling frozen yogurt, meats, etc., by weight inside) as opposed to offering just one particular product or commodity as in the past. Thus, many facilities now have multiple different types of weighing and measuring devices in use at the same place of business. He went on to state that if a business of this nature had all devices of one particular device type set on the negative or short side (for whatever reason), but each device was within tolerance and the other devices of other types were random, the number of those affected devices of that particular type wouldn’t constitute “predominance.” For example, if six diesel meters in the truck lanes out back were all on the short side (set that way because they made the most money from them or for whatever reason), but were within tolerance and the 12 retail meters out front and the five scales inside were random, the six diesel meters all on the short side would not constitute “predominance” at that location and the jurisdiction could not address the issue. In such instances, the jurisdiction would have no mechanism to remove those

devices from service, but if the code was changed to address today's marketplace, jurisdictions would have a mechanism to address this problem. Further, jurisdictions could still look at the total number of devices regardless of type, thus, making this language more flexible overall and not more restrictive. Dr. Curran specifically added that although NIST stated this language was more restrictive, it was actually less restrictive and gave the jurisdiction definitive authority to do what many were already doing in this regard. Dr. Curran went on to state that this issue was also introduced by Ms. Julie Quinn (Minnesota) last year in a proposal for the Liquid Measuring Devices (LMD) Code, but the S&T Committee stated it felt it would be more appropriate to address this in the General Code.

Mr. Henry Oppermann (Weights and Measures Consulting, LLC) speaking on behalf of Seraphin Test Measure Company, noted that predominance is typically applied to the errors resulting from the testing of retail motor fuel dispensers at a gas station. Proposals to provide guidance and promote uniformity in the assessment of the predominance of error, particularly regarding retail motor fuel devices, have been addressed several times over the years by the S&T Committee. He reported that Seraphin (Test Measure Company) supports the efforts to achieve greater uniformity in the interpretation and assessment of the predominance in errors. Mr. Oppermann provided background information containing excerpts from a draft training manual, "Introduction to Liquid Measuring Devices," that had been prepared for the NIST Office of Weights and Measures that provide an indication of the effects of temperature on test results for liquid measuring systems. This information has been inserted in Appendix A of this report. Mr. Oppermann also provided a copy of one state's policy in applying existing NIST Handbook 44 requirements associated with predominance to commercial retail dispensers.

Mr. Kurt Floren (Los Angeles County, California) voiced opposition to the proposed changes noting that predominance applies not only to retail motor fuel dispensers, but also to other weights and measures equipment, such as scales and other devices. He suggested possibly focusing in on the different applications and inserting requirements into the different codes of NIST Handbook 44 to address this concern. After Dr. Curran provided a more detailed explanation of the intent of the proposed change, Mr. Floren added he appreciated the clarification and did not have that understanding when he voiced his opposition but now understands the concerns this issue addresses.

The SMA provided comment in opposition to the item noting while it understands the intent of the item, it feels the existing language is sufficient to address the concern.

Ms. Quinn spoke in support of this item and provided related examples from grocery stores in her state. Ms. Quinn mentioned her similar proposal item last year for the LMD Code that the Committee opted to withdraw as it felt would be more appropriately addressed in the General Code.

Mr. Doug Deiman (Alaska) also spoke in support of this item and provided examples relating to hanging scales in his state.

In consideration of the comments received, the Committee agreed to amend the second sentence of paragraph G-UR.4.1.; delete the reference to "Introduction, Section Q" as shown below; and recommend the item for Vote.

**G-UR.4.1. Maintenance of Equipment** – All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment in service at a single place of business **(including, but not limited to, equipment of the same type or application)** found to be in error predominantly in a direction favorable to the device user shall not be considered "maintained in a proper operating condition." ~~(see also Introduction, Section Q)~~

#### **2015 NCWM Annual Meeting:**

At the 2015 NCWM Annual Meeting, the Committee heard a number of comments in both support and opposition to the proposal shown above. An industry representative voiced support for the intent of the changes, but encouraged additional review, questioning whether or not the language being proposed provided sufficient clarity. Several officials agreed with the comment.

Ms. Kristin Macey (California) commented that the additional language is not needed and questioned whether or not the LMD Code might be a more appropriate place to address "predominance." Mr. Steve Giguere (Maine) stated that he agreed with Ms. Macey's comments. Mr. Randy Jennings (Tennessee), Ms. Julie Quinn (Minnesota), and Mr. Mike

Sikula (New York) all supported the item. Mr. Constantine Cotsoradis (Flint Hills Resources) stated he supported the intent, but was concerned the language didn't accomplish the intent, to which Ms. Macey now agreed and proposed reverting to the original language, which was presented at the Interim. Mr. Tim Chesser (Arkansas) agreed it needed to be in the General Code as well and echoed Ms. Macey's suggestion to revert to the original language.

Dr. Curran, submitter of the item stated, in response to Ms. Macey's and Mr. Giguere's initial comments, he believed the General Code was the appropriate place to address this issue, and he noted that the S&T Committee withdrew a similar item last year that had been proposed specifically for the LMD Code as the Committee felt it was more appropriate in the General Code. Dr. Curran provided a hypothetical, but possible example of a business with 5 heavily used scales (and a significant portion of the businesses overall sales) inside and 15 fueling pumps outside where the 5 scales were within tolerance, but all set on the negative side and the 15 fueling pumps outside were all within tolerance, but not necessarily on the negative side, the weights and measures official would not be able to take the five scales out of service under this section of the General Code if a predominant number of the devices were not on the negative side, thus allowing the business to 'skim' from its customers. He further reiterated that several jurisdictions indicated they were already interpreting the General Code this way, which, he added, was further support for codifying what was already being interpreted by many weights and measures officials.

A representative from Connecticut stated the proposed change was not necessary. Mr. Richard Tucker (RL Tucker Consulting) expressed concern for placing examples in the General Code and provided a history of its inception in 1973. Mr. Richard Shapiro (Rice Lake) expressed concern that this change, if adopted, would put them in a "sticky" situation.

Mr. Russ Vires (Mettler-Toledo, LLC), speaking on behalf of the SMA, noted that the SMA took no position on this item.

Ms. Butcher reiterated comments NIST, OWM made during the 2015 Interim Meeting that the current language in paragraph G-UR.4.1. is adequately broad to provide jurisdictions the flexibility of being able to establish policies and guidelines for assessing "predominance" of equipment. OWM noted that the original proposal had been amended using alternative language provided by OWM. OWM commented that it believes the proposal is appropriate if others believe, as the submitter does, the change will strengthen a jurisdiction's ability to enforce this paragraph as it relates to "predominance."

OWM also noted if the Committee decided not to advance this proposal, the reference to Introduction, Section Q should still be deleted editorially; not only is the reference incorrect, it is of little benefit in interpreting and understanding the paragraph.

In considering the comments, the proposal received during the Open Hearings, the Committee agreed during its work session to amend the Item Under Consideration by reverting back to the language originally proposed by the submitter of the item and recommend the item be presented for Vote. Thus, the Committee agreed to replace the Item Under Consideration with the following:

**G-UR.4.1. Maintenance of Equipment** – All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment **of the same type or application** in service at a single place of business ~~(including, but not limited to, equipment of the same type or application)~~ found to be in error predominantly in a direction favorable to the device user shall not be considered "maintained in a proper operating condition." ~~(see also Introduction, Section Q)~~

During the voting session, Mr. Floren commented that he agreed with the intent of the proposal, yet was still having difficulty with the language proposed. He suggested amending the Item Under Consideration by creating two bulleted sentences within the paragraph to address the two different applications for which the paragraph is intended to apply. He offered some suggested changes, to which others, including the submitter agreed. Ms. Macey also stood in support of the proposed changes. The language was amended on the floor by the Committee as shown in the Item Under Consideration; voted on; and adopted.



**Regional Association Meetings:**

At its 2014 Interim Meeting, the CWMA S&T Committee received comments in support of this item. Multiple jurisdictions indicated that they believe the proposed changes will give them a stronger legal position. The CWMA agreed the proposed changes would strengthen the application of this code and forwarded the item to NCWM, recommending it as a Voting item. During the 2015 CWMA Annual Meeting, the CWMA reversed its earlier position and agreed to recommend the item be Withdrawn after indicating it believed the current language used in NIST Handbook 44 is sufficient. The CWMA also indicated it was in favor of striking the reference “(see also Introduction, Section Q)” from G-UR.4.1.

At the 2014 WWMA Annual Meeting, opposition to this item was expressed during Open Hearings. Several regulators spoke to the potential for multiple interpretations/confusion and the belief that the intent of the proposal was geared toward LMD in spite of it being located in the General Code. Based on testimony given, WWMA did not forward this item to the NCWM.

At its 2014 Annual Meeting, the SWMA did not hear any comments in opposition to this item and supported the intent to clarify this section and make it more defensible. The SWMA reported that it also believes the recommended language strengthens the existing paragraph. The SWMA forwarded the item to the NCWM and recommended that it be a Voting item.

NEWMA reported at its 2014 Interim Meeting that it believes the proposal provides beneficial clarification to the General Code. NEWMA forwarded the item to the NCWM and recommended that it be a Voting item. At its 2015 Annual Meeting, NEWMA agreed to recommend the item for Vote based on the belief the item has merit.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**320 SCALES****320-1 W A.1. General.**

(This item was Withdrawn.)

**Source:**

KSi Conveyors, Inc. (2015)

**Purpose:**

Provide clarity in NIST Handbook 44 as to what standards apply to weighing and measuring systems that provide a finished product based on the measurement of raw materials.

**Item Under Consideration:**

Amend NIST Handbook 44 Scales Code as follows:

**A.1. General.** – This code applies to all types of weighing devices other than automatic bulk-weighing systems, belt-conveyor scales, and automatic weighing systems, including non-automatic batching systems. The code comprises requirements that generally apply to all weighing devices, and specific requirements that are applicable only to certain types of weighing devices.

(Amended 1972 and 1983)

**Background/Discussion:**

The reference to batching systems will accompany the proposal to add a definition for “batching systems” to NIST Handbook 44, Appendix D – Definitions. The CWMA agreed to forward the definition to the NCWM S&T Committee with the recommendation that it be a Voting item. The CWMA noted that the definition needs to reference the specific codes where the definition is applicable.

There are both automatic and non-automatic batching systems that utilize scales and/or meters already in the market place and have been for many years. The lack of a definition and the accompanying references may have just been an oversight on the part of the NCWM S&T Committee. For further clarification and justification please refer to the proposal to add a definition for “batching systems,” which was also submitted to the SWMA for consideration.

At the 2015 NCWM Interim Meeting, the Committee agreed to group together Agenda Items 320-1, 324-1, 330-1, and 360-1 since these items are related and announced comments on all four items would be taken together during the Committee’s Open Hearings.

Short presentations concerning these items were provided by Mr. Henry Oppermann (Weights and Measures Consulting, LLC) and Mr. Dominic Meyer (KSi Conveyors, Inc.), both of whom described the automatic operation of a seed treatment process involving a hopper scale used to weigh the seed. In describing the scale’s operation, Mr. Oppermann classified the scale as an automatic bulk weighing system (ABWS). He stated, it is the application of a scale that defines its classification. In a typical seed weighing operation, seed is loaded, weighed, and discharged from the hopper automatically and in repeated drafts until the weight of an order, which is pre-programmed into the system by an operator, is filled. Since only a single commodity is weighed, the scale cannot be classified as a batching scale, which would require two or more commodities to be weighed. The application of the scale makes it an ABWS. He stated that the scale does not comply with the ABWS Code because it does not record the no-load and loaded weight values accumulating the net weight of each draft, and there may be other compliance issues. He indicated it doesn’t make sense to include the term “batching system” in the Application Section of several NIST Handbook 44 device codes when nowhere within those codes are there specific requirements that apply to them. Mr. Oppermann also provided written comments to the Committee summarizing his opposition to the four proposals; these have been inserted into Appendix B of this report.

Mr. Richard Suiter (Richard Suiter Consulting) provided testimony on behalf of KSi Conveyors, Inc. He reported that he had contacted a number of different states about the KSi system. Some states questioned whether scales used to weigh seed should be considered grain-hopper scales. The Federal Grain Inspection Service (FGIS) does not consider seed a grain. Mr. Suiter provided a short history of the ABWS Code dating back to the late 1970s when a manufacturer produced an electronic weighing system designed to replace old mechanical “trip weighers,” which consisted of a mechanical hopper scale that would fill with grain to a preset weight then trip and dump. A problem encountered with these electronic automatic weighing systems was that the weigh hopper would sometimes fail to completely empty when grain was discharged from the weigh hopper. As a result, the scale did not return to zero after each load had been discharged because of product left remaining (often referred to as a “heel”) in the weigh hopper. At some point during a subsequent draft, the “heel” would discharge out of the weigh hopper along with the rest of the load; this caused a zero load balance change on the negative side of zero, which did not comply with NIST Handbook 44 and would cause the system to “lock up.” The manufacturer of the system worked closely with the State of Nebraska and FGIS to recognize a system that would utilize “no-load reference values” that could be on either the negative or positive sides of zero. This effort resulted in the initial version of the ABWS for Grain Code being adopted by the NCWM in 1983.

Mr. Suiter reported that KSi Conveyors had submitted and received an NTEP CC for a bulk weighing system controller used in an ABWS application after one state had classified the system as an ABWS. He also stated that NTEP had already determined that the earlier system in question was not an ABWS and so stated on the Certificate of Conformance (CC). He stated that the KSi system does not necessarily retain a heel. Most products pass through the KSi system completely, returning to a zero indication following the discharge of each repeated load from the weigh hopper when in automatic operation. Mr. Suiter noted there are scales used in automatic batching operations that are not considered ABWSs. He concluded it is not necessary that these systems record the no-load and loaded weight values providing the scales in these systems return to zero following discharge of the product from the weigh hopper.

The SMA supported the item and suggested the wording offered by the SWMA be used. The SMA also supported the addition of definitions for non-automatic and automatic batching systems.

Ms. Tina Butcher (OWM) provided a summary of OWM’s analysis of these items, which has been copied below and was made available to the NCWM membership during the Open Hearings of the S&T Committee.

**OWM Analysis of S&T Items 320-1, 324-1, 330-1, and 360-1:**

OWM considers Items 320-1, 324-1, and 330-1 companions to this item (360-1) and understands these first three items were submitted after it was made known to the submitter that definitions can only be added to NIST Handbook 44 to define terms appearing in one or more of the codes within the Handbook. That is, it is believed that Items 320-1, 324-1, and 330-1 were submitted as an afterthought because nowhere in the “Application” section of the Scales Code (Section 2.20.), Automatic Weighing Systems Code (Section 2.24.), or Liquid-Measuring Devices Code (Section 3.30.) of NIST Handbook 44 does the term “batching system” appear. The devices associated with these three codes are often components of batching systems. OWM presumes the submitter is proposing this term be included in each of these device codes to make clear that these codes are intended to apply to these devices when installed in a batching system and to help differentiate a batching system from an automatic bulk weighing system. The justification given for proposing a definition be added is that one state tried to categorize batching systems as automatic bulk weighing systems under NIST Handbook 44, Section 2.22. Automatic Bulk Weighing Systems Code.

Adding the term “batching system” to the “Application” section of each of these device codes when nowhere else within any of these codes is that term used is an inappropriate approach. It is not the batching system as a whole that typically gets inspected. The different devices used commercially in a batching system are examined independently of each other (and of the system) using the appropriate codes that apply to those devices (i.e., the General Code and whichever device code applies to the type of device being inspected as part of the batching system).

The proposed definition of “batching system” does not provide sufficient information to allow a conclusive distinction be made between a batching system and an ABWS. For example, nowhere in the definition does it specify that the commercial devices used in a batching system designed to automatically weigh commodities in successive drafts must start each draft (i.e., the first and each successive draft) from a zero-load balance condition (if a scale), yet this is a significant distinguishing factor between an ABWS and a scale used in a batching system designed to operate in automatic mode. For this reason, OWM does not believe that the addition of the definition being proposed will solve the problem that the submitter has identified; nor does OWM believe that a definition of “batching system” is needed.

OWM’s research into the history of the ABWS Code revealed the ABWS Code was first added to NIST Handbook 44 in 1984. It was developed by the U.S. Department of Agriculture (USDA) Federal Grain Inspection Service (FGIS) in consultation with OWM to recognize electronic grain weighing systems, which were becoming more prevalent at that time. Originally titled “Automatic Bulk Weighing Systems for Grain” the words “for Grain” were deleted from the title in 1987 to broaden the application of the code to include all ABWS.

In 1981 (three years prior to the code being added to NIST Handbook 44), the NCWM adopted five new principles relating to the design, operation, and testing of an ABWS that had been developed by USDA’s FGIS and OWM. Of notable mention, the first three principles (shown below) recognize that in order to weigh repeated drafts accurately, a no-load reference value must be indicated, recorded, and taken into account in the determination of the net load of *each* draft. In adopting these principles, the NCWM recognized that ABWS operate by weighing repeated drafts automatically (without intervention of an operator) and the net weight determination is made by calculating the difference between the no-load reference value and the value of each draft load.

1. No Load Reference – Although NIST Handbook 44 seems to require an indication of “zero” as a no load reference, the principle expressed is to weigh accurately it is necessary that a readily understandable, repeatable, and effective “no load reference” be indicated and recorded. Since automatic bulk weighing systems operate by weighing repeated drafts and the net weight determination is made by calculating the difference between the no load reference values and the values obtained with an equilibrium at specific loads, it is necessary only that the no load reference meet the previously mentioned criterion. A positive value seems to meet that criterion and additionally can be more accurate since the no load reference value is automatically determined and used in the calculation after every draft. Consequently, any change in the no load equilibrium condition does not require the intervention of an operator. Therefore, for this special equipment, paragraph S.1.1. Zero Indications, should be interpreted as requiring only an appropriate “no load reference” rather than a “zero” reference. Also, paragraph UR.4.1. Balance Condition, should be interpreted as requiring that the “no load” or “zero load reference be indicated and recorded.

2. Recorded Values. – It is necessary that these systems be equipped with recording elements since it is impractical and probably impossible to manually record the correct values in such a repeated operation. Other conditions necessary are:
  - a) an effective motion detect system consistent with the requirements of NIST Handbook 44 so that the values can be recorded only when the device is in stable equilibrium;
  - b) the values are displayed during the printing cycle;
  - c) some guarantee and indication that both gates (weigh hopper and loading garner) are closed during the print cycle;
  - d) the system shuts down automatically when it fails to operate in accord with its design;
  - e) some guarantee that a final partial draft quantity is recorded;
  - f) in direct sale applications a complete record of all recorded values is provided to the party not operating the equipment;
  - g) the values recorded are consistent with the requirements of G-S.5. (i.e., clear, definite and easily read under normal conditions of operation);
  - h) some guarantee that any test weights installed in the system cannot interfere with correct weighing; and
  - i) when the system is designed to transport grain through the scale without being weighed, means shall be provided to indicate clearly that this mode of operation is being utilized.
3. No Load Reference Sequence. – Since these systems are used both to “weigh in” and/or to “weigh out” the sequence in which the quantity received or quantity delivered is determined must be stipulated. When the quantity of product received is being determined, it is necessary that the “no load reference value” be determined and recorded first and the “full load reference value” determined and recorded next. Thus the difference is the amount received. Conversely, when the quantity of product delivered is being determined, the sequence must be reversed; that is, “full load reference” first, and “no load reference” next. If a system does not have this dual capability, it can be considered appropriate only for service consistent with its design.

OWM believes it is important that these same three principles listed above be applied today to systems that weigh a single bulk commodity in repeated, automatic drafts. This especially holds true for weighing any commodity where some residual product is likely to remain inside the load-receiving element (e.g., the hopper) after the discharge cycle has been completed. Certain types of products being weighed will inherently cling to the vessel in which they are contained, thus, preventing complete product discharge. There is no way to predict how much residual product will remain after each weighing/discharge cycle; that is, the amount will likely change with each discharged load and be reflected as a persistent change in the zero-load balance. The most accurate way to account for this remaining product is to require the no-load starting reference be recorded and taken into account in the calculation of each draft load. Rezeroing the scale to account for these changes should not be considered an option because such action would result in inaccurate net weight determinations. That is, if residual product remains after a weighed load has been discharged and its weight then zeroed off before the next load to be weighed is added, any difference in the amount of residual product remaining after that next load is discharged will not be accounted for in the net weight of that load. For example, if 20 lb of residual product left remaining in a weigh hopper were zeroed off to start a new draft load and 1000 lb of product was then added to the hopper and weighed, a 10 lb weighing error would result if, when the load was discharged, 10 lb of residual product remained. When multiple draft loads are weighed to achieve some targeted load, such as is usually the case with ABWSs, rezeroing the scale to account for zero-load balance changes at the start of each draft load will result in cumulative errors affecting the entire load. In such applications, an automatic bulk weighing system is required.

The remaining two principles adopted in 1981 relate to the proposals in a less significant degree, but are copied below for reference.

4. Other Design Considerations. – There are, of course, other design and operating characteristics that must be considered in determining the appropriateness of these systems. A check list has been developed by FGIS which is as complete as circumstances allow and this information will be included in the checklist developed for the National Type Approval Task Force as soon as possible.
5. Test Procedures. – The test of this equipment must follow the principles expressed in NIST Handbook 112; that is, “A precise operation based upon proven standards and so conducted as to duplicate, as nearly as practicable, service conditions of operation.”

It is the device application that differentiates a scale used in a batching system from one used in an ABWS and, therefore, determines the appropriate NIST Handbook 44 codes that apply. In a batching operation, more than one product is weighed and/or measured and mixed together to form a batch (hence the name). A batching system typically consists of weighing elements (e.g., one or more weigh hoppers) that facilitate multiple individual weighments of different ingredients that ultimately get mixed together to form a product mix (or recipe). The system may be comprised of one or more commercial weighing and/or measuring devices. Each new draft load must be initiated from a zero-load balance condition. That is, the weighing process for each draft of a targeted load must start with the weighing/load-receiving element empty and the scale indicating zero (i.e., a correct zero-load balance condition). The Scales Code and General Code apply to the scales used in a batching operation. In contrast, an ABWS weighs a single commodity in successive drafts of predetermined amounts and automatically records the no-load starting reference and loaded weight values, accumulating the net weight of each draft. The no-load starting reference for each draft is most oftentimes a value other than zero and must be recorded by the system (as required by the ABWS Code of NIST Handbook 44). Only when the application of the system is understood can a determination of type of device be made and the appropriate NIST Handbook 44 code applied.

A review of existing NTEP CCs for scale system controllers used in bulk weighing operations shows inconsistent terms used to identify them: Batching Controller; Bulkweighing System, Scale System Controller (Concrete/Asphalt Batching System Controller, Digital Electronic); etc. Coupled with information appearing in the “Application” portion of the CC leaves questionable whether some of these scale system controllers were evaluated for use in a batching operation, an ABWS operation, or both. Not knowing whether these inconsistencies might have been part of the reason, which ultimately led to this proposal, NTEP may wish to consider a review of existing CCs to determine whether additional information might be needed to identify the intended application(s) as well as providing additional guidance to the NTEP weighing evaluators regarding completion of future CCs.

The Committee agreed to Withdraw these items in consideration of the comments and analysis that were provided. In discussing the issue, the Committee agreed that residual product left remaining in a weigh hopper following the discharge of product that is weighed automatically in repeated drafts could cause significant error in the weighing result of the summed total for all drafts. In reaching its decision to Withdraw these items, the Committee considered the weighing application for which the proposals were intended to address. That is, the Committee considered the density and cost of the products (seeds) being weighed and their propensity to clinging to the sides of a hopper when being discharged after weighing. The Committee felt, in the case of some seeds, especially seed types that are lightweight, not all of the weighed seed would necessarily be discharged when the hopper is emptied following completion of a weighing cycle. This being the case, the Committee was concerned that significant weighing errors could result from automatic operation of the system. The Committee recognized there are some applications (e.g., the weighing of stone, etc.) in a batching operation where, due to the weight and physical characteristics of the product being weighed, there is a presumed likelihood that all product would be discharged from a hopper following completion of each weighing cycle. In such applications, the no-load reference would not need to be recorded since the scales being used in these applications would presumably start on zero at the start of each new draft load to be weighed. The Scales Code would apply to the scales used in these batching systems and officials could and should confirm as part of their official examination of the system, that the scales return to zero each time a load is discharged from the weigh hopper. (*NIST Technical Advisor’s Note: The Committee’s acknowledgement that the Scales Code would apply is in recognition of the following reminder appearing in Agenda Item 304-3 of the 1985 NCWM Final Report of the S&T Committee: “The Committee reminds the Conference that this code (i.e., the ABWS Code) does not apply to batching systems, for which the Scale Code applies.”*) The Committee also considered whether or not it

was appropriate to add the term “batching system” to various device codes in NIST Handbook 44 as proposed when there are no requirements in any of those codes that apply specifically to batching systems. The Committee saw no benefit to adding the term and was concerned that by doing so, it could lead to confusion.

An action suggested by the Committee is that NTEP review all existing CCs issued for a scale system controller to confirm the application(s) for which they were evaluated and ensure those applications are clearly specified on the CC.

**Regional Association Meetings:**

SWMA 2014 Annual Meeting: The SWMA did not hear any comments in opposition to this item during its 2014 Annual Meeting. The Committee revised the proposed language to clarify, but not change the intent. SWMA suggested that the NCWM S&T Committee may wish to consider merging Agenda Items 320-1; 324-1; 330-1; and 360-1 as they are all related. Comments were heard for all four of these agenda items at the same time. SWMA forwarded the item to NCWM recommending it as a Voting item as amended below.

**A.1. General.** – This code applies to all types of weighing devices, including non-automatic batching systems. This code does not apply to other than automatic bulk-weighing systems, belt-conveyor scales, and automatic weighing systems. The code comprises requirements that generally apply to all weighing devices, and specific requirements that are applicable only to certain types of weighing devices.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**320-2 VC T.N.3.5. Separate Main Elements.**

(This item was Adopted.)

**Source:**

Ohio NTEP Laboratory (2015)

**Purpose:**

Improve uniformity in how the tolerance is applied by providing clarification of the intent.

**Item Under Consideration:**

Amend NIST Handbook 44, Scales Code as follows:

**T.N.3.5. Separate Main Elements: Load Transmitting Element, Indicating Element, Etc.** – If a main element separate from a complete weighing device is submitted for laboratory type evaluation, the tolerance for the main element is 0.7 that for the complete weighing device. This fraction includes the tolerance attributable to the testing devices used.

(Amended 2015)

**Background/Discussion:**

The submitter wants to distinguish the difference between laboratory testing and field testing to eliminate any confusion as to what tolerance to apply. The word “laboratory” is not implied in the current wording. As worded, there are differences in opinions as to the intent on this paragraph. This proposal would improve uniformity in all NTEP evaluations. The Ohio NTEP Laboratory has held field evaluations to 0.7 tolerance in the past.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee considered the following proposal intended to provide additional clarification regarding the application of Scales Code paragraph T.N.3.5. Separate Main Elements: Load Transmitting Element, Etc.:

**T.N.3.5. Separate Main Elements: Load Transmitting Element, Indicating Element, Etc.** – If a main element separate from a **complete** weighing device is submitted for **laboratory** type evaluation, the tolerance for the **main** element is 0.7 that for the complete weighing device. This fraction includes the tolerance attributable to the testing devices used.

The SMA supported this item but recommended the word “laboratory” be removed noting that type evaluations are performed both in the field and laboratory. Ms. Fran Elson-Houston (Ohio), submitter of the item, agreed with the removal of the word “laboratory” from the proposal.

In discussing this item, the Committee felt the proposed changes would help improve understanding of the paragraph, but also agreed that the word “laboratory” should be deleted from the proposal. Consequently, the Committee agreed to recommend this item for Vote absent the word “laboratory” as follows:

**T.N.3.5. Separate Main Elements: Load Transmitting Element, Indicating Element, Etc.** – If a main element separate from a **complete** weighing device is submitted for type evaluation, the tolerance for the **main** element is 0.7 that for the complete weighing device. This fraction includes the tolerance attributable to the testing devices used.

#### **2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: Ms. Elson-Houston recommended the word “laboratory” be reinserted into the proposal before the words “type evaluation.” She commented the reduced 0.7 tolerance is not intended to apply to type evaluations performed in the field. The reduced tolerance should only be applied in controlled laboratory environments. Mr. Russ Vires (Mettler-Toledo, LLC), Mr. Steve Langford (Cardinal Scale Manufacturing Co.), and Mr. Lou Straub (Fairbanks Scales) provided comments in support of reinserting the word “laboratory” back into the paragraph. Consequently, the Committee agreed to add the word “laboratory” into the proposal and recommend the item be presented for vote as shown in Item Under Consideration.

#### **Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA received comments in support of this item. The CWMA believes this item is sufficiently developed and forwarded the item to NCWM, recommending it as a Voting item. During the 2015 CWMA Annual Meeting, the item was supported by the SMA and the item submitter, Ms. Fran Elson-Houston (Ohio), who also recommended some proposed changes to the item. The CWMA agreed to amend the proposal as recommended by Ms. Houston and forward the item to NCWM, recommending it as a Voting item. CWMA agreed to amend the item to read as follows:

**T.N.3.5. Separate Main Elements: Load Transmitting Element, Indicating Element, Etc.** – If a main element separate from a **complete** weighing device is submitted for **laboratory** type evaluation, the tolerance for the **main** element is 0.7 that for the complete weighing device. This fraction includes the tolerance attributable to the testing devices used. **If there are no means to control environmental conditions, such as a field evaluation, full acceptance tolerance would be applied to the main element.**

WWMA 2014 Annual Meeting: The WWMA did not receive testimony on this item during the Annual Meeting. The WWMA S&T Committee reported it would like additional background information and questioned whether this item would be more suited to NCWM Publication 14 rather than NIST Handbook 44. WWMA forwarded this item to NCWM and recommended that it be an Informational item.

SWMA 2014 Annual Meeting: The SWMA did not hear any comments in opposition to this item during its Annual Meeting. SWMA forwarded the item to NCWM, recommending it as a Voting item.

NEWMA 2014 Interim Meeting: NEWMA reported it believed the justifications for the item have merit and agreed to forward the item to NCWM recommending that it be a Voting item. At its 2015 Annual Meeting, NEWMA agreed to recommend the item move forward as a Voting item noting the belief that the changes would improve understanding of the paragraph.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**320-3 W Table 7a. Typical Class or Type of Device for Weighing Applications**

(This item was Withdrawn.)

**Source:**

Ohio NTEP Laboratory (2015)

**Purpose:**

Require that hopper scales less than 2000 lb, which are not grain hoppers, be class III devices and allow “special devices” greater than 30 000 lb that are not vehicle scales and not currently listed under Class III L, to be categorized as Class III L.

**Item Under Consideration:**

Amend NIST Handbook 44 Scales Code as follows:

<b>Table 7a. Typical Class or Type of Device for Weighing Applications</b>	
<b>Class</b>	<b>Weighing Application or Scale Type</b>
I	Precision laboratory weighing
II	Laboratory weighing, precious metals and gem weighing, grain test scales
III	All commercial weighing not otherwise specified, grain test scales, retail precious metals and semi-precious gem weighing, grain-hopper scales, <b>other hopper scales under 2000 lb</b> , animal scales, postal scales, vehicle on-board weighing systems with a capacity less than or equal to 30 000 lb, and scales used to determine laundry charges
III L	Vehicle scales, vehicle on-board weighing systems <b>and other special devices</b> with a capacity greater than 30 000 lb, axle-load scales, livestock scales, railway track scales crane scales, and hopper (other than grain hopper) scales
III	Wheel-load weighers and portable axle-load weighers used for highway weight enforcement
<b>Note:</b> A scale with a higher accuracy class than that specified as “typical” may be used.	

(Amended 1985, 1986, 1987, 1988, 1992, 1995, and 2012)

**Background/Discussion:**

Many small hoppers that are not grain hoppers are already receiving CCs as Class III hoppers, which does not satisfy the categories in Table 7a. There are also a few large capacity floor scales that have to meet Class III tolerances that really don’t need that level of accuracy and would benefit from being categorized as a Class III L device.

**2015 NCWM Interim Meeting:**

The SMA opposed this item and provided the following rationale for its position: This item would unnecessarily restrict applications of hopper scales or devices with capacities greater than 30 000 lb.

An official questioned why 2000 lb was selected as the proposed threshold, as opposed to some other capacity value, such as 5000 lb, and the meaning of “other special devices.”

Ms. Fran Elson-Houston (Ohio) reported that “other special devices” is intended to address a particular scale of special design (i.e., a scale designed for use in weighing rolls of coil) that had been submitted to the Ohio NTEP lab.



OWM noted that Table 7a is not a requirement, but rather identifies typical classes of devices for weighing applications. The “Note” at the bottom of the table specifies that a scale with a higher accuracy class than that specified as “typical” may be used (“higher” meaning, a level higher in the table, with Class I being the highest, and Class III the lowest). Considering this point, the table provides scale manufacturers the necessary flexibility of being able to design and build scales of similar or same capacity, but with different levels of accuracy; this enables them to meet the demands of their customers by being able to supply them with scales suitable for many different weighing applications. With regard to the two sentences shown at the beginning of the “Background/Discussion” of this item, it is incorrect to say that a small hopper scale of Accuracy Class III does not meet Table 7b considering the explanation provided in the “Note” at the bottom of the table. While the second sentence may be true, scale manufacturers designate the accuracy class for scales they manufacture. Users are required to select a scale suitable for the application and officials verify that a proper scale has been selected based on its application. In some cases, users will select a scale with a higher accuracy class than what’s needed for the application. Doing so is not a violation, but rather provides scale owners the opportunity of being able to use a scale that is more accurate than what’s required or needed. For these reasons, OWM does not believe changes are needed to the table and making them could cause unnecessary confusion.

Members of the Committee were concerned the changes proposed might cause unnecessary confusion. In recognition of the fact that Table 7a is intended to identify typical classes of weighing devices and that the “note” in Table 7a makes it permissible for a scale with a higher accuracy class than that specified as “typical” to be used (e.g., the note makes it permissible for a hopper scale under 2000 lb capacity to be classified as a Class III device), the Committee agreed to Withdraw this item from its agenda.

#### **Regional Association Meetings:**

**CWMA 2014 Interim Meeting:** The CWMA reported that an industry representative suggested that the phrase “other special devices” needs clarification. It was then suggested the wording “other special devices” be changed to “other special application scales.” Another industry representative voiced support for this change because it gives the manufactures more latitude when designing devices. The CWMA forwarded the item to NCWM recommending it as a Voting item with the following change to the proposal: change the phrase, “other special devices” to “other devices” in the box for class III.

**WWMA 2014 Annual Meeting:** The WWMA did not receive comments on this item at its 2014 Annual Meeting. The WWMA S&T Committee would like to see further clarification of “other special devices.” Further, the Committee would like consideration to be given to including hopper scales with a capacity of less than 5000 lb to better align with other weighing devices in Class III. The WWMA forwarded this item to NCWM and recommended that it be a Developing item.

**SWMA 2014 Annual Meeting:** The SWMA questioned why the proposed limit was set at 2000 lb and not 5000 lb. The Committee noted it would appreciate the SMA’s comments concerning this question. The SWMA forwarded the item to NCWM, recommending it as a Voting item.

**NEWMA 2014 Interim Meeting:** NEWMA’s S&T Committee wanted more information on the proposal, such as whether there are hopper scales over 2000 lb to consider in this item? NEWMA forwarded the item to NCWM and recommended that it be an Information item.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **320-4 VC Part 2.20. Weigh-In-Motion Vehicle Scales for Law Enforcement – Work Group**

(This item was Adopted.)

**Source:**

NIST, OWM, Mr. Richard Harshman, on behalf of the U.S. Federal Highway Administration (FHWA) (2011)

**Purpose:**

To provide the U.S. Weights and Measures community (equipment manufacturers, weights and measures officials, truck weight enforcement officials, and other users) with legal metrology requirements to address WIM systems used for vehicle enforcement screening.

**Item Under Consideration:**

Adopt the proposed Section 2.25. Weigh-In-Motion Systems Used for Vehicle Enforcement Screening Code shown in Appendix C as a tentative code in Section 2 of NIST Handbook 44, and adopt the proposed definitions of terms used in the tentative code (also included in Appendix C) into NIST Handbook 44, Appendix D – Definitions.

**Background Discussion:**

The nation's highways, freight transportation system, and enforcement resources are being strained by the volume of freight being moved and the corresponding number of commercial vehicles operating on its roads. Traditional, static-based vehicle inspection activities simply cannot keep pace with anticipated truck volume increases. Current U.S. Department of Transportation (DOT) forecasts project freight volumes to double by 2035 and commercial vehicles to travel an additional 100 billion miles per year by 2020. WIM technology has been targeted by FHWA and Federal Motor Carrier Safety Administration (FMCSA) as a technology capable of supporting more effective and efficient truck weight enforcement programs.

Several DOT efforts are underway and planned for the future to maintain adequate levels of enforcement that ensure equity in the trucking industry market and protection of highway infrastructure. Judicial support for enforcement decisions to apply more intense enforcement actions on specific trucks depends on support from the U.S. legal metrology community. Standards are needed in NIST Handbook 44 to address the design, installation, accuracy, and use of WIM systems used in a screening/sorting application. The implementation of a uniform set of standards will greatly improve the overall efficiency of the nation's commercial vehicle enforcement process.

Once adopted by the truck weight enforcement community, these requirements will enhance the accuracy of the nation's WIM scale systems; serve as a sound basis for judicial support of next-generation truck weight enforcement programs; and result in fewer legally loaded vehicles being delayed at static weigh station locations, thus, reducing traffic congestion and non-productive fuel consumption and improving the movement of freight on our nation's roadways.

**Purpose of the Project:**

The FHWA's Office of Freight Management and Operations recognized a need to encourage uniformity in the design, testing, installation, and performance of WIM technology and subsequently encourage acceptance by prosecution agencies (administrative or judicial) regarding the validity of WIM technology's role in supporting commercial motor vehicle weight enforcement.

In response to this need and recognizing the value of having a standard included in NIST Handbook 44 because it lends integrity and is more recognizable in legal actions, the FHWA seeks to integrate requirements for WIM technology into the Handbook. The FHWA contracted the services of the Texas Transportation Institute of the Texas A&M University System and Battelle (a private company) to begin this process. Additionally, a small oversight Committee was formed by the FHWA made up of three representatives from the FHWA, NIST, and a U.S. manufacturer of WIM equipment to validate that each contract deliverable is completed according to contract. NIST, OWM also agreed to provide a Technical Advisor to the associated work group (WG) tasked with development of the proposed code.

The intended application of the proposed new code is for screening purposes only (i.e., for screening/sorting commercial vehicles for possible violations of vehicle weight requirements).

To view a detailed summary on the progress of this project since its inception in December 2011 through 2012, refer to “Timeline of Completed Tasks Relating to the Project” in S&T Agenda Item 360-3 in the Committee’s 2012 Final Report. Additional background information and information on the work is also included in that report.

Also see the Committee’s 2013 and 2014 Final Reports for additional details and background information relating to the development of a new NIST Handbook 44 device code applicable to weigh-in-motion systems used for vehicle enforcement screening.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Ms. Tina Butcher (OWM) thanked the WIM WG for providing fair consideration of OWM’s many comments, which were provided throughout the different revisions of the draft code. She noted that although the process of developing the draft code may have taken longer than some had originally anticipated, the additional time taken had proven to be of benefit because it allowed for greater discussion and understanding of some of the more complex issues concerning WIM systems. OWM believes the Work Group has presented a draft code that is ready to be adopted and placed into NIST Handbook 44 as a tentative code. OWM encouraged the use of the code, especially while in a tentative status, to help identify any remaining concerns. OWM also pointed out that the Section number designation “2.20.” prefacing the title of this item is incorrect. The proposal is to add a tentative code into Section 2 of NIST Handbook 44 and not Section 2.20.

Mr. Langford, speaking on behalf of the SMA, stated that the SMA continues to support the efforts of the WG and recommends a July Vote on the final draft of the code.

In consideration of the comments provided in support of the item, the Committee agreed to recommend it move forward for Vote.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee heard several comments in support of adding a new tentative code titled “Weigh-In-Motion Systems Used for Vehicle Enforcement Screening Code” to NIST Handbook 44. Mr. Steve Langford (Cardinal Scale Manufacturing Co.) commented that he was a member of the FHWA Project Oversight Committee and, as such, commended the WIM WG for its great work in developing the code. He reported Cardinal Scale Manufacturing Co. manufactures in-motion vehicle scale systems and that the code is needed from a manufacturer’s standpoint. Mr. Lou Straub (Fairbanks Scales) also commented in support of adopting the draft as a tentative code.

Ms. Kristin Macey (California) voiced support for the code, but questioned how the tolerances in Section 2.2. of the draft code were determined. Mr. Darrell Flocken (NCWM and Chairman of the WIM WG) in answering her question indicated the tolerances were recommended by the WIM manufacturers participating on the WG. The WIM manufacturers already have WIM systems in operation and the tolerances in Section 2.2. were based on the accuracy that could be expected from them. Ms. Fran Elson-Houston (Ohio) also voiced support for the code.

Ms. Butcher stated that OWM encourages adoption of the draft as a tentative code. It includes the necessary components to:

- Improve uniformity and consistency in the inspection and testing of WIM vehicle scales used in law enforcement applications throughout the country;
- Reduce vehicles operating within legal load limits from being unnecessarily detained for static weighing; and
- Improve the flow of freight, a key reason for the code’s development.

Ms. Butcher noted that weights and measures agencies are not the only ones who will use this code. Federal, state, and local agencies responsible for highway weight enforcement, traffic monitoring, and pavement design will also use

the code. Some already use NIST Handbook 44 for static vehicle scales and are looking to include WIM requirements to provide the same credibility and uniformity as other NIST Handbook 44 requirements. OWM encourages these agencies to provide feedback on refinements needed as they begin using the code.

The Committee agreed to recommend the item be presented for Vote as shown in Item Under Consideration, hearing numerous comments in support of the proposal and no comments in opposition.

**Regional Association Meetings:**

**CWMA 2014 Interim Meeting:** The CWMA reported that a regulatory official commented that these devices may not be under Weights and Measures jurisdiction. CWMA forwarded the item to NCWM, recommending it as an Information item. During the 2015 CWMA Annual Meeting Open Hearings, the SMA, industry representatives, and officials voiced support of the proposal, and there were no comments made in opposition. Consequently, the CWMA agreed to recommend the item be forwarded to the NCWM as a Voting item.

**WWMA 2014 Annual Meeting:** Testimony was presented in support of this item moving forward as a Voting item and several felt that it is sufficiently developed. The WWMA supports this item and looks forward to it being presented on the 2015 NCWM Annual Meeting Agenda. WWMA recommends that this item be a Voting item.

**SWMA 2014 Annual Meeting:** The SWMA did not hear any comments in opposition to this item. The Committee recognizes the interest by the community to further develop this item and recommended that it be a Developing item.

**NEWMA 2014 Interim Meeting:** NEWMA received comment that new information will be forthcoming from the WIM group in January 2015; the Committee recommended that the item remain Developing. During NEWMA's 2015 Annual Meeting, the SMA supported the item, and there were no comments received in opposition. Consequently, NEWMA recommended the item move forward as a Voting item.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

## **321 BELT-CONVEYOR SCALE SYSTEMS**

### **321-1 VC A.1. General.**

(This item was Adopted.)

**Source:**

U.S. National Work Group on Belt-Conveyor Scales (2015)

**Purpose:**

Expand the application of the Belt-Conveyor Scale (BCS) Systems Code to include weigh-belt systems to ensure that they are held to proper standards.

**Item Under Consideration:**

Amend NIST Handbook 44, BCS Systems Code as follows:

**A.1. General.** – This code applies to belt-conveyor scale systems and weigh-belt systems used for the weighing of bulk materials

(Amended 2015)

**Background/Discussion:**

The USNWG for BSC has identified gaps in multiple locations within the NIST Handbook 44, BCS Systems Code that would not allow a typical “weigh-belt system” type of design to be appropriately covered by the requirements found in this code. The USNWG has developed a number of proposals to amend each of these requirements so that

weigh-belt systems will be in compliance with them. Paragraph A.1. is the first in this series of proposed changes. This proposed change expressly states that the NIST Handbook 44, BCS Systems Code will also apply to “weigh-belt systems.”

NIST Handbook 44, BCS Systems Code language that existed prior to 2001 provided an exemption for BCS systems designed and furnished by the manufacturer from requirements that concerned the details of installation of BCS systems. Generally, weigh-belt systems are designed and built by the manufacturer as a unit and are, therefore, less likely to be susceptible to malfunctions or operational defects directly caused by a variance from the manufacturer’s intended installation specifications. This is in contrast to BCS systems that are typically installed as separate components (conveyor, weighing system, belt loading system, speed sensor, etc.) within an existing conveyor system where the details of the installation for each component may greatly influence the performance of other components in the system. That language (which has since been deleted) is shown below:

**UR.2.2.1. For Scales Not Installed by the Manufacturer.** – Unless the scale is installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications, the conveyor shall comply with the following minimum requirements:

...\*

(Amended 1998)

\*The subparagraphs that followed, UR.2.2.1.(a) through (j), consisted of requirements addressing specific criteria related to design and installation of the conveyor system.

The deletion of the statement: “installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications” created a situation where all BCS systems that were covered by the NIST Handbook 44, BCS Code were to meet requirements that included: specific limitations on the location of conveyor components in relation to the weighing element; specific limits on the length of the conveyor; and the type of take-up device used in the system. Due to the design and construction of typical weigh-belt systems, this type of device was not able to comply with these requirements largely due to the size, placement, and location of components in a weigh-belt type of system and the distances required between those components and the weighing elements.

USNWG members have agreed that it is important not to impose prescriptive requirements, which may restrict innovation in the design of this type of device. Requirements that place limitations on the placement of components in a conveyor system in relation to the weighing device and to each other are viewed as being arbitrary and may be invalid if the design of a system is shown to operate within performance requirements regardless of the configuration of its components.

BCS manufacturers who are members of the USNWG reported a demand from various clients for relatively compact weigh-belt type of systems to be used as a commercial device. However, unless the NIST Handbook 44 BCS Code is amended to allow for their unique design characteristics, there was not an appropriate code in NIST Handbook 44 to apply to weigh-belt systems. The USNWG, therefore, has developed a number of proposed changes throughout the existing BCS Systems Code to adapt these requirements so that they may be applied to weigh-belt systems as well.

#### **2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 321-1 through 321-8 were grouped together and comments taken simultaneously as the Committee considered them all related. Ms. Tina Butcher (OWM) spoke in support of this item. She stated that NIST Handbook 44 included certain exceptions for installations of BCS systems installed under close supervision and control of the scale system manufacturer (prior to 2001). Ms. Butcher went on to state that it would be appropriate to reinstate these exemptions for the weigh-belt systems, as recognized by this item and she concurred these items should be grouped together (with perhaps the exception being Item 321-6) and designated as Voting. Item 321-6 is different in that the item does not relate to the inclusion of the term “weigh-belt systems” into the BCS Systems Code of NIST Handbook 44. Mr. Steve Langford representing the Scale Manufacturer's Association stated the SMA had no position on these items.

In consideration of the comments provided the Committee agreed to recommend this item for Vote.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: At the Open Hearings, the Committee announced it was grouping Agenda Items 321-1 through 321-8 together and taking comments on all simultaneously.

Mr. Russ Vires (Mettler-Toledo, LLC) speaking on behalf of the SMA reported the SMA supports the Committee's grouping of the items and supports all of the items in the group.

Ms. Butcher noted that Item 321-6 doesn't fall under the same umbrella as the other items in the batch because, unlike the other items, it is not related to the inclusion of "weigh belts" into the BCS Systems Code; however, OWM would still support grouping all the items together. She also thanked the Committee for accepting OWM's changes to Item 321-6 and explained that the USNWG on BCSs had concurred with OWM's proposed changes to this item following the 2015 NCWM Interim Meeting.

Hearing no comments in opposition and in consideration that these items were developed and being recommended by the USNWG on BCSs, the Committee agreed to present Items 321-1 through 321-8 for Vote, each without change as shown in Item Under Consideration.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA received a comment from a regulatory official who agreed with the necessity of this requirement. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to NCWM, recommending it as a Voting item. At the 2015 CWMA Annual Meeting, the CWMA recommended the item be forwarded to the NCWM as a Voting item since there were no opposing comments and the item was supported by the SMA.

WWMA 2014 Annual Meeting: Testimony was presented in support of this item and moving it to a Voting status. The WWMA S&T Committee agreed that it was sufficiently developed and recommended that 2014 WWMA S&T Agenda Items 321-1, 321-2, 321-3, 321-4, 321-5, 321-6, 321-7, and 321-8 be combined into one proposal. The WWMA agreed and forwarded this item to NCWM and recommended that it be a Voting item.

SWMA 2014 Annual Meeting: The SWMA recommended Items 321-1 through 321-8 be combined into one agenda item since they are all related to BCS. Comments were heard on all eight of these agenda items at the same time. The SMWA forwarded this item to the NCWM and recommended that it be a Voting item.

NEWMA 2014 Interim Meeting: NEWMA supported the recommendations of the USNWG on BCSs since the majority of these devices are located outside of the northeast region. NEWMA forwarded the item to the NCWM and recommended that it be a Voting item. During the 2015 NEWMA Annual Meeting, NEWMA's S&T Committee agreed to group together Agenda Items 321-1 through 321-8 and take comments simultaneously. The SMA supported all items in the group. NEWMA agreed to recommend all items in the group move forward as Voting items.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**321-2 VC S.4. Marking Requirements.**

(This item was Adopted.)

**Source:**

U.S. National Work Group on Belt-Conveyor Scales (BCS) (2015)

**Purpose:**

Add "weigh-belt systems" to the code and also create a new marking requirement to provide an accurate representation of the actual belt speed on systems that may operate at more than one speed. This information is needed to ensure that the system is operated within limitations of its ability to maintain accuracy and for testing purposes.

**Item Under Consideration:**

Amend NIST Handbook 44, BCS Systems Code as follows:

**S.4. Marking Requirements.** – ~~A-b~~**Belt-conveyor scales and weigh-belt systems** shall be marked with the following: (Also see also G-S.1. Identification.)

- (a) the rated capacity in units of weight per hour (minimum and maximum);
- (b) the value of the scale division;
- (c) the belt speed in terms of feet (or meters) per minute at which the belt will deliver the rated capacity, or the maximum and minimum belt speeds at which the conveyor system will be operated for variable speed belts;
- (d) the load in terms of pounds per foot or kilograms per meter (determined by materials tests); and
- (e) *the operational temperature range if other than – 10 °C to 40 °C (14 °F to 104 °F).*  
[Nonretroactive as of January 1, 1986]

**(Amended 2015)****Background/Discussion:**

Many belt-conveyor type of scale systems have the capability to operate at more than one belt speed setting or have the ability to operate using a variable belt speed. Since the weighing operation in a BCS system is dependent upon the belt speed (as a critical performance factor), it is important that the speed at which the belt travels be accounted for during an evaluation of the system. Changes in the speed of belt travel can result in significant changes to the performance of the weighing system, therefore, the requirement for the marking of belt speed on the device is significant.

In spite of the maximum capacity for which a conveyor system is designed, belt speed at which the system will be operated will be primarily determined by characteristics of components that comprise the entire system. Generally, the belt speed will be adjusted to a maximum setting that will permit optimal output of the system, but also so that the individual components in the system are not overloaded with the flow of material. In addition, on systems where different materials are weighed, the belt speed may be adjusted to accommodate the physical characteristics of different types of materials. Therefore, the speed setting at which the conveyor belt is operated at may vary in accordance with these considerations and the USNWG on BCSs agreed that this variation should be reflected in the marking of the belt speed(s) which will be used.

NIST Handbook 44, BCS Systems Code language that existed prior to 2001 provided an exemption for BCS systems designed and furnished by the manufacturer from requirements that concerned the details of installation of BCS systems. Generally, weigh-belt systems are designed and built by the manufacturer as a unit and are, therefore, less likely to be susceptible to malfunctions or operational defects directly caused by a variance from the manufacturer's intended installation specifications. This is in contrast to BCS systems that are typically installed as separate components (conveyor, weighing system, belt loading system, speed sensor, etc.) within an existing conveyor system where the details of the installation for each component may greatly influence the performance of other components in the system. That language which has since been deleted is shown below:

**UR.2.2.1. For Scales Not Installed by the Manufacturer.** – Unless the scale is installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer's specifications, the conveyor shall comply with the following minimum requirements:

...\*

(Amended 1998)

\*The subparagraphs that followed, UR.2.2.1.(a) through (j), consisted of requirements addressing specific criteria related to design and installation of the conveyor system.

The deletion of the statement: "installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer's specifications" created a situation where all BCS systems that were covered by the NIST

Handbook 44, BCS Code were to meet requirements that included specific limitations on the location of conveyor components in relation to the weighing element; specific limits on the length of the conveyor; and the type of take-up device used in the system. Due to their typical design and construction, weigh-belt systems were generally not able to comply with these requirements; this was largely due to the size, placement, and location of components in a weigh-belt type of system and the distances required between those components and the weighing elements.

The USNWG members have agreed that it is important not to impose prescriptive requirements, which may restrict innovation in the design of this type of device. Requirements that place limitations on the placement of components in a conveyor system in relation to the weighing device and to each other are viewed as being arbitrary and may be invalid if the design of a system is shown to operate within performance requirements regardless of the configuration of its components.

BCS manufacturers who are members of the USNWG reported a demand from various clients for relatively compact weigh-belt type of systems to be used as a commercial device. However, unless the NIST Handbook 44, BCS Code is amended to allow for their unique design characteristics, there was not an appropriate code in NIST Handbook 44 to apply to weigh-belt systems. Therefore, the USNWG has developed a number of proposed changes throughout the existing BCS Systems Code to adapt these requirements so that they may be applied to weigh-belt systems as well.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 321-1 through 321-8 were grouped together and comments taken simultaneously as the Committee considered them all related. Ms. Tina Butcher (OWM) spoke in support of this item. She stated that NIST Handbook 44 included certain exceptions for installations of BCS systems installed under close supervision and control of the scale system manufacturer (prior to 2001). Ms. Butcher went on to state that OWM believes it would be appropriate to reinstate these exemptions for the weigh-belt systems as recognized by this item and concurs that these items should be grouped together (with perhaps the exception being Item 321-6) and designated as Voting. Item 321-6 is different in that the item does not relate to the inclusion of the term “weigh-belt systems” into the BCS Systems Code of NIST Handbook 44. Mr. Steve Langford representing the Scale Manufacturer's Association stated the SMA had no position on these items.

In consideration of the comments provided, the Committee agreed to recommend this item for Vote.

**NCWM 2015 Annual Meeting:**

NCWM 2015 Annual Meeting: At the Open Hearings, the Committee grouped Agenda Items 321-1 through 321-8 together and took comments on all simultaneously. See Agenda Item 321-1 for a summary of the comments heard on these items.

Hearing no comments in opposition and in consideration that these items were developed and being recommended by the USNWG on BCSs, the Committee agreed to present Items 321-1 through 321-8 for Vote, each without change as shown in Item Under Consideration.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA received a comment during the Interim Meeting from a regulatory official who agreed with the necessity of this requirement. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to the NCWM, recommending it as a Voting item. At its 2015 Annual Meeting, the CWMA recommended the item be forwarded to the NCWM as a Voting item since there were no opposing comments and the item was supported by the SMA.

WWMA 2014 Annual Meeting: Testimony was presented in support of this item and moving it to a Voting Status. The WWMA S&T Committee agreed that it was sufficiently developed and recommended that 2014 WWMA S&T Agenda Items 321-1, 321-2, 321-3, 321-4, 321-5, 321-6, 321-7, and 321-8 be combined into one proposal. The WWMA forwarded this item to NCWM and recommended that it be a Voting item.

SWMA 2014 Annual Meeting: The SWMA recommended, at its Annual Meeting, Items 321-1 through 321-8 be combined into one agenda item since they are all related to BCSs. Comments were heard on all eight of these agenda items at the same time. The SMWA forwarded this tem to the NCWM and recommended that it be a Voting item.



NEWMA 2014 Interim Meeting: NEWMA supported the recommendations of the USNWG on BCSs since the majority of these devices are located outside of the northeast region. NEWMA forwarded the item to the NCWM and recommended that it be a Voting item. During the 2015 NEWMA Annual Meeting, NEWMA's S&T Committee grouped together Agenda Items 321-1 through 321-8 and took comments simultaneously. The SMA supported all items in the group. NEWMA agreed to recommend all items in the group move forward as Voting items.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### 321-3 VC N.2.1. Initial Verification.

(This item was Adopted.)

**Source:**

U.S. National Work Group on Belt-Conveyor Scales (BCS) (2015)

**Purpose:**

Include "weigh-belt systems" in the test note. Also, clearly identify how many tests are to be performed and the specific settings at which they will be conducted. Provide specific testing guidance according to the configuration of the system and to clarify the required procedures.

**Item Under Consideration:**

Amend NIST Handbook 44, BCS Systems Code as follows:

**N.2.1. Initial Verification.** – A belt-conveyor scale system or a weigh-belt system shall be ~~verified with tested using~~ a minimum of two test runs performed at each ~~of the following flow rates: setting for belt speed/belt loading as indicated in Table N.2.1.~~

- ~~(a) normal use flow rate;~~
- ~~(b) 35 % of the maximum rated capacity; and~~
- ~~(c) an intermediate flow rate between these two points.~~

Results of the individual test runs in each pair of tests shall not differ by more than the absolute value of the tolerance as specified in T.2. Tolerance Values, Repeatability Tests. All tests shall be within the tolerance as specified in T.1. Tolerance Values.

Test runs may also be conducted at any other rate of flow that may be used at the installation. A minimum of four test runs may be conducted at only one flow rate if evidence is provided that the system is used at a single flow rate constant speed/constant loading setting and that rate does not vary in either direction by an amount more than 10 % of the normal flow rate that can be developed at the installation for at least 80 % of the time.

<b><u>Table N.2.1.</u></b> <b><u>Initial Verification</u></b>		
<b><u>Device Configuration</u></b>	<b><u>Minimum of Two Test Runs at Each of the Following Settings</u></b>	<b><u>Total Tests (Minimum)</u></b>
<b><u>Constant belt speed/Variable loading</u></b>	<ul style="list-style-type: none"> <li>– <b><u>belt loading: high (normal)</u></b></li> <li>– <b><u>belt loading: medium (intermediate)</u></b></li> <li>– <b><u>belt loading: low (35 %)</u></b></li> </ul>	<b><u>6</u></b>
<b><u>Variable belt speed/Constant loading</u></b>	<ul style="list-style-type: none"> <li>– <b><u>belt speed: maximum</u></b></li> <li>– <b><u>belt speed: medium</u></b></li> <li>– <b><u>belt speed: minimum</u></b></li> </ul>	<b><u>6</u></b>
<b><u>Variable belt speed/Variable loading</u></b>	<ul style="list-style-type: none"> <li>– <b><u>speed: maximum/belt loading: high (normal)</u></b></li> <li>– <b><u>speed: maximum/belt loading: medium (intermediate)</u></b></li> <li>– <b><u>speed: maximum/belt loading: low (35 %)</u></b></li> <li>– <b><u>speed: minimum/belt loading: high (normal)</u></b></li> <li>– <b><u>speed: minimum/belt loading: medium (intermediate)</u></b></li> <li>– <b><u>speed: minimum/belt loading: low (35 %)</u></b></li> </ul>	<b><u>12</u></b>
<p><b><u>Use the device configurations in the left-hand column to identify the scale being tested.</u></b></p> <p><b><u>Perform two test runs (minimum) at each of the settings shown in the center column.</u></b></p> <p><b><u>The following terminology applies:</u></b></p> <ul style="list-style-type: none"> <li>• <b><u>High: maximum (normal use) operational rate.</u></b></li> <li>• <b><u>Low: 35 % of the maximum rated capacity of the system.</u></b></li> <li>• <b><u>Medium: an intermediate rate between the high and low settings.</u></b></li> </ul>		

(Table Added 2015)

(Added 2004) (Amended 2009 and 2015)

**Background/Discussion:**

Existing paragraph N.2.1. specifically references “BCS system” in the opening sentence, but does not mention “weigh-belt systems.” The USNWG on BCSs agreed that given this omission of the term “weigh-belt system,” this type of system would be excluded from the NIST Handbook 44, BCS Systems Code. The proposed changes, therefore, include the addition of “weigh-belt systems” in this sentence.

In addition, the current language used in N.2.1. does not take into consideration that on some conveyor systems there can be two separate means to adjust the rate of product flow across the weighing device. The flow of material onto the belt may be increased at the loading point, which will result in a higher weight per unit of belt length. This may result in an increased rate of material flow across the weighing device, or the speed of belt travel may simply be increased, which will also result in an increase of material flow rate.

At its February 2014 meeting, the USNWG on BCSs reached a consensus that testing should include the variation of product flow through the adjustment of: 1) the rate at which the material is loaded on to the belt and 2) the belt speed, where the system has a means for such adjustment. The existing language does not provide specific instruction needed to adequately evaluate systems that may normally operate at more than one belt speed and are equipped with means

to adjust the flow of material by either adjusting the speed of the belt or the flow of material at the loading point on the belt.

The proposed amendments to N.2.1. and the accompanying Table N.2.1. will clearly identify how many tests are to be performed and at what specific settings they will be conducted. These proposed changes are intended to provide specific testing guidance according to the configuration of the system and to clarify the required procedures.

NIST Handbook 44, BCS Systems Code language that existed prior to 2001 provided an exemption for BCS systems designed and furnished by the manufacturer from requirements that concerned the details of installation of BCS systems. Generally, weigh-belt systems are designed and built by the manufacturer as a unit and are, therefore, less likely to be susceptible to malfunctions or operational defects directly caused by a variance from the manufacturer's intended installation specifications. This is in contrast to BCS systems that are typically installed as separate components (conveyor, weighing system, belt loading system, speed sensor, etc.) within an existing conveyor system where the details of the installation for each component may greatly influence the performance of other components in the system. That language which has since been deleted is shown below:

**UR.2.2.1. For Scales Not Installed by the Manufacturer.** – Unless the scale is installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer's specifications, the conveyor shall comply with the following minimum requirements:

...\*

(Amended 1998)

\*The subparagraphs that followed, UR.2.2.1.(a) through (j), consisted of requirements addressing specific criteria related to design and installation of the conveyor system.

The deletion of the statement: "installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer's specifications" created a situation where all BCS systems that were covered by the NIST Handbook 44, BCS Code were to meet requirements that included: specific limitations on the location of conveyor components in relation to the weighing element; specific limits on the length of the conveyor; and the type of take-up device used in the system. Due to their typical design and construction, weigh-belt systems were not generally able to comply with these requirements; this was largely due to the size, placement, and location of components in a weigh-belt type of system and the distances required between those components and the weighing elements.

USNWG members have agreed it is important not to impose prescriptive requirements, which may restrict innovation in the design of this type of device. Requirements that place limitations on the placement of components in a conveyor system in relation to the weighing device and to each other are viewed as being arbitrary and may be invalid if the design of a system is shown to operate within performance requirements regardless of the configuration of its components.

BCS manufacturers who are members of the USNWG reported a demand from various clients for relatively compact weigh-belt type of systems to be used as a commercial device. However, unless the NIST Handbook 44, BCS Code is amended to allow for their unique design characteristics, there was not an appropriate code in NIST Handbook 44 to apply to weigh-belt systems. Therefore, the USNWG has developed a number of proposed changes throughout the existing BCS Systems Code to adapt these requirements so that they may be applied to weigh-belt systems as well.

### **2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 321-1 through 321-8 were grouped together and comments taken simultaneously since the Committee considered them all related. Ms. Tina Butcher (OWM) spoke in support of this item. She stated that NIST Handbook 44 included certain exceptions for installations of BCS systems installed under close supervision and control of the scale system manufacturer (prior to 2001). Ms. Butcher went on to state that OWM believes it would be appropriate to reinstate these exemptions for the weigh-belt systems, as proposed by this item. She concurred these items should be grouped together (with perhaps the exception of Item 321-6) and designated as Voting; however, she noted that Item 321-6 is different in that the item does not relate to the addition of the term "weigh-belt systems" into the BCS Systems Code of NIST Handbook 44. Mr. Steve Langford representing the Scale Manufacturer's Association stated the SMA had no position on these items.

In consideration of the comments provided the Committee agreed to recommend this item for a Vote.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: Open Hearings, the Committee announced it was grouping Agenda Items 321-1 through 321-8 together and taking comments on all simultaneously. See Agenda Item 321-1 for a summary of the comments heard on these items.

Hearing no comments in opposition and in consideration that these items were developed and recommended by the USNWG on BCSs, the Committee agreed to present Items 321-1 through 321-8 for Vote, each without change as shown in the Item Under Consideration.

**Regional Association Meetings:**

Interim 2014 Meeting: The CWMA received a comment from a regulatory official who agreed with the necessity of this requirement. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to the NCWM, recommending it as a Voting item. At the 2015 CWMA Annual Meeting, the CWMA recommended the item be forwarded to NCWM as a Voting item since there were no opposing comments and the item was supported by the SMA.

WWMA 2014 Annual Meeting: Testimony was presented in support of this item and moving it to a Voting status. The WWMA S&T Committee agreed that it was sufficiently developed and recommended that 2014 WWMA S&T Agenda Items 321-1, 321-2, 321-3, 321-4, 321-5, 321-6, 321-7, and 321-8 be combined into one proposal. The WWMA forwarded this item to NCWM and recommended that it be a Voting item.

SWMA 2014 Annual Meeting: The SWMA recommended Items 321-1 through 321-8 be combined into one agenda item since they are all related to BCSs. Comments were heard on all eight of these agenda items at the same time. The SMWA forwarded this item to the NCWM and recommended that it be a Voting item.

NEWMA Interim 2014 Meeting: NEWMA supported the recommendations of the USNWG on BCSs since the majority of these devices are located outside of the northeast region. NEWMA forwarded the item to the NCWM and recommended that it be a Voting item. During the 2015 NEWMA Annual Meeting, NEWMA's S&T Committee agreed to group together Agenda Items 321-1 through 321-8 and take comments simultaneously. The SMA supported all items in the group. NEWMA agreed to recommend all items in the group move forward as Voting items.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**321-4 VC N.2.3. Minimum Test Load.**

(This item was Adopted.)

**Source:**

U.S. National Work Group on Belt-Conveyor Scales (BCSs) (2015)

**Purpose:**

Add the appropriate minimum test load for weigh-belt systems that are being proposed to be included in this code under a separate proposal.

**Item Under Consideration:**

Amend NIST Handbook 44, Belt-Conveyor Scale (BCS) System Code as follows:

**N.2.3. Minimum Test Load.**

**N.2.3.1. Minimum Test Load, Weigh-Belt Systems. – The minimum test load shall not be less than the largest of the following values.**

**(a) 800 scale divisions;**

(b) **the load obtained at maximum flow rate in one revolution of the belt; or**

(c) **at least one minute of operation.**

**(Amended 2015)**

**N.2.3.2. Minimum Test Load, All Other Belt-Conveyor Scale Systems.** – Except for applications where a normal weighment is less than 10 minutes, the minimum test load shall not be less than the largest of the following values.

- (a) 800 scale divisions;
- (b) the load obtained at maximum flow rate in one revolution of the belt; or
- (c) at least 10 minutes of operation.

For applications where a normal weighment is less than 10 minutes (e.g., belt-conveyor scale systems used exclusively to issue net weights for material conveyed by individual vehicles and railway track cars) the minimum test load shall be the normal weighment that also complies with **N.2.3.2.**(a) and (b).

The official with statutory authority may determine that a smaller minimum totalized load down to 2 % of the load totalized in 1 hour at the maximum flow rate may be used for subsequent tests, provided that:

1. the smaller minimum totalized load is greater than the quantities specified in **N.2.3.2.** (a) and (b); and
2. consecutive official testing with the minimum totalized loads described in **N.2.3.2.** (a), (b), or (c) and the smaller minimum test load has been conducted that demonstrates the system complies with applicable tolerances for repeatability, acceptance, and maintenance.

(Added 2004) (Amended 2008 **and 2015**)

**Background/Discussion:**

Since the typical design of weigh-belt systems (see the Committee’s proposal to add a new definition for “weigh-belt systems” in NIST Handbook 44, Appendix D) consists of significantly shorter conveyors compared to those normally found in BCS systems, the time needed for a complete revolution of the belt to occur on a weigh-belt system is much shorter. The USNWG on BCSs agreed, due to the generally shorter time needed for a belt revolution on a weigh-belt system, the dynamics of the weigh-belt system could be evaluated without the need of an extended (10 min) period of operation as is required for a BCS system. The USNWG concluded that the weigh-belt systems could be sufficiently evaluated over a shorter time span and recommended that, as a minimum, one minute of operation would suffice.

Longer periods of operation of a belt-conveyor or weigh-belt system during a test will provide more time in which the effects of extreme low and high points of belt loading would be mitigated since these highs and lows are averaged into the total load. The high and low points of the belt loading would be seen during the start-up of the conveyor when material is just beginning to be loaded on the belt and then when the flow of material is cut off at the end of a “run” where a gradual decrease of material on the belt occurs. These extremes of belt loading would comprise a larger proportion of the total load during shorter periods of operation and could expose errors caused by inconsistent belt loading or other problems within the system. Thus, a test comprised of a shorter duration could be interpreted as being more stringent than one of a longer duration.

NIST Handbook 44, BCS Systems Code language that existed prior to 2001 provided an exemption for BCS scale systems designed and furnished by the manufacturer from requirements that concerned the details of installation of BCS systems. Generally, weigh-belt systems are designed and built by the manufacturer as a unit and are, therefore, less likely to be susceptible to malfunctions or operational defects directly caused by a variance from the manufacturer’s intended installation specifications. This is in contrast to BCS systems that are typically installed as separate components (conveyor, weighing system, belt loading system, speed sensor, etc.) within an existing conveyor

system where the details of the installation for each component may greatly influence the performance of other components in the system. That language, which has since been deleted, is shown below:

**UR.2.2.1. For Scales Not Installed by the Manufacturer.** – Unless the scale is installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications, the conveyor shall comply with the following minimum requirements:

...\*

(Amended 1998)

\*The subparagraphs that followed, UR.2.2.1.(a) through (j), consisted of requirements addressing specific criteria related to design and installation of the conveyor system.

The deletion of the statement: “installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications” created a situation where all BCS systems that were covered by the NIST Handbook 44, BCS Code were to meet requirements that included specific limitations on the location of conveyor components in relation to the weighing element; specific limits on the length of the conveyor; and the type of take-up device used in the system. Due to their typical design and construction, weigh-belt systems were not generally able to comply with these requirements; this was largely due to the size, placement, and location of components in a weigh-belt type of system and the distances required between those components and the weighing elements.

USNWG members have agreed that it is important not to impose prescriptive requirements, which may restrict innovation in the design of this type of device. Requirements that place limitations on the placement of components in a conveyor system in relation to the weighing device and to each other are viewed as being arbitrary and may be invalid if the design of a system is shown to operate within performance requirements regardless of the configuration of its components.

BCS manufacturers who are members of the USNWG reported a demand from various clients for relatively compact weigh-belt type of systems to be used as a commercial device. However, unless the NIST Handbook 44, BCS Code is amended to allow for their unique design characteristics, there was not an appropriate code in NIST Handbook 44 to apply to weigh-belt systems. Therefore, the USNWG has developed a number of proposed changes throughout the existing BCS Systems Code to adapt these requirements so that they may be applied to weigh-belt systems as well.

#### **2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 321-1 through 321-8 were grouped together and comments taken simultaneously since the Committee considered them all related. Ms. Tina Butcher (OWM) spoke in support of this item. She stated that NIST Handbook 44 included certain exceptions for installations of BCS systems installed under close supervision and control of the scale system manufacturer (prior to 2001). Ms. Butcher went on to state that OWM believes it would be appropriate to reinstate these exemptions for the weigh-belt systems, as proposed by this item. She concurred these items should be grouped together (with perhaps the exception of Item 321-6) and designated as Voting; however, she noted that Item 321-6 is different in that the item does not relate to the addition of the term “weigh-belt systems” into the BCS Systems Code of NIST Handbook 44. Mr. Steve Langford representing the Scale Manufacturer’s Association (SMA) stated the SMA had no position on these items.

The Committee concluded that the alternative language provided by OWM is more appropriate and agreed to replace the submitter’s original proposed language (shown below) with the alternative language developed by OWM as shown in “Item Under Consideration.” The Committee then agreed to recommend this item for Vote.

**N.2.3. Minimum Test Load.** – Except for applications where a normal weighment is less than 10 minutes, the minimum test load shall not be less than the largest of the following values.

- (a) 800 scale divisions;
- (b) the load obtained at maximum flow rate in one revolution of the belt; or
- (c) at least 10 minutes of operation **for belt-conveyor scale systems or, for weigh-belt systems only, at least 1 min of operation.**

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting Open Hearings: The Committee announced it was grouping Agenda Items 321-1 through 321-8 together and taking comments on all simultaneously. See Agenda Item 321-1 for a summary of the comments heard on these items.

Hearing no comments in opposition and in consideration that these items were developed and recommended by the USNWG on BCSs, the Committee agreed to present Items 321-1 through 321-8 for Vote, each without change as shown in the “Item Under Consideration.”

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The reported that a regulatory official questioned the one-minute requirement. It was suggested that the one-minute operational time proposed in paragraph N.2.3.(c) for weigh-belt systems was to warm the belt prior to testing. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to the NCWM, recommending it as a Voting item. At the 2015 CWMA Annual Meeting, the CWMA recommended the item be forwarded to the NCWM as a Voting item since there were no opposing comments and the item was supported by the SMA.

WWMA 2014 Annual Meeting: Testimony was presented in support of this item and moving it to a Voting status. The WWMA S&T Committee agreed that it was developed and recommended that 2014 WWMA S&T Agenda Items 321-1, 321-2, 321-3, 321-4, 321-5, 321-6, 321-7, and 321-8 be combined into one proposal. The WWMA forwarded this item to the NCWM and recommended that it be a Voting item.

SWMA Annual 2014 Meeting: The SWMA recommended Items 321-1 through 321-8 be combined into one agenda item since they are all related to BCSs. Comments were heard on all eight of these agenda items at the same time. The SMWA forwarded this tem to the NCWM and recommended that it be a Voting item.

NEWMA 2014 Interim Meeting: NEWMA supported the recommendations of the USNWG on BCSs since the majority of these devices are located outside of the northeast region. NEWMA forwarded the item to the NCWM and recommended that it be a Voting item. During the 2015 NEWMA Annual Meeting, NEWMA’s S&T Committee agreed to group together Agenda Items 321-1 through 321-8 and take comments simultaneously. The SMA supported all items in the group. NEWMA agreed to recommend all items in the group move forward as Voting items.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**321-5 VC N.3.1.1. Determination of Zero.**

(This item was Adopted.)

**Source:**

U.S. National Work Group on Belt-Conveyor Scales (BCSs) (2015)

**Purpose:**

Segregating the requirements for BCSs that use electronic integrators from those that use mechanical integrators and add weigh-belt systems to the code.

**Item Under Consideration:**

Amend NIST Handbook 44, BCS Code as follows:

**N.3.1.1. Determination of Zero.** – A zero-load test is a determination of the error in zero, expressed as an internal reference, a percentage of the full-scale capacity, or a change in a totalized load over a whole number of complete belt revolutions. ~~For belt-conveyor scales with electronic integrators, the test must be performed over a period of at least three minutes and with a whole number of complete belt revolutions. For belt-conveyor scales with mechanical integrators, the test shall be performed with no~~

~~less than three complete revolutions or 10 minutes of operation, whichever is greater.~~ **A zero-load test shall be performed as follows:**

- (a) **For belt-conveyor scales with electronic integrators, the test must be performed over a period of at least three minutes and with a whole number of complete belt revolutions;**
- (b) **For belt-conveyor scales with mechanical integrators, the test shall be performed with no less than three complete revolutions or 10 minutes of operation, whichever is greater;**
- (c) **For weigh belt systems the test must be performed over a period of at least one minute and at least one complete revolution of the belt.**

(Added 2002) **(Amended 2015)**

**Background/Discussion:**

Since the typical design of weigh-belt systems (see the Committee’s proposal to add definition in Appendix D for “weigh-belt systems”) consists of significantly shorter conveyors compared to those normally found in BCS systems, the time needed for a complete revolution of the belt to occur on a weigh-belt system is much shorter. The USNWG on BCSs agreed that due to the generally shorter time needed for a belt revolution on a weigh-belt system, the dynamics of the weigh-belt system (including the ability to maintain a zero load reference) could be evaluated without the need of an extended (10 min) period of operation as is required for a BCS system. The USNWG concluded that the weigh-belt system’s ability to maintain a stable zero condition could be sufficiently evaluated over a shorter time span and recommended that, as a minimum, one minute of operation would suffice. This provision has been added in bullet point (c) in the “Item Under Consideration.”

This proposed amendment is also considered to improve the structure of the existing language in paragraph UR.3.1.1. by segregating the requirements for BCSs that use electronic integrators from those that use mechanical integrators into bullet points (a) and (b).

NIST Handbook 44, BCS Systems Code language that existed prior to 2001 provided an exemption for BCS systems designed and furnished by the manufacturer from requirements that concerned the details of installation of BCS systems. Generally, weigh-belt systems are designed and built by the manufacturer as a unit and are, therefore, less likely to be susceptible to malfunctions or operational defects directly caused by a variance from the manufacturer’s intended installation specifications. This is in contrast to BCS systems that are typically installed as separate components (e.g., conveyor, weighing system, belt loading system, speed sensor, etc.) within an existing conveyor system where the details of the installation for each component may greatly influence the performance of other components in the system. That language which has since been deleted is shown below:

**UR.2.2.1. For Scales Not Installed by the Manufacturer.** – Unless the scale is installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications, the conveyor shall comply with the following minimum requirements:

...\*

(Amended 1998)

\*The subparagraphs that followed, UR.2.2.1.(a) through (j), consisted of requirements addressing specific criteria related to design and installation of the conveyor system.

The deletion of the statement: “installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications” created a situation where all BCS systems that were covered by the NIST Handbook 44, BCS Code were to meet requirements that included: specific limitations on the location of conveyor components in relation to the weighing element; specific limits on the length of the conveyor; and the type of take-up device used in the system. Due to their typical design and construction, weigh-belt systems were not generally able to comply with these requirements; this was largely due to the size, placement, and location of components in a weigh-belt type of system and the distances required between those components and the weighing elements.

USNWG members have agreed it is important not to impose prescriptive requirements, which may restrict innovation in the design of this type of device. Requirements that place limitations on the placement of components in a conveyor



system in relation to the weighing device and to each other are viewed as being arbitrary and may be invalid if the design of a system is shown to operate within performance requirements regardless of the configuration of its components.

BCS manufacturers who are members of the USNWG reported a demand from various clients for relatively compact weigh-belt type of systems to be used as a commercial device. However, unless the NIST Handbook 44, BCS Code is amended to allow for their unique design characteristics, there was not an appropriate code in NIST Handbook 44 to apply to weigh-belt systems. Therefore, the USNWG has developed a number of proposed changes throughout the existing BCS Systems Code to adapt these requirements so they may be applied to weigh-belt systems as well.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 321-1 through 321-8 were grouped together and comments taken simultaneously since the Committee considered them all related. Ms. Tina Butcher (OWM) spoke in support of this item. She stated that NIST Handbook 44 included certain exceptions for installations of BCS systems installed under close supervision and control of the scale system manufacturer (prior to 2001). Ms. Butcher went on to state that OWM believes it would be appropriate to reinstate these exemptions for the weigh-belt systems, as proposed by this item. She concurred these items should be grouped together (with perhaps the exception of Item 321-6) and designated as Voting; however, she noted that Item 321-6 is different in that the item does not relate to the addition of the term “weigh-belt systems” into the BCS Systems Code of NIST Handbook 44. Mr. Steve Langford representing the Scale Manufacturer’s Association stated the SMA had no position on these items.

In consideration of the comments provided the Committee agreed to recommend this item for Vote.

NCWM 2015 Annual Meeting Open Hearings: The Committee announced it was grouping Agenda Items 321-1 through 321-8 together and taking comments on all simultaneously. See Agenda Item 321-1 for a summary of the comments heard on these items.

Hearing no comments in opposition and in consideration that these items were developed and recommended by the USNWG on BCSs, the Committee agreed to present Items 321-1 through 321-8 for Vote, each without change as shown in the “Item Under Consideration.”

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA did not receive comments on this item. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to the NCWM recommending it as a Voting item. At the 2015 CWMA Annual Meeting, the CWMA recommended the item be forwarded to the NCWM as a Voting item since there were no opposing comments and the item was supported by the SMA.

WWMA 2014 Annual Meeting: Testimony was presented in support of this item and moving it to a Voting status. The WWMA S&T Committee agreed it was sufficiently developed and recommended that 2014 WWMA S&T Agenda Items 321-1, 321-2, 321-3, 321-4, 321-5, 321-6, 321-7, and 321-8 be combined into one proposal. The WWMA forwarded this item to the NCWM and recommended that it be a Voting item.

SWMA 2014 Annual Meeting: The SWMA recommended Items 321-1 through 321-8 be combined into one agenda item since they are all related to BCSs. Comments were heard on all eight of these agenda items at the same time. The SMWA forwarded this item to the NCWM and recommended it be a Voting item.

NEWMA 2014 Interim Meeting: NEWMA supported the recommendations of the USNWG on BCSs, since the majority of these devices are located outside of the region. NEWMA forwarded the item to the NCWM and recommended that it be a Voting item. During the 2015 NEWMA Annual Meeting, NEWMA’s S&T Committee agreed to group together Agenda Items 321-1 through 321-8 and take comments simultaneously. The SMA supported all items in the group. NEWMA agreed to recommend all items in the group move forward as Voting items.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **321-6 VC UR.1.2. Conveyor Installation.**

(This item was adopted.)

**Source:**

U.S. National Work Group on Belt-Conveyor Scales (BCSs) (2015)

**Purpose:**

Remove ambiguous and prescriptive language that fails to recognize improvements in manufacturing.

**Item Under Consideration:**

Amend NIST Handbook 44, BCS Systems Code as follows:

**UR.1.2. Conveyor Installation**

.....

- (k) **Belt Composition and Maintenance.** – ~~Conveyor belting shall be no heavier than is required for normal use.~~ In a loaded or unloaded condition, the belt shall make constant contact with horizontal and wing rollers of the idlers in the scale area. Splices shall not cause any undue disturbance in scale operation. (Also see N.3. Test Procedures.)

(Amended 1998, 2000, ~~and 2001~~, and 2015)

**Background/Discussion:**

The existing language in the requirement being proposed for deletion is intended to prevent the use of excessively thick, heavy-duty belt material that could be problematic when its rigidity would prevent the belt from making proper contact with the contour of the rollers that support the belt in the weighing area of the system. This could result in poor performance of the weighing system. In addition, a heavier belt would create a larger value for the “dead load” weight that must be accounted for by the scale in an unloaded zero-balance condition.

The USNWG on BCSs considers the use of the term “heavier” to be ambiguous in that it can be interpreted to mean a higher weight value per unit of length or it may mean that the relative thickness of the belt is greater than a “lighter” version of belt material. The USNWG recognizes manufacturers of belt material have made improvements to their products through modernized manufacturing processes and the use of alternative raw materials. These practices have resulted in improvements over the traditional-style belt material and may allow for belts of various thickness or weights to be used without detracting from scale performance.

The language that is proposed to be stricken is viewed as being prescriptive and the USNWG believes that the requirement should not attempt to establish a parameter for the design of belt material. The remaining portion of the requirement is considered as being sufficient for conveying the intent of the requirement in that, regardless of the manufacturing characteristics, the belt must make contact with the supporting rollers and be spliced appropriately to avoid the introduction of significant weighing errors.

NIST Handbook 44, Systems BCS Code language, which existed prior to 2001, provided an exemption for BCS systems designed and furnished by the manufacturer from requirements that concerned the details of installation of BCS systems. Generally, weigh-belt systems are designed and built by the manufacturer as a unit and are, therefore, less likely to be susceptible to malfunctions or operational defects directly caused by a variance from the manufacturer's intended installation specifications. This is in contrast to BCS systems that are typically installed as separate components (conveyor, weighing system, belt loading system, speed sensor, etc.) within an existing conveyor system where the details of the installation for each component may greatly influence the performance of other components in the system. That language, which has since been deleted, is shown below:

**UR.2.2.1. For Scales Not Installed by the Manufacturer.** – Unless the scale is installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications, the conveyor shall comply with the following minimum requirements:

...\*

(Amended 1998)

\*The subparagraphs that followed, UR.2.2.1.(a) through (j), consisted of requirements addressing specific criteria related to design and installation of the conveyor system.

The deletion of the statement, “installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications” created a situation where all BCS systems, which were covered by the NIST Handbook 44, BCS Code, were to meet requirements that included specific limitations on the location of conveyor components in relation to the weighing element; specific limits on the length of the conveyor; and the type of take-up device used in the system. Due to their typical design and construction, weigh-belt systems were not generally able to comply with these requirements; this was largely due to the size, placement, and location of components in a weigh-belt type of system and the distances required between those components and the weighing elements.

USNWG members have agreed that it is important not to impose prescriptive requirements, which may restrict innovation in the design of this type of device. Requirements that place limitations on the placement of components in a conveyor system in relation to the weighing device and to each other are viewed as being arbitrary and may be invalid if the design of a system is shown to operate within performance requirements regardless of the configuration of its components.

BCS manufacturers who are members of the USNWG reported a demand from various clients for relatively compact weigh-belt type of systems to be used as a commercial device. However, unless the NIST Handbook 44, BCS Code is amended to allow for their unique design characteristics, there was not an appropriate code in NIST Handbook 44 to apply to weigh-belt systems. Therefore, the USNWG has developed a number of proposed changes throughout the existing BCS Systems Code to adapt these requirements so that they may be applied to weigh-belt systems as well.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 321-1 through 321-8 were grouped together and comments taken simultaneously since the Committee considered them all related. Ms. Tina Butcher (OWM) spoke in support of this item. She stated that NIST Handbook 44 included certain exceptions for installations of BCS systems installed under close supervision and control of the scale system manufacturer (prior to 2001). Ms. Butcher stated OWM believes it would be appropriate to reinstate these exemptions for the weigh-belt systems, as proposed by this item. She concurred these items should be grouped together (with perhaps the exception of Item 321-6) and designated as Voting; however, she noted that Item 321-6 is different in that the item does not relate to the addition of the term “weigh-belt systems” into the BCS Systems Code of NIST Handbook 44. Mr. Steve Langford, representing the Scale Manufacturer's Association, stated the SMA had no position on these items.

Hearing no comments in opposition to this item, the Committee agreed to recommend this item for vote.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting Open Hearings: The Committee announced it was grouping Agenda Items 321-1 through 321-8 together and taking comments on all simultaneously. See Agenda Item 321-1 for a summary of the comments heard on these items.

Hearing no comments in opposition and in consideration that these items were developed and recommended by the USNWG on BCSs, the Committee agreed to present Items 321-1 through 321-8 for Vote each without change as shown in the “Item Under Consideration.”

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA did not receive comments on this item. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to the NCWM, recommending it as a Voting item. At the 2015 CWMA Annual Meeting, the CWMA recommended the item be

forwarded to the NCWM as a Voting item since there were no opposing comments, and the item was supported by the SMA.

WWMA 2014 Annual Meeting: Testimony was presented in support of this item and moving it to a Voting Status. The WWMA S&T Committee agreed that it was sufficiently developed and recommended that 2014 WWMA S&T Agenda Items 321-1, 321-2, 321-3, 321-4, 321-5, 321-6, 321-7, and 321-8 be combined into one proposal. The WWMA forwarded this item to NCWM and recommended that it be a Voting item.

SWMA 2014 Annual Meeting: The SWMA recommended: Items 321-1 through 321-8 be combined into one agenda item since they are all related to BCSs. Comments were heard on all eight of these agenda items at the same time. The SMWA forwarded this tem to the NCWM and recommended that it be a Voting item.

NEWMA Interim 2014 Meeting: NEWMA supported the recommendations of the USNWG on BCSs since the majority of these devices are located outside of the northeast region. NEWMA forwarded the item to the NCWM and recommended that it be a Voting item. During the 2015 NEWMA Annual Meeting, NEWMA's S&T Committee agreed to group together Agenda Items 321-1 through 321-8 and take comments simultaneously. The SMA supported all items in the group. NEWMA agreed to recommend all items in the group move forward as Voting items.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**321-7 VC UR.3.1. Scale and Conveyor Maintenance. – ~~Belt-conveyor scales~~Weighing Systems.**

(This item was Adopted.)

**Source:**

U.S. National Work Group on Belt-Conveyor Scales (BCSs) (2015)

**Purpose:**

Allow paragraph UR.3.1. to apply to weigh-belt systems and require alignment checks whenever work is performed on weigh-belt systems as well as BCS systems that may alter the alignment.

**Item Under Consideration:**

Amend NIST Handbook 44 Belt-Conveyor Scale Systems Code as follows:

**UR.3.1. Scale and Conveyor Maintenance. – ~~Belt-conveyor scales~~Weighing systems** and idlers shall be maintained and serviced in accordance with manufacturer's instructions and the following:

...  
.  
.

- (e) **Scale Alignment.** – Alignment checks shall be conducted in accordance with the manufacturer's recommendation ~~when conveyor work is performed in the scale area~~. A material test is required after any realignment.

(Amended 1986, ~~and~~ 2000, and 2015)

**Background/Discussion:**

The USNWG on BCSs has proposed a number of changes to the NIST Handbook 44, BCS Code intended to allow the code to be applied to "weigh-belt systems" as well as BCS systems. To facilitate this effort references to "BCSs" are being proposed to be changed to a more inclusive terminology such as is recommended in the first sentence in UR.3.1. (See also remarks in "Additional Considerations" below.) This proposed change is intended to eliminate the exclusion of weigh-belt systems from this requirement.

Since the typical design of weigh-belt systems consists of an all-inclusive unit and significantly shorter conveyors as compared to those normally found in BCS system, *any* work performed on weigh-belt systems could possibly be considered to take place “in the scale area.” (See the Committee’s proposal to add a new definition for “weigh-belt systems” in NIST Handbook 44, Appendix D.) Any misalignment of the conveyor belt during its operation can have a detrimental effect on the performance of the system.

The USNWG on BCS agreed it is appropriate to require alignment checks whenever work is performed on weigh-belt systems (as well as BCS systems) that may alter this alignment. The USNWG members, who are employees of device manufacturers, have stated that the manufacturers of weigh-belt systems will emphasize the critical nature of belt alignment and will specify that owners/operators check the belt alignment if work is performed on the conveyor system that could have any effect on this. Therefore, the USNWG agreed that the proposed change to require an alignment check to be done according to manufacturer’s instructions is a sound proposal.

NIST Handbook 44, BCS Systems Code language, which existed prior to 2001, provided an exemption for BCS systems designed and furnished by the manufacturer from requirements that concerned the details of installation of BCS systems. Generally, weigh-belt systems are designed and built by the manufacturer as a unit and are, therefore, less likely to be susceptible to malfunctions or operational defects directly caused by a variance from the manufacturer’s intended installation specifications. This is in contrast to BCS systems that are typically installed as separate components (e.g., conveyor, weighing system, belt loading system, speed sensor, etc.) within an existing conveyor system where the details of the installation for each component may greatly influence the performance of other components in the system. That language which has since been deleted is shown below:

**UR.2.2.1. For Scales Not Installed by the Manufacturer.** – Unless the scale is installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications, the conveyor shall comply with the following minimum requirements:

...\*

(Amended 1998)

\*The subparagraphs that followed, UR.2.2.1.(a) through (j), consisted of requirements addressing specific criteria related to design and installation of the conveyor system.

The deletion of the statement, “installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications” created a situation where all BCS systems, which were covered by the NIST Handbook 44, BCS Code, were to meet requirements that included specific limitations on the location of conveyor components in relation to the weighing element; specific limits on the length of the conveyor; and the type of take-up device used in the system. Due to their typical design and construction, weigh-belt systems were not generally able to comply with these requirements; this was largely due to the size, placement, and location of components in a weigh-belt type of system and the distances required between those components and the weighing elements.

USNWG members have agreed that it is important not to impose prescriptive requirements, which may restrict innovation in the design of this type of device. Requirements that place limitations on the placement of components in a conveyor system in relation to the weighing device and to each other are viewed as being arbitrary and may be invalid if the design of a system is shown to operate within performance requirements regardless of the configuration of its components.

BCS manufacturers who are members of the USNWG reported a demand from various clients for relatively compact weigh-belt type of systems to be used as a commercial device. However, unless the NIST Handbook 44, BCS Code is amended to allow for their unique design characteristics, there was not an appropriate code in NIST Handbook 44 to apply to weigh-belt systems. Therefore, the USNWG has developed a number of proposed changes throughout the existing BCS Systems Code to adapt these requirements so that they may be applied to weigh-belt systems as well.

#### **2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 321-1 through 321-8 were grouped together and comments taken simultaneously since the Committee considered them all related. Ms. Tina Butcher (OWM) spoke in support of this item. She stated that NIST Handbook 44 included certain exceptions for installations of BCS systems installed under

close supervision and control of the scale system manufacturer (prior to 2001). Ms. Butcher went on to state that OWM believes it would be appropriate to reinstate these exemptions for the weigh-belt systems, as proposed by this item. She concurred these items should be grouped together (with perhaps the exception of Item 321-6) and designated as Voting; however, she noted that Item 321-6 is different in that the item does not relate to the addition of the term “weigh-belt systems” into the BCS Systems Code of NIST Handbook 44. Mr. Steve Langford representing the Scale Manufacturer’s Association stated the SMA had no position on these items.

In consideration of the comments provided the Committee agreed to recommend this item for Vote.

**2015 NCWM Annual Meeting:**

Annual Meeting 2015 Open Hearings: The Committee announced it was grouping Agenda Items 321-1 through 321-8 together and taking comments on all simultaneously. See Agenda Item 321-1 for a summary of the comments heard on these items.

Hearing no comments in opposition and in consideration that these items were developed and recommended by the USNWG on BCSs, the Committee agreed to present Items 321-1 through 321-8 for Vote each without change as shown in Item Under Consideration.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA received a comment from a regulatory official supporting this item. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to the NCWM, recommending it as a Voting item. At the 2015 CWMA Annual Meeting, the CWMA recommended the item be forwarded to the NCWM as a Voting item since there were no opposing comments and the item was supported by the SMA.

WWMA 2014 Annual Meeting: Testimony was presented in support of this item and moving it to a Voting status. The WWMA S&T Committee agreed it was sufficiently developed and recommended that 2014 WWMA S&T Agenda Items 321-1, 321-2, 321-3, 321-4, 321-5, 321-6, 321-7, and 321-8 be combined into one proposal. The WWMA forwarded this item to the NCWM and recommended that it be a Voting item.

The SWMA 2014 Annual Meeting: Recommended Items 321-1 through 321-8 be combined into one agenda item since they are all related to BCSs. Comments were heard on all eight of these agenda items at the same time. The SMWA forwarded this item to the NCWM and recommended that it be a Voting item.

NEWMA 2014 Interim Meeting: NEWMA supported the recommendations of the USNWG on BCSs since the majority of these devices are located outside of the northeast region. NEWMA forwarded the item to the NCWM and recommended that it be a Voting item. During the 2015 NEWMA Annual Meeting, NEWMA’s S&T Committee agreed to group together Agenda Items 321-1 through 321-8 and take comments simultaneously. The SMA supported all items in the group. NEWMA agreed to recommend all items in the group move forward as Voting items.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**321-8 VC Appendix D – Definitions. – Weigh-Belt Systems.**

(This item was Adopted.)

**Source:** U.S. National Work Group on Belt-Conveyor Scales (BCSs) (2015)

**Purpose:**

Provide a definition for this device type if other proposals are adopted, which would reference it in the BCS Code.

**Item Under Consideration:**

Amend NIST Handbook 44, Appendix D – Definitions as follows:

**weigh-belt systems. – A type of belt-conveyor scale system designed by the manufacturer as a self-contained conveyor system and which is installed as a unit. The units are comprised of integral components including as a minimum: conveyor belt; belt drive; conveyor frame; and weighing system. They may operate at single or multiple flow rates and may use variable-speed belt drives.**

**(Added 2015)**

**Background/Discussion:**

Several terms have been used to describe relatively shorter conveyor systems including “weigh-belts” and “weigh-feeders.” The USNWG agreed that the term “weigh-belt system” is best suited for describing this type of device. The WG also agreed that if this term is to be understood and routinely used to describe a specific type of weighing device/system, then a definition should be developed and included in NIST Handbook 44, Appendix D. Definitions.

Based on the submission of proposed changes to the NIST Handbook 44, Belt-Conveyor Scale (BCS) Systems Code that are intended to facilitate the application of that code to a specific, self-contained type of design devices commonly referred to as “weigh-belt systems,” the USNWG on BCSs agreed it is necessary to establish a definition for this type of device. This definition would help to distinguish the weigh-belt type of systems from the more familiar BCS systems.

NIST Handbook 44, BCS Systems Code language that existed prior to 2001 provided an exemption for BCS systems designed and furnished by the manufacturer from requirements that concerned the details of installation of BCS systems. Generally, weigh-belt systems are designed and built by the manufacturer as a unit and are, therefore, less likely to be susceptible to malfunctions or operational defects directly caused by a variance from the manufacturer’s intended installation specifications. This is in contrast to BCS systems that are typically installed as separate components (conveyor, weighing system, belt loading system, speed sensor, etc.) within an existing conveyor system where the details of the installation for each component may greatly influence the performance of other components in the system. That language, which has since been deleted, is shown below:

**UR.2.2.1. For Scales Not Installed by the Manufacturer.** – Unless the scale is installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications, the conveyor shall comply with the following minimum requirements:

...\*

(Amended 1998)

\*The subparagraphs that followed, UR.2.2.1.(a) through (j), consisted of requirements addressing specific criteria related to design and installation of the conveyor system.

The deletion of the statement, “installed in a conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer’s specifications,” created a situation where all BCS systems that were covered by the NIST Handbook 44, BCS Code were to meet requirements that included specific limitations on the location of conveyor components in relation to the weighing element; specific limits on the length of the conveyor; and the type of take-up device used in the system. Due to their typical design and construction, weigh-belt systems were not generally able to comply with these requirements; this was largely due to the size, placement, and location of components in a weigh-belt type of system and the distances required between those components and the weighing elements.

USNWG members have agreed that it is important not to impose prescriptive requirements, which may restrict innovation in the design of this type of device. Requirements that place limitations on the placement of components in a conveyor system in relation to the weighing device and to each other are viewed as being arbitrary and may be invalid if the design of a system is shown to operate within performance requirements regardless of the configuration of its components.

BCS manufacturers who are members of the USNWG reported a demand from various clients for relatively compact weigh-belt type of systems to be used as a commercial device. However, unless the NIST Handbook 44, BCS Code is amended to allow for their unique design characteristics, there was not an appropriate code in NIST Handbook 44 to apply to weigh-belt systems. Therefore, the USNWG has developed a number of proposed changes throughout the existing BCS Systems Code to adapt these requirements so that they may be applied to weigh-belt systems as well.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 321-1 through 321-8 were grouped together and comments taken simultaneously since the Committee considered them all related. Ms. Tina Butcher (OWM) spoke in support of this item. She stated that NIST Handbook 44 included certain exceptions for installations of BCS systems installed under close supervision and control of the scale system manufacturer (prior to 2001). Ms. Butcher went on to state that OWM believes it would be appropriate to reinstate these exemptions for the weigh-belt systems, as proposed by this item. She concurred these items should be grouped together (with perhaps the exception of Item 321-6) and designated as Voting; however, she noted that Item 321-6 is different in that the item does not relate to the addition of the term “weigh-belt systems” into the BCS Systems Code of NIST Handbook 44. Mr. Steve Langford representing the Scale Manufacturer's Association stated the SMA had no position on these items.

In consideration of the comments provided the Committee agreed to recommend this item for Vote.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting Open Hearings: The Committee announced it was grouping Agenda Items 321-1 through 321-8 together and taking comments on all simultaneously. See Agenda Item 321-1 for a summary of the comments heard on these items.

Hearing no comments in opposition and in consideration that these items were developed and being recommended by the USNWG on BCSs, the Committee agreed to present Items 321-1 through 321-8 for Vote, each without change as shown in Item Under Consideration.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA did not receive comments on this item. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to the NCWM, recommending it as a Voting item. At the 2015 CWMA Annual Meeting, the CWMA recommended the item be forwarded to the NCWM as a Voting item since there were no opposing comments and the item was supported by the SMA.

WWMA 2014 Annual Meeting: Testimony was presented in support of this item and moving it to a Voting status. The WWMA S&T Committee agreed that it was sufficiently developed and recommended that 2014 WWMA S&T Agenda Items 321-1, 321-2, 321-3, 321-4, 321-5, 321-6, 321-7, and 321-8 be combined into one proposal. The WWMA forwarded this item to the NCWM and recommended that it be a Voting item.

The SWMA 2014 Annual Meeting: The SWMA recommended, at its, Items 321-1 through 321-8 be combined into one agenda item since they are all related to BCSs. Comments were heard on all eight of these agenda items at the same time. The SWMA forwarded this tem to the NCWM and recommended that it be a Voting item.

NEWMA2014 Interim Meeting: NEWMA supported the recommendations of the USNWG on BCSs since the majority of these devices are located outside of the northeast region. NEWMA forwarded the item to the NCWM and recommended that it be a Voting item. During the 2015 NEWMA Annual Meeting, NEWMA's S&T Committee agreed to group together Agenda Items 321-1 through 321-8 and take comments simultaneously. The SMA supported all items in the group. NEWMA agreed to recommend all items in the group move forward as Voting items.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).



## 322 AUTOMATIC BULK WEIGHING SYSTEMS

### 322-1 D N.1. Testing Procedures.

**Source:**

Oregon (2015)

**Purpose:**

Modify the test method to reflect as-used dynamic conditions.

**Item Under Consideration:**

Amend NIST Handbook 44, Automatic Bulk Weighing Systems Code as follows:

#### N.1. Testing Procedures.

~~N.1.1. Test Weights.—The increasing load test shall be conducted using test weights equal to at least 10 % of the capacity of the system:~~

~~(a) on automatic grain bulk weighing systems installed after January 1, 1984; and~~

~~(b) on other automatic bulk weighing systems installed after January 1, 1986.~~

~~(Amended 1987)~~

~~N.1.2. Increasing Load Test.—An increasing load test consisting of substitution and strain load tests shall be conducted up to the used capacity of the weighing system.~~

~~(Amended 1987)~~

~~N.1.3. Decreasing Load Test.—A decreasing load test shall be conducted on devices used to weigh out.~~

~~(Added 1986)~~

N.1.1. Material Tests. – Material used for test must be the actual material weighed by system or similar in nature. Material tests should be conducted using actual scale loading conditions. These loading conditions shall include, three accumulation tests consisting of three loadings at maximum capacity for the material and a partial loading of between 30 % and 50 % (three and a partial loadings).

On subsequent verifications, at least two individual accumulation tests shall be conducted. The results of all tests shall be within tolerance limits.

Either pass a quantity of pre-weighed material through the Automatic Bulk Weighing system in a manner as similar as feasible to actual loading conditions, or weigh all material that has passed through the Automatic Bulk Weighing System. Means for weighing the material test load will depend on the capacity of the system and availability of a suitable scale for the test. To assure that the test load is accurately weighed and determined, the following precautions shall be observed:

(a) The containers, whether railroad cars, trucks, or boxes, must not leak, and shall not be overloaded to the point that material will be lost.

(b) The actual empty or tare weight of the containers shall be determined at the time of the test. Stenciled tare weight of railway cars, trucks or boxes shall not be used. Gross and tare weights shall be determined on the same scale.

**(c) When a pre-weighed test load is passed through the scale, the loading system shall be examined before and after the test to assure that the system is empty and that only the material of the test load has passed through the scale.**

**(d) Where practicable, a reference scale should be tested within 24 hours preceding the determination of the weight of the test load used for an Automatic Bulk Weighing System material test.**

**A reference scale which is not “as found” within maintenance tolerance should have its accuracy re-verified after the Automatic Bulk Weighing System test with a suitable known weight load if the “as found” error of the Automatic Bulk Weighing System material test exceeds maintenance tolerance values.\***

**(e) If any suitable known weight load other than a certified test weight load is used for re-verification of the reference scale accuracy, its weight shall be determined on the reference scale after the reference scale certification and before commencing the Automatic Bulk Weighing System material test.\***

**(f) The test shall not be conducted if the weight of the test load has been affected by environmental conditions.**

**\*Note: Even if the reference scale is within maintenance tolerance it may require adjusting to be able to meet paragraph N.1.1.1. Accuracy of Material.**

**N.1.1.1. Accuracy of Material. – The quantity of material used to conduct a material test shall be weighed on a reference scale to an accuracy within 0.1 %. Scales typically used for this purpose include Class III and III L scales or a scale without a class designation as described in Handbook 44, Section 2.20., Table T.1.1. Tolerances for Unmarked Scales.**

**N.1.1.2. Associated Equipment. – All associated equipment in local vicinity shall be in operation at time of test. This would include items such as conveyors; tote dumps, cleaning drums, rock separators, etc.**

**N.1.4. N.1.2. Zero-Balance or No-Load Reference Value Change Test.** – A test for change of zero-balance or no-load reference value shall be conducted on all scales after the removal of any test load. The change shall not be more than the minimum tolerance applicable.

**N.1.5. N.1.3. Discrimination Test.** – *A discrimination test shall be conducted on all automatic indicating scales with the weighing device in equilibrium at zero-load and at maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained.*

*[Nonretroactive as of January 1, 1986]*

**N.1.5.1. N.1.3.1. Digital Device.** – On a digital device, this test is conducted from just below the lower edge of the zone of uncertainty for increasing-load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

(Added 1987)

**T.1.2. To Increasing Load Tests. Basic tolerances shall be applied.**

**T.1.3. To Decreasing Load Tests. Basic tolerances shall be applied to systems used to weigh out.**

(Added 1986)

~~T.1.4.~~ **T.1.2. To Tests Involving Digital Indications or Representations.** – To the tolerances that would otherwise be applied, there shall be added an amount equal to one-half the value of the scale division. This does not apply to digital indications or recorded representations that have been corrected for rounding using error weights.

(Added 1986)

### **T.3. Basic Tolerance Values.**

**T.3.1. Acceptance Tolerance.** – The basic acceptance tolerance shall be one-half the basic maintenance tolerance.

**T.3.2. For Systems Used to Weigh Grain.** – The basic maintenance tolerance shall be 0.1 % of ~~test load~~ **accumulation material test.**

**T.3.3. For All Other Systems.** – The basic maintenance tolerance shall be 0.2 % of ~~test load~~ **accumulation material test.**

(Amended 1986)

**T.5. Repeatability.** – The ~~results obtained by several weighings of the same load under reasonably static test conditions~~ **variation in the values obtained during the conduct of accumulation material** tests shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances.

(Added 1986) (Amended 20XX)

### **Background/Discussion:**

The purpose of this proposal is to change the test notes and tolerances to reflect the way these devices are actually used. These are not “static” devices they are “dynamic.” Being dynamic devices, they have many additional factors affecting their accuracy compared to static devices. Some of these additional factors are: timing of gates and conveyors; additional vibration from system while trying to capture weight; operation of software; characteristics of materials being weighed; and environmental situations.

While evaluating Automatic Bulk Weighing Systems in the State of Oregon it was found that devices meeting static testing tolerances were in fact weighing with errors as high as 6 %. Through investigation it was found that a high percentage of the Automatic Bulk Weighing Systems in the state were in fact weighing in error when operating in their normal dynamic mode. These same devices would have received approval using only static methods.

The fundamentals of testing call for “testing as used.” This proposal lays out a method to do exactly that “test as used.”

Some facilities may find it difficult to accommodate the material test method. There may be substantial cost in restructuring facilities to allow for either the capture or introduction of test material.

Adopting this proposal would align the requirements with those of another dynamic device type, BCSs, which are addressed in NIST Handbook 44, Section 2.21.

### **2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The SMA opposed this item, providing the rationale that this item should be addressed in the initial verification of the device and not affect the type evaluation testing procedures.

Mr. Doug Deiman (AK) stated that while the proposal provided by the State of Oregon is a serious issue that needs to be addressed, he could not support a material test as written and gave an example of a test of fish scales commonly used in Alaska. As an illustration, Mr. Deiman noted that it would be necessary to procure thousands of pounds of fish to conduct each test and that the product would be largely destroyed in the process. He also noted that a test using substitute material would also be cumbersome and present a different set of problems. Mr. Deiman also pointed out

that the material testing would largely be a waste of time, based on the data provided by the submitter, which showed that gate timing was the problem on many of the test results. Mr. Deiman noted that gate timing is a process that is controlled and adjusted outside the sealable parameters of the system and could easily be manipulated after the tests are performed. Mr. Deiman stated he could not give a recommendation to the Committee on a course of action, but he could not support the proposal as written.

Mr. Jeff McLaughlin (InterSystems, Inc.) provided comments in opposition to the proposal, questioning how the same NIST Handbook 44 tolerances can be applied to both static and material tests.

Mr. Richard Suiter (Richard Suiter Consulting) stated he sees a lot of problems with the way the proposal was written. He voiced opposition to removing the static test from the ABWS Code and identified a number of concerns relating to the selection of a suitable reference scale including:

- the value of its minimum scale division (d);
- its degree of accuracy; and
- its location and distance from the ABWS that is to be tested.

Ms. Tina Butcher (OWM) provided a summary of OWM's analysis of this item, which has been copied below and was made available to the NCWM membership during the Open Hearings of the S&T Committee.

*OWM Analysis S&T Item 324-1*

A material test may have merit. The data provided by the State of Oregon during the 2014 Western Weights and Measures Association's Annual Meeting and included in their Annual Report seems to suggest that the results of a static test are not a true reflection of the accuracy of an ABWS when it is being operated in its normal automatic mode. For this reason, OWM encourages careful consideration be given when deciding the need for whether or not a material test should be part of the official examination of an ABWS. Although there are questions concerning the procedures used to collect the data, OWM believes that because of the magnitude of difference in the error when comparing results of static versus material tests, the concern being raised is worthy of additional investigation. OWM notes that a material test is part of Measurement Canada's Field Inspection Manual for ABWSs (referred to as "Bulk Weighing" or "Discontinuous Totalizing Devices") and of type evaluation criteria using OIML R 107 Discontinuous totalizing automatic weighing instruments (totalizing hopper weighers).

With regard to testing both statically (using physical standards) and dynamically (using reference material), OWM believes there may be value to both tests in that the results of each might be used to detect different problems within the system. For example, results of a static test might determine the accuracy of the scale and whether or not adjustment is necessary. If the static test proves the scale accurate, then inaccuracies detected during a material test might provide an indication of problems of another sort; for example, improper venting, vibration, printing of unstable weight indications, etc. In considering the future possibility of NIST Handbook 44 requiring both tests, the following are some unanswered questions raised by members of OWM's Legal Metrology Devices Program:

1. Should there be a different tolerance applied for each test, and if so, what should the tolerance be for each test?
2. What would be the proper use of adjustment required by a service technician when adjusting the scale to "as close to zero error as practical?" For example, would adjustments be made based on the results of the dynamic testing or the static testing?
3. Should the results of a static test be compared to the results of a material test and a repeatability tolerance applied? (OWM does not believe a repeatability tolerance should be applied to the results of different tests.)

The following are some additional issues, concerns, comments, and questions identified by OWM as needing to be addressed, including additional follow-up work needed in consideration of this proposal:

1. How does one account for the loss of material caused by conveyance of the reference material (e.g., water loss, if weighing wet commodities such as fish; grain loss if using circulating augers to transfer; etc.)? Guidelines for weighing and controlling the reference material will need to be developed.
2. Guidelines will also need to be established for determining the suitability and accuracy of the reference scale used to weigh the material used for the material test and the timing of the testing in relation to when material tests are conducted.
3. Can we get more comparison data for other commodities?
4. Should the material test be optional? This item isn't ready for vote – the issue needs more investigation.
5. How many material tests need to be conducted considering the weight/varieties of commodities weighed?

As a final note pertaining to proposed paragraph N.1.1.1. Accuracy of Material, OWM wishes to point out that it would not be appropriate to use material weighed to an accuracy within 0.1 % as a standard in testing another scale that has an applicable tolerance of 0.05 % (the current basic acceptance tolerance applicable to an ABWS used to weigh grain) or 0.1 % (the current basic acceptance tolerance applicable to an ABWS used to weigh products other than grain). The Fundamental Considerations of NIST Handbook 44 require the combined error and uncertainty of any standard used without correction to be less than one-third the applicable tolerance of the device being tested. In the case of a material test, the material that gets weighed on a suitable reference scale becomes the standard in testing when conducting the material tests. Thus, to be able to meet this requirement for use as a standard in testing an ABWS used to weigh grain, the maximum combined error and uncertainty of the material would need to be less than 0.033 % of its actual weight if applying basic acceptance tolerance (i.e., a value smaller than the quotient resulting from dividing 0.1 % by 3) unless corrections are made.

In discussing this item, several members of the Committee voiced disappointment that the submitter of the item was not present at the meeting to provide additional information concerning the data that had been collected or to answer questions regarding the proposal. The Committee initially considered withdrawing the item, but chose to assign it a Developing status in consideration of the large weighing errors reported, which were allegedly caused by weighing product using an ABWS in automatic operation soon after the scale portion of the ABWS had been tested statically and approved. In assigning the Developing status, the Committee wanted to provide the submitter the opportunity to develop the proposal further and receive additional input from the regional weights and measures associations.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: Mr. Steve Harrington (Oregon) reported that the State of Oregon's development of the item is ongoing. He asked that the Committee maintain its Developing status of the item to allow sufficient time for the Oregon to complete a more detailed proposal.

Mr. Russ Vires (Mettler-Toledo, LLC), speaking on behalf of the SMA reported that the SMA opposes the item. The SMA believes this item should be addressed in the initial verification of the device and not affect the type evaluation testing procedures.

A county official from the State of California commented that ABWS testing needs to start with a static test. A material test should be optional at the discretion of the official.

Ms. Tina Butcher (OWM) commented that OWM acknowledges it may not be practical to perform a material test on all ABWSs due to the large capacities of some systems and/or the types of commodities weighed. This point should be considered when further developing any proposal to add a material test to the ABWS Code of NIST Handbook 44; this includes clarifying when a test would be required and when a test would be conducted at the discretion of an official.

Ms. Butcher noted that a material test is part of Measurement Canada's Field Inspection Manual for ABWSs and the international type evaluation criteria included in OIML R 107. MC usually conducts both static and material tests on

ABWSs at facilities receiving inbound grain from the field. MC's S&T advisor reported that MC officials do NOT conduct a material test on *all* ABWSs. Two examples where a material test is *not* typically performed:

- 1) some larger capacity ABWSs (e.g., systems at export terminals used to weigh grain for ship loading); and
- 2) ABWSs used to weigh fish being received in bulk from commercial fishing vessels.

Ms. Butcher also reiterated many of the more significant points OWM had made in its analysis of the item for the 2015 Interim Meeting as follows:

- A material test may have merit. Data provided by the State of Oregon at the 2014 WWMA meeting seems to suggest that the results of a static test are not a true reflection of the accuracy of an ABWS in normal operation. Careful consideration should be given when deciding the need for whether or not a material test should be part of the official examination of an ABWS. The magnitude of difference in the error being reported when comparing results of static versus material tests makes it worthy of additional investigation.
- There may be value to testing both statically (using physical standards) and dynamically (using reference material).
- With regard to proposed paragraph N.1.1.1. Accuracy of Material, it would be inappropriate to use material weighed to an accuracy within 0.1 % as a standard in testing another scale that has an applicable tolerance of 0.05 % (the current basic acceptance tolerance applicable to an ABWS used to weigh grain) or 0.1 % (the current basic acceptance tolerance applicable to an ABWS used to weigh products other than grain).

She also reiterated many of issues, concerns, comments, and questions identified as needing to be addressed by members of OWM's Legal Metrology Devices Program (LMDP) in its analysis of this item leading up the NCWM Interim meeting as follows:

- Should there be a different tolerance applied for the different tests (static and material), and if so, what should the tolerance be for each test?
- What would be the proper use of adjustment required by a service technician when adjusting the scale to as close to zero error as practical?
- Should the results of a static test be compared to the results of a material test and a repeatability tolerance applied? (OWM does not believe a repeatability tolerance should be applied to the results of different tests.)
- Guidelines for weighing and controlling the reference material will need to be developed that provides instructions including: how to account for the loss of material caused by conveyance of the reference material (e.g., water loss, if weighing wet commodities such as fish; grain loss, if using circulating augers to transfer; etc.), and will tests need to be performed using all types of materials (products) that are weighed by the system?
- Guidelines will also need to be established for determining the suitability and accuracy of the reference scale used to weigh the material used for the material test and the timing of the reference scale testing in relation to when material tests are conducted.
- Is it possible to collect additional data for the weighing of other commodities (e.g., grain, seed, and coal) in this type of system?

In consideration of the comments received in support of this item and its ongoing development, the Committee agreed to maintain the Developing status of this item on its agenda.

**Regional Association Comments:**

CWMA 2014 Interim Meeting: The CWMA received a comment from an industry representative suggesting retaining the stricken language and potentially using the new language as a supplemental test method. The CWMA reported to the NCWM that it was unable to consider the item at this time, yet noted that it supported the development of this item. At the 2015 CWMA Annual Meeting, the SMA opposed this item providing the rationale that the issue should be addressed in the initial verification of the device and not affect the type evaluation testing procedures. The CWMA agreed to recommend the item move forward as a Developing item based on the CWMA S&T Committee's support for continued development.

Testimony was provided both for and against the proposal at the 2014 WWMA Annual Meeting. Several concerns were raised with the elimination of static testing in the original proposal. The item was updated based on these concerns to include both static and dynamic testing. In addition, the proposal will more closely align NIST Handbook 44 with OIML recommendations. The WWMA forwarded the item to the NCWM and recommended it as a Voting item as amended below:

**N.1.4. Material Tests. – Material used for test must be the actual material weighed by system or similar in nature. Material tests should be conducted using actual scale loading conditions. These loading conditions shall include, three accumulation tests consisting of three loadings at maximum capacity for the material and a partial loading of between 30 % and 50 % (three and a partial loadings).**

**On subsequent verifications, at least two individual tests shall be conducted. The results of all tests shall be within tolerance limits.**

**Either pass a quantity of pre-weighed material through the Automatic Bulk Weighing system in a manner as similar as feasible to actual loading conditions, or weigh all material that has passed through the Automatic Bulk Weighing System. Means for weighing the material test load will depend on the capacity of the system and availability of a suitable scale for the test. To assure that the test load is accurately weighed and determined, the following precautions shall be observed:**

- (a) **The containers, whether railroad cars, trucks, or boxes, must not leak, and shall not be overloaded to the point that material will be lost.**
- (b) **The actual empty or tare weight of the containers shall be determined at the time of the test. Stenciled tare weight of railway cars, trucks or boxes shall not be used. Gross and tare weights shall be determined on the same scale.**
- (c) **When a pre-weighed test load is passed through the scale, the loading system shall be examined before and after the test to assure that the system is empty and that only the material of the test load has passed through the scale.**
- (d) **Where practicable, a reference scale should be tested within 24 hours preceding the determination of the weight of the test load used for an Automatic Bulk Weighing System material test.**

**A reference scale which is not “as found” within maintenance tolerance should have its accuracy re-verified after the Automatic Bulk Weighing System test with a suitable known weight load if the “as found” error of the Automatic Bulk Weighing System material test exceeds maintenance tolerance values.\***

- (e) **If any suitable known weight load other than a certified test weight load is used for re-verification of the reference scale accuracy, its weight shall be determined on the reference scale after the reference scale certification and before commencing the Automatic Bulk Weighing System material test.\***

- (f) **The test shall not be conducted if the weight of the test load has been affected by environmental conditions.**

\*Note: Even if the reference scale is within maintenance tolerance it may require adjusting to be able to meet paragraph N.1.1.1. Accuracy of Material.

**N.1.4.1. Accuracy of Material. – The quantity of material used to conduct a material test shall be weighed on a reference scale to an accuracy within 0.1 %. Scales typically used for this purpose include Class III and III L scales or a scale without a class designation as described in Handbook 44, Section 2.20., Table T.1.1. Tolerances for Unmarked Scales.**

**N.1.4.2. Associated Equipment. – All associated equipment in local vicinity shall be in operation at time of test. This would include items such as conveyors; tote dumps, cleaning drums, rock separators, etc.**

~~N.1.4.~~ **N.1.5. Zero-Balance or No-Load Reference Value Change Test.** – A test for change of zero-balance or no-load reference value shall be conducted on all scales after the removal of any test load. The change shall not be more than the minimum tolerance applicable.

~~N.1.5.~~ **N.1.6. Discrimination Test.** – *A discrimination test shall be conducted on all automatic indicating scales with the weighing device in equilibrium at zero-load and at maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained.*

*[Nonretroactive as of January 1, 1986]*

~~N.1.5.1.~~ **N.1.6.1. Digital Device.** – On a digital device, this test is conducted from just below the lower edge of the zone of uncertainty for increasing-load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

(Added 1987)

### **T.3. Basic Tolerance Values.**

**T.3.2. For Systems Used to Weigh Grain.** – The basic maintenance tolerance shall be 0.1 % ~~of~~ **and apply to both the test load and material test.**

**T.3.3. For All Other Systems.** – The basic maintenance tolerance shall be 0.2 % ~~of~~ **and apply to both the test load and material test.**

(Amended 1986)

### **T.5. Repeatability.**

**T.5.1. Static Test Load** – The results obtained by several weighings of the same load under reasonably static test conditions tests shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances.

(Added 1986)

**T.5.2. Material Test – Variation in the values obtained during the conduct of material tests shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances.**

SWMA 2014 Annual Meeting: The SWMA recommended forwarding the language as drafted by the submitter after the Western Regional Meeting to the NCWM S&T so long as it is an optional test and recommended that the item be a Voting item.



NEWMA reported, at its 2014 Interim Meeting, it believes the justification for the proposal has merit. NEWMA recommended the item be forwarded to the NCWM for Vote. At its 2015 Annual Meeting, NEWMA's S&T Committee indicated more work needs to be completed on this item and recommended it remain in a Developing status. Consequently, NEWMA agreed to recommend the item move forward as a Developing item.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

## 324 AUTOMATIC WEIGHING SYSTEMS

### 324-1 W A.1. General.

(This item was Withdrawn.)

**Source:**

KSi Conveyors, Inc. (2015)

**Purpose:**

Provide clarity in NIST Handbook 44 as to what standards apply to weighing and measuring systems that provide a finished product based on the measurement of raw materials.

**Item Under Consideration:**

Amend NIST Handbook 44, Automatic Weighing Systems Code as follows:

**A.1. General.** – This code applies to devices used to automatically weigh pre-assembled discrete loads or single loads or loose materials in applications where automatic weighing systems<sup>1</sup> are used or employed in the determination of quantities, things, produce, or articles for distribution, for purchase, offered or submitted for sale, for distribution, purchase, or in computing any basic charge or payment for services rendered on the basis of weight, and in packaging plants subject to regulation by the USDA. Some weigh-labelers and checkweighers may also include a scale that is incorporated in a conveyor system that weighs packages in a static or non-automatic weighing mode.<sup>2</sup>

This includes:

- (a) Automatic weigh-labelers;
- (b) Combination automatic and non-automatic weigh-labelers;
- (c) Automatic checkweighers;
- (d) **Automatic batching systems;**
- (~~e~~) Combination automatic and non-automatic checkweighers; and
- (~~f~~) Automatic gravimetric filling machines that weigh discrete loads or single loads of loose materials and determine package and production lot compliance with net content representations.

(Amended 1997 and 2004)

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<sup>1</sup>An automatic weighing system does not require the intervention of an operator during the weighing process. The necessity to give instructions to start a process or to release a load or the function of the instrument (static, dynamic, set-up, etc.) is not relevant in deciding the category of automatic or non-automatic instruments.

(Added 2004)

<sup>2</sup>Prepackaging scales (and other commercial devices) used for putting up packages in advance of sale are acceptable for use in commerce if all appropriate provisions of NIST Handbook 44 are met. Users of such devices must be alert to the legal requirements relating to the declaration of quantity on a package. Such requirements are to the effect that, on the average, the contents of the individual packages of a particular commodity comprising a lot, shipment, or delivery must contain at least the quantity declared on the label. The fact that a scale or other commercial device may overregister, but within established tolerances, and is approved for commercial service is not a legal justification for packages to contain, on the average, less than the labeled quantity.

(Added 2004)

#### **Background/Discussion:**

The proposed addition to reference “batching systems” in the Application section of the Automatic Weighing Systems Code will accompany the proposal to add a definition for “batching systems” to NIST Handbook 44, Appendix D – Definitions. The CWMA has already agreed to forward the definition to the NCWM S&T Committee with the recommendation that it be a Voting item. The CWMA noted that the definition needs to reference the specific codes where the definition is applicable.

There are both automatic and non-automatic batching systems that utilize scales and/or meters already in the marketplace and there have been such devices in use for many years. The lack of a definition and the accompanying references may have just been an oversight on the part of the NCWM S&T Committee. For further clarification and justification please refer to the proposal in Item 360-1 to add a definition for “batching systems” which was also submitted to the SWMA for consideration.

#### **2015 NCWM Interim Meeting:**

The Committee agreed to group Agenda Items 320-1, 324-1, 330-1, and 360-1 together since these items are related and announced that comments on all four items would be taken together during its Open Hearings. The Committee agreed to withdraw these items in consideration of the comments and analysis that were provided. Refer to Agenda Item 320-1 for a summary of the comments provided concerning these four items and the reasons why they were withdrawn.

#### **Regional Association Meetings:**

SWMA 2014 Annual Meeting: The SWMA did not hear any comments in opposition to this item. The SWMA suggested that the NCWM S&T Committee may wish to consider merging Agenda Items 320-1, 324-1, 330-1, and 360-1 since they are all related. Comments were heard for all four of these agenda items at the same time. Mr. Dick Suiter (Richard Suiter Consulting) speaking on behalf of KSi Conveyors, Inc., provided an explanation and need for this item stating current language didn’t address auto-batching (or “all in one”) units. Several members asked questions regarding the proposals and some indicated confusion with the language. The SWMA forwarded the item to the NCWM recommending it as a Voting item.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

## **330 LIQUID MEASURING DEVICES**

### **330-1 W A.1. General.**

(This item was Withdrawn.)

#### **Source:**

KSi Conveyors, Inc. (2015)

#### **Purpose:**

Provide clarity in NIST Handbook 44 as to what standards apply to weighing and measuring systems that provide a finished product based on the measurement of raw materials.

**Item Under Consideration:**

Amend NIST Handbook 44, Liquid-Measuring Devices Code as follows:

**A.1. General.** – This code applies to:

- (a) devices used for the measurement of liquids, including liquid fuels and lubricants; ~~and~~
- (b) ~~wholesale~~ devices used for the measurement and delivery of agri-chemical liquids such as fertilizers, feeds, herbicides, pesticides, insecticides, fungicides, and defoliants; ~~and~~ and
- (c) liquid batching systems using meters to measure raw materials.

(Added 1985)

**Background/Discussion:**

The proposed addition to reference “batching systems” in the Application Section of the LMD Code will accompany the proposal to add a definition for “batching systems” to NIST Handbook 44, Appendix D – Definitions. The CWMA has already agreed to forward the definition to the NCWM S&T Committee with the recommendation that it be a Voting item. The CWMA noted that the definition needs to reference the specific codes where the definition is applicable. With the current definition for “retail” referring to an end user, the term “wholesale” should be removed from A.1.(b).

There are both automatic and non-automatic batching systems that utilize scales and/or meters already in the marketplace, and there have been such devices in use for many years. The lack of a definition and the accompanying references may have just been an oversight on the part of the NCWM S&T Committee. For further clarification and justification, please refer to the proposal in Item 360-1 to add a definition for “batching systems,” which was also submitted to the SWMA for consideration.

**2015 NCWM Interim Meeting:**

The Committee agreed to group Agenda Items 320-1, 324-1, 330-1, and 360-1 together since these items are related and announced that comments on all four items would be taken together during the Open Hearings. The Committee agreed to withdraw these items in consideration of the comments and analysis that were provided. Refer to Agenda Item 320-1 for a summary of the comments provided concerning these four items and the reasons why they were withdrawn.

**Regional Association Meetings:**

SWMA 2014 Annual Meeting: The SWMA requested an explanation from the submitter as to why “wholesale” was stricken from the language in the proposal. The submitter explained when the definition for “retail” was amended last, it referenced the end user, which excluded retail applications under the new definition. The SWMA did not hear any comments in opposition to this item. SWMA suggested that the NCWM S&T Committee may wish to consider merging agenda Items 320-1, 324-1, 330-1, and 360-1 since they are all related. Comments were heard for all four of these agenda items at the same time. The SWMA forwarded the item to the NCWM, recommending it as a Voting item.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**330-2 V Table S.2.2. Categories of Device and Methods of Sealing.**

(This item was Adopted.)

**Source:**  
Gilbarco, Inc. (2015)

**Purpose:**  
Recognize an electronic means to transfer the event logger information for Category 3 event loggers.

**Item Under Consideration:**  
Amend NIST Handbook 44, Liquid Measuring Devices Code as follows:

<i><b>Table S.2.2. Categories of Device and Methods of Sealing</b></i>	
<i><b>Categories of Device</b></i>	<i><b>Methods of Sealing</b></i>
<p><i><b>Category 1:</b> No remote configuration capability.</i></p>	<p><i>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i></p>
<p><i><b>Category 2:</b> Remote configuration capability, but access is controlled by physical hardware.</i></p> <p><i>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.</i></p>	<p><i>[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.]*</i></p> <p><i>[*Nonretroactive as of January 1, 1996]</i></p>
<p><i><b>Category 3:</b> Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</i></p> <p><i>[Nonretroactive as of January 1, 1995]</i></p> <p><i>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.</i></p> <p><i>[Nonretroactive as of January 1, 2001]</i></p>	<p><i>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available <u>on demand</u> through the device or through another on-site device. <u>The information may also be available electronically.</u> The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</i></p>

*[Nonretroactive as of January 1, 1995]*

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

**Background/Discussion:**

This proposal would recognize the use of an electronic means such as a thumb drive, flash drive, laptop computer, e-mail, or cell phone to receive event logger information from a dispenser or another on-site device. Event logger information in an electronic format is easier to sort and search than the traditional paper format. Paper versions of the event logger cannot be readily sorted and analyzed like an electronic log. NIST Handbook 44 allows the use of electronic receipts for consumers. Event loggers could be developed to take advantage of technology to facilitate weights and measures officials' review of event logs. A point to consider in evaluating this proposal is that weights and measures officials may not have means to receive the electronic version of the event logger.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee considered the following proposal to amend the sealing requirements for Category 3 devices covered by the Liquid Measuring Devices Code:

*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. **The use of an electronic means such as a thumb drive, flash drive, laptop computer, e-mail, cell phone may be used to receive the event logger information from a dispenser or another on-site device.** A printed copy of the information must be available through the device or through another on-site device **if the device is not equipped to offer an electronic means of supplying the information.** 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.)*

During the Open Hearings, Mr. Gordon Johnson (Gilbarco), submitter of the item, gave a short presentation on the merits of the proposal. During the presentation, Mr. Johnson requested that the original language proposed be amended to that shown in "Item Under Consideration." He noted this new language also incorporated slight changes that had been recommended by the Meter Manufacturers Association, and he agreed with those changes.

Ms. Tina Butcher (OWM) commented that while OWM understands the desire to make the information electronically accessible and agrees with the need to move in that direction, inspectors need the information at the time of inspection and in a form that is readily reviewable. This allows for better analysis and review of the changes that have been made over time. Inspectors need to be able to review the changes before they begin their inspection of the device. Inspectors shouldn't be expected to provide the equipment necessary for retrieval of the information, and the use of foreign storage devices to retrieve the information would likely be a security issue for some jurisdictions. She also noted that reviewing a history of changes on a cell phone would be difficult because of the limited display size. A printed log of the changes is needed to enable a review of the changes made over time.

Mr. Ross Andersen (New York, retired) stated the proposed changes are not needed and are already addressed in the public record laws of each state. Some questioned whether or not those laws apply to this type of record and suggested further examination of those laws is needed.

A few regulatory officials voiced concern regarding the equipment that would be needed to access the information and whether or not every official in every jurisdiction would have access to the equipment. An additional concern raised by officials is how secure the data would be if collected electronically. With respect to the security concern, it was suggested that perhaps equipment manufacturers could design their equipment in such a way to prevent uploads of data from occurring. Another suggestion was to possibly password encrypt the data. Comments in support of being able to access the data electronically were also heard. Ms. Kristin Macey (California) stated that we absolutely need the ability to provide information electronically; government will catch up.

Mr. Paul Lewis (Rice Lake Weighing) pointed out that officials typically only look at the sealable parameters that have changed since last inspecting the device. He reported, in his experience, that it's not all that much information.

The Committee agreed to replace the language originally proposed by the submitter with that shown in the "Item Under Consideration" and move this item forward for a Vote.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee heard numerous comments in support of the proposal by both industry and officials. Several of those providing comment in support of the proposal acknowledged the need for weights and measures officials to begin recognizing the use of electronic information. There was also testimony received from several weights and measures officials expressing concern over installing an electronic device such as a thumb drive, flash drive, etc. into government computers due to IT restrictions and potential transfer of computer viruses. A representative of an electric vehicle fueling device manufacturer stated that the Category 3 event logger information should only be required to be available electronically and the requirement that a printed copy be available through the device or another on-site device is archaic.

With respect to the concerns raised over installing an electronic device into government computers, Ms. Angela Godwin (Ventura County Department of Weights and Measures, California) offered one possible solution. She reported there are dedicated devices available in the marketplace capable of receiving digital storage devices that cost approximately \$200.00.

Ms. Butcher commented that OWM understands and supports the concept of eventually allowing required information to be made available electronically, but only if provisions are in place to make that information readily accessible. She noted that event logger information is used by officials to determine possible device manipulation. For this reason, the information needs to be made readily available to the official in hard copy at the time of inspection and in a format that is readily reviewable so changes that have been made over time are evident.

Ms. Butcher further commented that inspectors should not be expected to provide the equipment necessary to view the information. That equipment needs to be supplied by the owner/operator of the device, as is currently the case. As noted in OWM's comments at the 2015 Interim Meeting:

- Inspectors don't universally have access to the equipment needed to receive the event logger information onsite; and in many cases they would not be permitted to install a "foreign" storage device into a government issued computer, due to security reasons.
- Reviewing a history of changes using a cell phone or other device with a limited display would be very difficult. A printed log will typically better enable an inspector to review a device's history and determine the changes that have been made over time.
- Some of the Regional Weights and Measures Associations and the Measuring Sector have noted these same concerns.

Ms. Butcher noted that since the current requirement does not does not prohibit supplying the information electronically in addition to the hard copy, OWM believes the proposed changes are unnecessary and may cause undue confusion. Based on input from 2015 spring regional weights and measures association meetings, the language proposed seems to already be causing unnecessary confusion to an otherwise clear and straightforward requirement. Some are interpreting the changes to mean the event logger information can be solely provided electronically. OWM recommends that should the Committee still believe changes to the paragraph are necessary, the following alternative language, which makes clearer the need to provide the information in hard copy at time of inspection, should be considered:

*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 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.)*

Not everyone agreed with OWM's assertion that the proposed changes would cause confusion. Mr. Ron Hasemeyer (Alameda County Department of Weights and Measures, California) commented that the changes proposed would

still require the information be provided in hard copy. Other officials commented in support of Mr. Hasemeyer's interpretation noting that the words "must be available on demand" (as shown in the Item Under Consideration) and make clear that the information must be made available in hard copy at time of inspection, if requested.

The Committee, in considering the testimony received during the Open Hearings, agreed the changes being proposed should not lead to confusion. That is the Committee agreed the words "must be available on demand" could only be interpreted to mean that the event logger information must be available in printed form at the time of inspection. Thus, the Committee agreed to recommend the item be presented for Vote as shown in the Item Under Consideration.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: This item did not appear on the CWMA's S&T Agenda at the 2014 CWMA Interim Meeting, but did appear on the agenda at the 2015 CWMA Annual Meeting. During the CWMA S&T Committee's Open Hearings, Mr. Gordon Johnson (Gilbarco) gave a brief history of this item. Comments were received from industry supporting the item. Ms. Julie Quinn (Minnesota) voiced concern with potential manipulation of the software data. Ms. Fran Elson Houston (Ohio) commented the same software could potentially manipulate the printed receipt as well. The CWMA agreed to recommend the item move forward as a Voting item.

Testimony was presented by the submitter during the 2014 WWMA Annual Meeting with no opposing opinions being presented. The WWMA S&T Committee felt that the item had merit and would more easily facilitate examination of an audit trail. However, there are some concerns with respect to data security and the transfer of information to weights and measures officials. Therefore, the WWMA forwarded the item to NCWM, recommending that it be a Developing item to allow the submitter to refine the proposal.

SWMA 2014 Annual Meeting: The SWMA reported that it supported the general concept of this item, but believes it needs to be further developed by the submitter. Specifically, concerns were raised regarding corruption of files, violation of government IT policies pertaining to foreign devices interacting with government computers, and input by other manufacturers. The SWMA forwarded the item to the NCWM, recommending it as a Developing item.

**Measuring Sector Actions:**

The Measuring Sector considered this item during its 2014 meeting (2014 Measuring Sector Agenda Item 16) and decided that this proposal needs further development and agreed to carry it over to its 2015 Agenda.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**330-3 W N.4.1.3. Normal Tests on Wholesale Multi-Point Calibration Devices.**

(This item was Withdrawn.)

**Source:**

NCWM Multi-Point Calibration Group (MPCG) (2015)

**Purpose:**

Update the Liquid Measuring Device Code to reflect advances in meter calibration technology.

**Item Under Consideration:**

Add a new paragraph to the NIST Handbook 44 Liquid Measuring Devices Code as follows:

**N.4.1.3. Normal Tests on Wholesale Multi-Point Calibration Devices. – The normal test of a wholesale liquid-measuring device with electronically programmed linearization factors for various flow rates shall be made at the maximum discharge rate developed by the installation. Any additional tests conducted at flow rates down to and including the rated minimum discharge flow rate shall be considered normal tests.**

**Background/Discussion:**

New technology makes it possible to use linearization factors to optimize accuracy at every flow rate for which a wholesale meter is programmed to deliver. A special tolerance has traditionally been applied to slow flow tests on wholesale meters with mechanical single-point calibrators because accuracy could only be optimized at one flow rate. A wholesale multi-point calibrated meter does not require a special tolerance at any flow rate since every flow rate can be adjusted as close to zero as practicable.

This supports the principle expressed in G-UR.4.3. that adjustments shall be made so as to bring performance errors as close to zero as possible. It also reduces the amount of bias error, which startup and shutdown rates introduce into the proving process, by reducing performance errors at slow-flow startup and shutdown flow rates. The proposed paragraph N.1.4.3. would apply only to meters that are actually configured with multiple calibration points. Meter owners who do not want to take the time to calibrate at multiple flow rates may configure their meters for single point calibration.

This allows meters with single point calibration to have a larger tolerance at slow-flow rates than meters with multi-point calibration. Multi-point calibrated devices are increasingly used as commercial meters. The question of whether they should be treated differently than devices with single-point calibration needs to be addressed.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 330-3, 331-1, and 360-2 were grouped together and comments taken simultaneously since the Committee considered them related. A summary of comments heard on all three items are as follows:

With respect to Agenda Item 330-3, Ms. Tina Butcher (NIST, OWM) stated that there appears to be a “structural issue” and potential conflict with N.4.1.3. She provided a brief summary of OWM’s analysis of this item (shown below), which was provided to Committee members in a written report and made available to the NCWM membership during the Open Hearings.

*NIST OWM’s Analysis of Agenda Item 330-3*

Additional work is needed on this proposal. In considering this item, NIST, OWM identified the following issues that will need to be addressed:

- The second sentence of proposed new paragraph N.4.1.3. conflicts with the second sentence of current paragraph N.4.1. Normal Tests. Given this conflict, how can the code best be structured to accommodate the addition of this new proposed requirement? That is, what should the paragraph hierarchy look like and will current requirements need to be changed to avoid conflicts and added confusion?
- Why does the proposal limit tests to wholesale devices? OWM questions why this principle wouldn’t apply to any measuring device with multi-point calibration capability?
- Should Table T.2. be amended to make clear the tolerance intended to apply to the results of all the testing that will need to be conducted on devices with multi-point calibration?
- Paragraph N.4.2. Special Tests specifies that a “Special Test” shall be made; yet, OWM believes that the multi-calibration group intends for all testing associated with a device equipped with multi-point calibration be “Normal” tests and “Normal” test tolerances intended to apply. If this is the case, how are officials to meet the obligation of performing a “Special Test” as specified?

How will the addition of this new paragraph affect other paragraphs in the code? All current paragraphs should to be reviewed to make certain additional conflicts or confusion isn’t being created by the addition of any new paragraph.



With respect to Agenda Item 331-1, Ms. Butcher noted that NIST, OWM's analysis and comments for the item are the same those made in NCWM S&T Item 330-3. However, it is important to point out that the language proposed was copied and pasted from NCWM S&T Item 330-3 and then modifications of terms from "wholesale" to "vehicle-tank" were made. The reference to "wholesale" multi-point calibrated devices was overlooked in several places and remains in this item. Consequently, there are multiple corrections that must be made to change references from "wholesale" to "vehicle-tank" or "vehicle-tank meter" as appropriate. In that regard, the following amendments are needed:

1. Amend the proposal's NCWM Publication 15 heading to read: "331-1 N.4.1.4. Normal Tests on ~~Wholesale~~ Vehicle-Tank Multi-Point Calibration Devices."
2. Amend the "Purpose" statement to read: "Update the ~~Liquid Measuring Device~~ Vehicle-Tank Meter Code to reflect advances in meter calibration technology."
3. Amend the Item Under Consideration statement to read: "Add a new paragraph to the NIST Handbook 44 ~~Liquid Measuring Devices~~ Vehicle-Tank Meter Code as follows:"
4. Amend the proposal's reference title to read: "N.4.1.4. Normal Tests on ~~Wholesale~~ Vehicle-Tank Multi-Point Calibration Devices."

With respect to Agenda Item 360-2, Ms. Butcher provided a brief summary of OWM's analysis of this item, which was also provided to Committee members in a written report and made available to the NCWM membership during the Open Hearings. The following analysis was provided:

*OWM's analysis of Agenda Item 360-2:*

If adopted, NCWM S&T Item 360-2 would do the following:

1. it would include citations to NIST Handbook 44, Sections 3.31., 3.32, 3.34., and 3.35. into the definition of "calibration parameter;" and
2. it would add a definition for "multi-point calibrated device."

The term "calibration parameter" is used in the *Categories of Device and Methods of Sealing* tables in NIST Handbook 44, Sections 3.31., 3.32., 3.34., and 3.35., but these Sections are not currently cited in the definition of calibration parameter. NIST OWM believes that for consistency and correctness it is appropriate that these references be added to this definition.

The term "multi-point calibrated device" does not currently appear in NIST Handbook 44, and for that reason, it would not be appropriate to add a definition unless one or more of the proposals related to multiple-point calibration are adopted. If this were to occur, then a definition would be necessary.

In the "Background/Discussion" portion of this item, there are comments that other equipment "such as meters, weighing devices, and other devices" has the capability of multiple-point calibration. This may be true; however, the term, "multi-point calibrated device" is not used in any of the current NIST Handbook 44 codes. Thus, NIST, OWM believes this definition is not necessary.

Due to the similar context, intent, and companionship of NCWM S&T Committee Agenda Items 330-3, 330-4, 331-1, 331-2, and 360-2, NIST, OWM recommends that all of these items be heard and discussed by the Conference at the same time.

- (1) Mr. Henry Oppermann (Weights and Measures Consulting, LLC) provided written comments to the Committee in opposition to Agenda Items 330-3 and 331-1 and provided a summary of his concerns during the Open

Hearings. He stated these items were against some weights and measures principles, and the existing tolerances for these devices are acceptable. The proposal would have the effect of changing NIST Handbook 44 tolerances by considering flow rates down to the minimum discharge rate of meter to be normal tests on multi-point calibration devices. This is wrong because:

1. Accuracy requirements (tolerances) are established based on the accuracy that is required for a particular application of the devices at a reasonable cost.
  2. The tolerances for a given measurement application are **not** based upon the technologies used in devices.
  3. Any device that meets the specifications and tolerances for a given application may be used for that application.
  4. It is wrong to penalize a technology with tighter tolerances simply because it can produce more accurate measurements than other technologies used in the same application.
- (2) Mr. Oppermann also noted that weights and measures officials, industry representatives, and users of weighing and measuring devices work together to establish acceptable tolerances for different applications based upon the fundamental consideration stated above. If changes to tolerances are considered, then the changes should apply to all devices and device technologies used in the application of interest. If weights and measures jurisdictions deviate from the principles stated above, then different tolerances could be established for positive displacement meters, turbine meters, and mass flow meters used in the same applications. Similarly, different tolerances could be proposed for mechanical versus load cell vehicle scales. This would be unnecessary and wrong. Tolerances for devices must be based upon what is considered acceptable for the application. Favoring or penalizing one technology or design over another is unacceptable.

Mr. Constantine Cotsoradis (Flint Hills Resources), a member of the multi-point calibration WG, stated this was an issue of a “Special Test” versus a “Normal Test” and puts the burden on the user.

Mr. Ross Andersen (New York, Retired) suggested that the “Fundamental Considerations” in NIST Handbook 44 needed to be fixed to address calibration drift. He stated meters operate in an environment, and it needs to be recognized that meter performance is affected by temperature, product viscosity, and other factors. He further noted that if you test the same meter once a week for an entire month, it will provide different results. Mr. Andersen agreed with Mr. Oppermann’s assessment that calibration curves change due to drift.

Mr. Dick Suiter (Richard Suiter Consulting) stated that if a meter with multi-point calibration is used, then weights and measures officials need to look at multiple points. Ms. Julie Quinn (Minnesota), Chair of the MPCG, requested this item remain in Developing status because a consensus within the MPCG has not been achieved. Mr. Dmitri Karimov representing the Meter Manufacturer’s Association and a member of the MPCG added that the MPCG also discussed the length of time for testing, which is also a concern.

The SMA reported that it opposed the definition of multi-point calibrated device and offered the following alternative for consideration:

**Multi-point calibration.** – A means to electronically program calibration factors at multiple measurement points.

The Committee agreed this item should move forward as a Developing item based on the comments received and the submitter’s recommendation that it remain Developing because additional work is needed.

#### **2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 330-3, 331-1, and 360-2 and take comments on these items simultaneously. Mr. Russ Vires (Mettler-Toledo, LLC) speaking on behalf of the SMA reported that the SMA is opposed to the definition being proposed for “multi-point calibrated device” in Agenda Item 360-2. Ms. Quinn, submitter of all the items in the group recommended Items 330-3 and 331-1 be Withdrawn

in their entirety. She also recommended that the Committee delete the definition of “multi-point calibrated device” in Agenda Item 360-2 and maintain its Developing status because further updates to the NIST Handbook 44 Code references within the current NIST Handbook 44 definition of “calibration parameter” are planned.

Hearing no comments in support of Agenda Items 330-3 and 331-1 and a recommendation by the submitter to Withdraw them, the Committee agreed to Withdraw these items. The Committee also agreed to delete the proposed definition of “multi-point calibrated device” from Agenda Item 360-2 and maintain its Developing status to allow the submitter of the item additional time to develop the proposal.

**Regional Association Comments:**

**CWMA 2014 Interim Meeting:** The CWMA received a presentation to clarify the purpose of this item. A regulatory official voiced support for this item. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to the NCWM, recommending it as a Voting item. At the 2015 CWMA Annual Meeting, there were no comments received on this item. The CWMA agreed to recommend the item move forward as a Developing item, noting that it supported its continued development.

**WWMA 2014 Annual Meeting:** Testimony was presented at the 2014 WWMA Annual Meeting by a member of the MPCG, stating that the item is fully developed and ready to be a Voting item. No opposition was heard during open hearing and the WWMA agreed that the item was sufficiently developed and forwarded it to NCWM, recommending that the item be a Voting item.

**SWMA 2014 Annual Meeting:** The SWMA S&T Committee recommended the item be Withdrawn based on concerns that, if adopted, it would result in extensive additional work required by inspectors; increased downtime for businesses; questionable gain when compared to existing tolerances; and result in the approval of devices for each product type. The SWMA doesn’t believe the handbooks are the proper place for examples. Based on the SWMA S&T Committee’s recommendation, the SWMA did not forward this item to the NCWM; recommending instead that it be Withdrawn.

**NEWMA 2014 Interim Meeting:** NEWMA combined Agenda Items 330-3, 331-1, and 360-2 into one agenda item. NEWMA reported it believes the item has merit, but required more information before any further judgment could be made on it. NEWMA forwarded the item to the NCWM and recommended that it be an Information item. NEWMA agreed to combine Agenda Items 360-2, 330-3, and 331-1 at its 2015 Annual Meeting and recommend this item move forward as a Developing item as the MPCG amends language in the proposal.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**330-4 D N.4.5. Determination of Error on Wholesale Devices with Multiple Flow Rates and Calibration Factors**

**Source:**

Minnesota Weights and Measures Division (2014)

**Purpose:**

To update NIST Handbook 44 to reflect the technological changes in registers for liquid measuring devices and to alert weights and measures officials to the fact that error in start-up and shut-down delivery quantities can introduce linear errors in the calibration at normal flow rates; these errors increase the further the delivered quantity deviates from the prover size used at calibration.

**Item Under Consideration:**

*(Note: This version of the proposal was added at the request of the submitter during the 2015 NCWM Annual Meeting and replaces previous versions of the proposal.)*

Amend NIST Handbook 44, Liquid-Measuring Devices Code as follows:

**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/Discussion:**

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 consumer’s favor) in the start-up and shut-down portions of the delivery may actually create shortages in the total delivery if calibration at the normal flow 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 that 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 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 they have no problems with this requirement by making sure their devices are in tolerance at slow flow start-up and shut-down rates and errors are not predominantly in one direction.

See Appendix D in this report, “How Slow Flow Accuracy Affects LMDs” for additional background information related to this proposal.

See the 2014 S&T Committee's Annual Report to review previous language and positions regarding the proposed addition of Paragraphs N.4.2.5. Initial Verification and UR. 2.5.1. Initial Verification Proving Reports to NIST Handbook 44, Liquid-Measuring Devices Code.

**2015 NCWM Interim Meeting:**

NCWM 2015 NCWM Interim Meeting: The Committee considered the following proposal to add two new paragraphs to NIST Handbook 44, Liquid-Measuring Devices Code:

**N.4.2.5. Initial Verification. – A wholesale liquid measuring device 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 wholesale liquid measuring device 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 meter is electronically programmed to deliver regular and premium gasoline at a startup/shutdown flow rate of 150 gpm, a normal operating flow rate of 650 gpm, and a fall-back rate of 450 gpm. The meter is to be tested with regular gasoline at 150 gpm, 450 gpm and 650 gpm; and with premium gasoline at 150 gpm, 450 gpm and 650 gpm.**

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

**UR.2.5.1. Initial Verification Proving Reports. – Initial verification proving reports for wholesale liquid measuring devices 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.**

The Committee decided to group together Items 330-4 and 331-2 and comments were taken simultaneously on those items since the Committee considered them companion items. Ms. Julie Quinn (Minnesota), speaking as Chair of the MPCG, stated that the MPCG received comments indicating there are concerns regarding the amount of time it would take to test multi-point calibration devices if this item were adopted. She recommended the item remain Developmental and stated that the MPCG may wish to consider the Canadian model in addressing devices equipped with multi-point calibration.

Ms. Tina Butcher (OWM) acknowledged 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. She reported OWM questions, however, whether it is reasonable to expect all regulatory jurisdictions be equipped with the resources necessary to perform the extensive amount of testing required by this proposal. OWM believes 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. Ms. Butcher also summarized the following list of issues that OWM had identified in its analysis of this item as needing additional work to further develop the proposal:

- 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 MPCG 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 MPCG to classify the testing to be performed on a device with multi-point calibration as “Normal” tests opposed to “Special” tests (which is NIST, 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.”

Mr. Oppermann provided the Committee a written analysis of these items, which he summarized as follows:

The test procedures proposed in Agenda Items 330-4 and 331-2 are directed to service companies placing meters into service and HB 44 is the wrong place for instructions to service companies regarding how devices are to be placed into service. The “Notes” section of these two device codes (LMD and VTM) already permits officials to conduct any additional tests that they deem necessary to determine the performance characteristics of the meters being tested. Each NIST EPO describes the minimum examination for official action. The EPOs provide officials the necessary latitude to conduct additional tests or to repeat any or all tests as part of the examination process. He also stated that the term “initial verification” is used incorrectly in the proposal to apply to tests performed by service company representatives when placing meters into service. Initial verification applies to the first inspection and test conducted by weights and measures officials on a new weighing or measuring device.

Ms. Quinn commented the term “initial verification” is meant to refer to devices being tested for the first time.

In consideration of the comments provided during the Open Hearings and the recommendation provided by the Chair of the WG that the item remain in a Developing status, the Committee agreed to assign this item a Developing status.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 330-4 and 331-2 and take comments simultaneously on these two items. During the Open Hearings, Ms. Quinn, submitter of the two items, asked that the language in the proposal considered by the Committee at the 2015 Interim Meeting be replaced with a revised version. 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 two proposals and, during this meeting, the group developed the revised version of the proposal. Based on Ms. Quinn’s recommendations, the Committee agreed to replace the previous proposal with that shown in the “Item Under Consideration” above.

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. Tina 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 needed to verify the performance of a metering system with multi-point calibration capabilities. She also indicated detailed procedures might be better suited

to inclusion 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 MPCG 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 MPCG 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? When using this term, did the MPCG 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?
  - 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 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 previously proposed language with that recommended by Ms. Quinn during the Open Hearings and the new language is now shown in the "Item Under Consideration." The Committee looks forward to future refinements of this item by the submitter:

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA received a presentation at the meeting, to clarify the purpose of this item. A regulatory official voiced support for this item. The CWMA agreed the item was sufficiently developed and recommended that it be a Voting item as amended below:

~~***N.4.2.5. Determination of Error on Whole Sale Devices with Multiple Flow Rates and Calibration Factors-Initial Verification. – On whole sale devices which are configured with multiple flow rates where each flow rate has its own calibration factor, and which are programmed to deliver a set quantity at a slow flow rate on start-up and/or shut-down, the effect of start-up and shut-down rates on the accuracy—the typical delivery shall be considered if the typical delivery is greater or less than the test measure used at the time of evaluation. The weights and measures jurisdiction shall determine the size of the typical delivery based upon available evidencee. A wholesale liquid measuring device shall be tested at all flow rates and with all products for which a calibration linearization factor has been electronically programmed prior to placing it into commercial service for the first time or after being repaired or replaced.***~~

***A wholesale liquid measuring device not equipped with means to electronically program its flow rates and calibration linearization 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 meter is electronically programmed to deliver regular and premium gasoline at a startup/shutdown flow rate of 150 gpm, a normal operating flow rate of 650 gpm, and a fall-back rate of 450 gpm. The meter is to be tested with regular gasoline at 150 gpm, 450 gpm and 650 gpm; and with premium gasoline at 150 gpm, 450 gpm and 650 gpm.***

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

***UR.2.5.1. Initial Verification Proving Reports. – Initial verification proving reports for wholesale liquid measuring devices 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.***

CWMA 2015 Annual Meeting Open Hearings: Ms. Julie Quinn (Minnesota), submitter of the item, reported that a WG is still Developing the item. Consequently, the CWMA agreed to recommend the item move forward as a Developing item noting support for its continued Development.

Testimony was presented at the 2014 WWMA Annual Meeting by a member of the MPCG, stating that the item is fully developed and ready to be a Voting item. No opposition was heard during the Open Hearings and the WWMA agreed that the item was sufficiently developed and recommended that it be a Voting item as amended below:

***N.4.1.3,N.4.2.5. Initial Verification.***

- (a) A wholesale liquid measuring device shall be tested at all flow rates and with all products for which a calibration linearization factor has been electronically programmed prior to placing it into commercial service for the first time or after being repaired or replaced.***



**(b) A wholesale liquid measuring device not equipped with means to electronically program its flow rates and calibration linearization 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 meter is electronically programmed to deliver regular and premium gasoline at a startup/shutdown flow rate of 150 gpm, a normal operating flow rate of 650 gpm, and a fall-back rate of 450 gpm. The meter is to be tested with regular gasoline at 150 gpm, 450 gpm and 650 gpm; and with premium gasoline at 150 gpm, 450 gpm and 650 gpm.**~~

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

**UR.2.6.UR.2.5.1. Initial Verification Proving Reports. – Initial verification proving reports for wholesale liquid measuring devices 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.**

SWMA 2014 Annual Meeting: The SWMA S&T Committee recommended the item be withdrawn based on concerns that, if adopted, it would result in extensive additional work required by inspectors; increased downtime for businesses; questionable gain when compared to existing tolerances; and the approval of devices for each product type. The Committee doesn't believe the handbooks are the proper place for examples. Based on the SWMA S&T Committee's recommendation, the SWMA did not forward this item to the NCWM; recommending, instead, it be Withdrawn.

NEWMA 2014 Interim Meeting: NEWMA did not receive comments on this item at its Interim Meeting and recommended that the item be Withdrawn. At its 2015 Annual Meeting NEWMA did not receive comments but changes its earlier position on this item recommending it be given a Developing status pending further information.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **331 VEHICLE-TANK METERS**

#### **331-1 W N.4.1.4. Normal Tests on Wholesale Multi-Point Calibration Devices.**

(This item was Withdrawn.)

**Source:**

NCWM Multi-Point Calibration Group (MPCG) (2015)

**Purpose:**

Update the Liquid Measuring Device Code to reflect advances in meter calibration technology.

**Item Under Consideration:**

Add a new paragraph to the NIST Handbook 44, Liquid Measuring Devices Code as follows:

**N.4.1.4. Normal Tests on Wholesale Multi-Point Calibration Devices. – The normal test of a vehicle tank meter with electronically programmed linearization factors for various flow rates shall be made at the maximum discharge rate developed by the installation. Any additional tests conducted at flow rates down to and including the rated minimum discharge flow rate shall be considered normal tests.**

**Background/Discussion:**

New technology makes it possible to use linearization factors to optimize accuracy at every flow rate for which a vehicle-tank meter is programmed to deliver. A special tolerance has traditionally been applied to slow flow tests on vehicle-tank meters with mechanical single-point calibrators because accuracy could only be optimized at one flow rate. A vehicle-tank multi-point calibrated meter does not require a special tolerance at any flow rate since every flow rate can be adjusted as close to zero as practicable.

This supports the principle expressed in G-UR.4.3. that adjustments shall be made so as to bring performance errors as close to zero as possible. It also reduces the amount of bias error that startup and shutdown rates introduce into the proving process by reducing performance errors at slow-flow startup and shutdown flow rates. The proposed paragraph N.4.1.4. would apply only to meters that are actually configured with multiple calibration points. Meter owners who do not want to take the time to calibrate at multiple flow rates may configure their meters for single point calibration.

This allows meters with single point calibration to have a larger tolerance at slow-flow rates than meters with multi-point calibration. Multi-point calibrated devices are increasingly used as commercial meters. The question of whether they should be treated differently than devices with single-point calibration needs to be addressed.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 330-3, 331-1, and 360-2 were grouped together and comments taken simultaneously since the Committee considered them related. See Agenda Item 330-3 for a summary of the comments heard on all three of these agenda items.

The Committee agreed this item should move forward as a Developing item based on the comments received and the submitter's recommendation that it remain Developing because additional work is needed.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 330-3, 331-1 and 3602 and take comments on these items simultaneously. Mr. Russ Vires (Mettler-Toledo, LLC) speaking on behalf of the SMA reported that the SMA is opposed to the definition being proposed for "multi-point calibrated device" in Agenda Item 360-2. Ms. Julie Quinn (Minnesota), submitter of all the items in the group recommended Items 330-3 and 331-1 be Withdrawn in their entirety. She also recommended the Committee delete the definition of "multi-point calibrated device" in Agenda Item 360-2 and maintain its Developing status because further updates to the NIST Handbook 44 Code references within the current NIST Handbook 44 definition of "calibration parameter" are planned.

Hearing no comments in support of Agenda Items 330-3 and 331-1 and a recommendation by the submitter to Withdraw them, the Committee agreed to withdraw these items. The Committee also agreed to delete the proposed definition of "multi-point calibrated device" from Agenda Item 360-2 and maintain its Developing status to allow the submitter of the item additional time to develop the proposal.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: CWMA heard a presentation at its Interim Meeting to clarify the purpose of this item. A regulatory official voiced support for this item. The CWMA appreciates the efforts of the WG and believes this item is sufficiently developed. The CWMA forwarded the item to the NCWM, recommending it as a Voting item. During the 2015 CWMA Annual Meeting, Ms. Quinn, submitter of the item, commented that the MPCG is still Developing the item. Consequently, the CWMA agreed to recommend the item move forward as a Developing item.

WWMA 2014 Annual Meeting: Testimony was presented at the 2014 WWMA Annual Meeting by a member of the MPCG, stating the item is fully developed and ready to be a Voting item. The item was amended to address concerns expressed during Open Hearings. No opposition was heard, and the WWMA agreed the item was sufficiently developed. The WWMA forwarded the item to NCWM and recommended it as a Voting item as amended below:

**N.4.1.4.N.4.1.3. Normal Tests on Wholesale Multi-Point Calibration Devices. – The normal test of a vehicle tank meter with electronically programmed linearization factors for various flow rates shall be**

**made at the maximum discharge rate developed by the installation. Any additional tests conducted at flow rates down to and including the rated minimum discharge flow rate shall be considered normal tests.**

SWMA 2014 Annual Meeting: The SWMA S&T Committee recommended the item be Withdrawn based on concerns that if adopted, it would result in extensive additional work required by inspectors; increased downtime for businesses; questionable gain when compared to existing tolerances; and result in the approval of devices for each product type. The SWMA doesn't believe the handbooks are the proper place for examples. Based on the SWMA S&T Committee's recommendation, the SWMA did not forward this item to the NCWM; recommending, instead, it be Withdrawn.

NEWMA 2014 Interim Meeting: NEWMA combined Agenda Items 330-3, 331-1, and 360-2 as one agenda item. NEWMA reported it believes the item has merit but required more information before any further judgment could be made on it. NEWMA forwarded the item to NCWM, recommending it as an Information item. NEWMA agreed to combine Agenda Items 360-2, 330-3, and 331-1 at its 2015 Annual Meeting and recommend this item move forward as a Developing item as the MPCG amends language in the proposal.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **331-2 D N.4.2.1. Determination of Error on Vehicle-Tank Meters with Multiple Flow Rates and Calibration Factors**

**Source:**

Minnesota Weights and Measures Division (2014)

**Purpose:**

To update NIST Handbook 44 to reflect the technological changes in registers for vehicle-tank meters and to alert weights and measures officials to the fact that error in start-up and shut-down delivery quantities can introduce linear errors in the calibration at normal flow rates which increase the further the delivered quantity deviates from the prover size used at calibration.

**Item Under Consideration:**

*(Note: This version of the proposal was added at the request of the submitter during the 2015 NCWM Annual Meeting and replaces previous versions of the proposal.)*

Amend NIST Handbook 44 Vehicle-Tanks Meter Code as follows:

**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/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 that do not use electronic calibration factors to optimize accuracy at every delivery rate. Even at locations that do, no action is required unless the official notices 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 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.

See Appendix E, How Slow Flow Errors Affect VTMs.

See the 2014 S&T Committee’s Annual Report to review previous language and positions to add Paragraphs N.4.5. Initial Verification and UR. 2.5.1. Initial Verification Proving Reports to NIST Handbook 44, Vehicle-Tank Meters Code.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee considered the following proposal to add two new paragraphs to NIST Handbook 44, Vehicle-Tank Meters Code:

**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.**

The Committee grouped together Items 330-4 and 331-2 and comments were taken simultaneously since the Committee considered these to be companion items. For a summary of the comments provided during the Open Hearings, refer to Agenda Item 330-4. In consideration of the comments received, the Committee agreed to assign a Developing status to both of these items.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 330-4 and 331-2 and take comments simultaneously on these two items. For a summary of the comments received during the Open Hearings on these two agenda items, refer to Agenda Item 330-4. During the Open Hearings, Ms. Julie Quinn (Minnesota), submitter of the two items, asked that the language in the proposal considered by the Committee at the 2015 Interim Meeting be replaced with a revised version. 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 two proposals, and during this meeting, the group developed the revised version of the proposal. Based on Ms. Quinn's recommendations, the Committee agreed to replace the previous proposal with that shown in the "Item Under Consideration" above.

**Regional Association Comments:**

CWMA 2014 Interim Meeting: The CWMA heard a presentation to clarify the purpose of this item. A regulatory official voiced support for this item. The CWMA agreed that the item was sufficiently developed and recommended it be a Voting item as amended below:

**N.4.6. Determination of Error on Vehicle Tank Meters with Multiple Flow Rates and Calibration Factors-Initial Verification. – On vehicle tank meters which are configured with multiple flow rates where each flow rate has its own calibration factor, and which are programmed to deliver a set quantity at a slow flow rate on start-up and/or shut-down, the effect of start-up and shut-down rates on the accuracy of the typical delivery shall be considered if the typical delivery is greater or less than the test measure used at the time of evaluation. The weights and measures jurisdiction shall determine the size of the typical delivery based upon available evidence. A vehicle tank meter shall be tested at all flow rates and with all products for which a calibration linearization 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 linearization 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.**

CWMA 2015 Annual Meeting: The CWMA received comments from the submitter of the item indicating a WG was still developing the item. Consequently, the CWMA agreed to change its earlier recommendation that the item move forward as a Voting item to the recommendation of moving the item forward as a Developing item.

WWMA 2014 Annual Meeting: Testimony was presented at the 2014 WWMA Annual Meeting by a member of the MPCG, stating that the item is fully developed and ready to be a Voting item. No opposition was heard during the WWMA Open Hearings and the WWMA agreed that the item was sufficiently developed and recommended that it be a Voting item as amended below:

**N.4.6. Initial Verification.**

- (a) A vehicle tank meter shall be tested at all flow rates and with all products for which a calibration linearization factor has been electronically programmed prior to placing it into commercial service for the first time or after being repaired or replaced.**
- (b) A vehicle tank meter not equipped with means to electronically program its flow rates and calibration linearization 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.**

SWMA 2014 Annual Meeting: The SWMA's S&T Committee recommended the item be Withdrawn based on concerns that, if adopted, it would result in extensive additional work required by inspectors; increased downtime for businesses; questionable gain when compared to existing tolerances; and the approval of devices for each product type. The SWMA S&T Committee doesn't believe the handbooks are the proper place for examples. Based on the Committee's recommendation, the SWMA did not forward this item to the NCWM; recommending instead, that it be Withdrawn.

NEWMA 2014 Interim Meeting: NEWMA did not receive comments on this item at its 2014 Interim Meeting and recommended the item be Withdrawn. At its 2015 Annual Meeting, NEWMA did not receive comments, but changed its earlier position on this item, recommending it be Developing pending further information.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### 332 LPG AND ANHYDROUS AMMONIA LIQUID-MEASURING DEVICES

332-1 I S.1.4.3. Provisions for Power Loss, S.1.5.1.1. Unit Price, S.1.5.1.2. Product Identity, S.1.6. For Retail Motor Vehicle Fuel Devices Only, S.1.7. For Wholesale Devices Only, UR.2.7. Unit Price and Product Identity, and UR.2.8. Computing Device.

**Source:**

California Department of Food and Agriculture Division of Measurement Standards (2014)

**Purpose:**

Add similar specifications and user requirements for other retail motor-fuel devices 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.

**Item Under Consideration:**

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

**S.1.4. For Retail Devices Only (No Change)**

**S.1.4.1. Indication of Delivery (No Change)**

**S.1.4.2. Return to Zero (No Change)**

**S.1.4.3. Provisions for Power Loss.**

**S.1.4.3.1. Transaction Information.**

**(a) In the event of a power loss, a computing retail liquefied petroleum dispensing device shall display 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 dispenser or at the console if the console is accessible to the customer.**

**(b) In the event of a power loss, both an electronic digital retail non-computing stationary liquefied petroleum gas dispenser and a vehicle-mounted electronic digital liquefied petroleum gas dispenser shall display the information needed to complete any transaction in progress at the time of the power loss.**

**S.1.4.3.2. User Information. – The device memory shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.**

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

**S.1.5.1. Display of Unit Price and Product Identity. – In 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.**

**S.1.5.1.1. Unit Price.**

**(a) A computing or money-operated device shall be able to display on each face the unit price at which the device is set to compute or to dispense.**

**(b) Except for dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), whenever a grade, brand, blend, or mixture is offered for sale from a device at more than one-unit price, then 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 for all grades, brands, blends, or mixtures 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 (b)(1), provided the system complies with S.1.6.8. 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 purchaser: 1) using controls on the device; 2) through the purchaser's use of personal or vehicle-mounted electronic equipment communicating with the system; or 3) verbal instructions by the customer.

**S.1.5.1.2. Product Identity.**

**(a) A device shall be able to conspicuously display on each side the identity of the product being dispensed.**

**(b) A device designed to dispense more than one grade, brand, blend, or mixture of product also shall be able to display on each side the identity of the grade, brand, blend, or mixture being dispensed.**

**S.1.6. For Wholesale Devices Only For Retail Motor Vehicle Fuel Devices Only.**

**S.1.6.1. Zero-Set-Back Interlock, 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.**



**S.1.6.2. Provisions for Power Loss.**

**S.1.6.2.1. Transaction Information.** – **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 dispenser or at the console if the console is accessible to the customer.**

**S.1.6.2.2. User Information.** – **The device memory shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.**

**S.1.6.3. Display of Unit Price and Product Identity.** **Except for fleet sales and other price contract sales, a motor vehicle fuel dispenser used to refuel vehicles shall be of the computing type and shall indicate the quantity, the unit price, and the total price of each delivery. The dispenser shall display the volume measured for each transaction.**

**S.1.6.4. 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.**

**S.1.6.5. Money-Value Divisions.** – **A computing type shall comply with the requirements of paragraph G-S.5.5. Money-Values, Mathematical Agreement, and the total price computation shall be based on quantities not exceeding 0.05 L for devices indicating in metric units and 0.01 gal intervals for devices indicating in inch-pound units.**

**S.1.7. For Wholesale Devices Only.** (Renumbered - No Change)

**UR.2.7. 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 or money-operated type, the unit price at which the dispenser is set to compute.**

**Provided that the dispenser complies with S.1.5.1.1. Display of Unit Price, it is not necessary that all the unit prices for all grades, brands, blends, or mixtures 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.**

**UR.2.8. 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 gallon, the total gallons delivered, and the total price of the sale; and**
- (2) unless a dispenser complies with S.1.6.4.1. 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 printed 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.**

**For systems equipped with the capability to issue an electronic receipt, the customer may be given the option to receive the receipt electronically (e.g., via cell phone, computer, etc.)**

**Background/Discussion:**

NCWM Publication 14, Checklist for Liquefied-Petroleum Gas (LPG) Retail Motor Fuel Devices verifies compliance with specifications, such as, “Power Loss” (which requires a 15 min power backup) and “Zero-Setback Interlocks.” However, these specifications are not located in Section 3.32. of NIST Handbook 44.

There are LPG devices with NTEP Certificates of Conformance (CC) that meet current “power loss” and “zero-setback interlock” requirements. However, there are other LPG retail motor-fuel devices in the field that consist of an assembly of separable, compatible, and type-evaluated LPG measuring and indicating elements, and key/card lock systems that do not meet the power loss and interlock requirements because those requirements are not within the LPG Code and those systems have not been submitted for type evaluation. This creates unfair competition with holders of type evaluation certificates for LPG retail dispensers.

There are newer LPG dispensers coming into use, where measuring, indicating, and computing elements are assembled in retail motor-fuel dispenser housings. These LPG devices serve as both propane bottle fillers and as retail motor-fuel devices using separate hoses and nozzles on a dispenser. While they do have a good safety history, many of these

dispensers are not assembled in compliance with safety standards such as UL 495 or 1238, or NFPA 50, nor, are they typically installed in accordance with NFPA 30A or NFPA 70.

Existing retail LPG dispensers can be adapted to fuel LPG-powered motor vehicles by adding a simple adaptor, which attaches to the LPG nozzle on the dispenser's hose. There are currently five active and two inactive NTEP CCs for LPG retail motor-fuel dispensers listed in the NCWM Database.

See the 2014 S&T Committee Annual Report for additional background information and to review previous language and positions to amend NIST Handbook 44, Liquefied Petroleum Gas and Anhydrous Liquid-Measuring Devices Code.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee heard comments in support of changing the status of this item from Developing to Informational. Ms. Kristin Macey (California) reported that the expert assigned by California Division of Measurement Standards (DMS) to further develop this item is no longer employed with the state, and there is no one else within the California DMS that has the level of expertise required to complete this assignment. She suggested OWM complete any final changes that might be needed.

Mr. Dmitri Karimov (Liquid Controls, LLC) voiced concern regarding proposed paragraph S.1.4.3. Provisions for Power Loss. He noted this paragraph, if adopted, would apply to both stationary and vehicle-mounted meters. Vehicle mounted meters receive power from a vehicle's battery. He indicated that he believes the power loss provision paragraph needs more consideration and also noted there is no such requirement in the Vehicle-Tank Meters Code of NIST Handbook 44.

Ms. Tina Butcher (NIST, OWM) commented that NIST, OWM believes this proposal includes much-needed changes that will help to align requirements for LPG retail motor-fuel systems with those for retail motor-fuel systems covered under other NIST Handbook 44 measuring codes. She noted that the California Division of Measurement Standards and the WWMA have done excellent work in developing this item and, with some additional changes, NIST, OWM believes the item is ready for NCWM consideration as a Voting item.

NIST, OWM recommended that the Item Under Consideration as shown in NCWM Publication 15 be replaced with the revised version presented by the WWMA, with the following additional changes from NIST, OWM. A revised version of the proposal (including the NIST, OWM proposed changes to the WWMA version) appears at the end of this summary.

*[Technical Advisor's Note: As requested by the S&T Committee, following the 2015 Interim Meeting, NIST Technical Advisors consulted with Mr. Karimov, representing the MMA, to discuss MMA's concerns over proposed power loss requirements. During this discussion, NIST OWM acknowledged that confusion exists about the application of requirements to retail fueling systems that are not enclosed in a "cabinet" or "dispenser" housing yet include the same major components as conventional "dispensers" and are used in the same application and noted that the current proposal is intended to clarify these requirements. NIST, OWM also noted that references to retail fueling systems are not consistent throughout this and other measuring device codes and the inconsistent use of terminology in NIST Handbook 44 may also be contributing to this confusion. NIST, OWM has begun reviewing existing terminology and may propose additional changes (as part of this item or as an additional, new item) to ensure consistency in references in this and other measuring codes to terms such as the following: "retail motor-fuel dispenser," "retail motor-fuel device," "retail motor-fuel system," "retail motor-fuel dispensing system," and "retail vehicle fuel device." NIST, OWM has since identified a few additional changes that it will propose and submit to the Committee to include with this item prior to the NCWM Annual Meeting.]*

**S.1.3.6. Transaction Information. – Move to S.1.5. Stationary Retail Devices:**

Consideration should be given to moving this paragraph (which addresses power loss requirements) to Section "S.1.5. For Stationary Retail Devices Only." While it makes sense for the paragraph to fall under requirements for "indicators," comments from industry have questioned its applicability to vehicle-mounted, retail meters. Industry has pointed out that other vehicle-mounted applications, as addressed in the Vehicle-Tank Meters Code, do not include

such provisions for retail deliveries. Thus, restricting its application to stationary retail devices in the LPG and NH<sub>3</sub> Code would eliminate this concern.

Additionally, OWM suggests that the title of this paragraph be revised to include a reference to “power loss” for easier reference.

**S.1.4. For Retail Devices Only.**

**S.1.4.1. Indication of Delivery.**

Modify S.1.4.1. as shown in NIST, OWM’s original, 2014 comments so it mirrors the corresponding paragraph (S.1.6.1. Indication of Delivery) in the LMD Code, both in language and in the requirement for electronic devices to inhibit indications until fueling conditions ensure that the delivery starts on zero.

**S.1.4.3. Zero-Set-Back Interlock for Retail Motor-Fuel Dispensers:**

Delete the reference to “retail motor-fuel” in the first sentence.

**S.1.5. For Stationary Retail Devices Only:**

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

Delete the proposed sub-paragraph (a). This language is redundant with the lead paragraph. Delete the letter “(b)” designation on the subsequent subparagraph and insert “and” after “fleet sales” in that same sub-paragraph. Delete the reference to “(b)” in subparagraph (2).

Change the reference to “purchaser” to “customer” in the “Note:” to be consistent with other references in this paragraph.

**S.1.5. For Stationary Retail Devices Only:**

OWM believes that existing paragraph “S.1.5.3. Recorded Representations, Point-of-Sale Systems” should be struck; proposed new S.1.5.5. Recorded Representations” and “S.1.5.6. Recorded Representations Where a Post-Delivery Discount(s) is Provided” would eliminate the need for the existing S.1.5.3. paragraph. Remaining paragraphs should be renumbered accordingly.

OWM believes that there is no need for the proposed “S.1.5.5. Recorded Representations” to be a given a “nonretroactive” status. The current paragraph “S.1.5.3. Recorded Representations, Point-of-Sale Systems” currently applies the *same* requirements to the *same* devices covered in the new paragraph S.1.5.5. on a “retroactive” basis. Likewise, the proposed paragraph S.1.5. mirrors a paragraph in the LMD Code which was added as a retroactive paragraph in the LMD Code in 2012.

**S.1.5.3. Agreement Between Indications (Proposed by WWMA as S.1.5.4.):**

Renumber to S.1.5.3. from S.1.5.4. in WWMA’s latest proposal. Suggest adding a proposal to modify LMD Code paragraph S.1.6.6.(b) to mirror the proposed language in part (b) of this proposal.

**S.1.5.4. Recorded Representations (Proposed by WWMA as S.1.5.5):**

Renumber to S.1.5.4. from S.1.5.5. in WWMA’s latest proposal.

**S.1.5.5. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided:**

Renumber to S.1.5.5. from S.1.5.6. in WWMA’s latest proposal.

Add “printed” prior to “receipt” in the first sentence to be consistent with the corresponding provision in the LMD Code.

**S.1.5.6. Transaction Information, Power Loss. (new):**

Move the paragraph S.1.3.6. proposed by the WWMA to become S.1.5.6. and modify the title as described above under S.1.3.6.

**UR.2.7.2. (b)(2) Computing Device:**

Correct reference to S.1.6.4.1. (a reference to an LMD Code paragraph) to be S.1.5.1.

Incorporating the changes proposed by OWM as outlined above in the WWMA proposal, the revised version would appear as follows:

**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, 20XX]

(Amended 20XX)

...

S.1.4.3. Zero-Set-Back Interlock for 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, 20XX]

(Added 20XX)

**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~~ **able to** 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, 20XX]

(Added 20XX)

~~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 x 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, 20XX]**

**(Added 20XX)**

**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 20XX)**

**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 20XX)**

**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, 20XX]

(Added 20XX)

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, 20XX]

(Added 20XX)

**UR.2. Use Requirements.**

**UR.2.7. For Stationary Retail Computing Type Systems Only, Installed After January 1, 20XX.**

**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 20XX)

**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 20XX)**

Based on comments heard during the Open Hearings indicating the proposal is nearly ready for adoption, the Committee agreed to elevate the status of this item to an Informational item as requested by the State of California. In doing so, the Committee also requested Mr. Karimov work with NIST, OWM to further refine the language to address any remaining concerns.

### **2015 NCWM Annual Meeting**

NCWM 2015 Annual Meeting: The Committee heard many comments in support of this item and none opposed. Ms. Tina Butcher (NIST, OWM) recommended the item move forward as revised at the 2014 WWMA with the proposed amendments of OWM and with continued input from the meter manufacturers. She commented that this item is very close to being ready for submittal as a Voting item.

Dmitri Karimov (IDEX Corporation), speaking on behalf IDEX Corporation and the MMA testified that the zero-set-back interlock requirement should be limited to stationary retail devices only. He also commented that he is working with NIST, OWM in refining this proposal, and it is very near moving forward as a Voting item.

One state weights and measures representative questioned the use of the words “shall be able to display” in the changes proposed to paragraph S.1.5.1. Display of Unit Price and Product Identity and why the words “shall display” were not proposed instead. Ms. Butcher answered the question noting that the words “shall be able to display” is referencing unit price, which can be changed. That is, the device must be capable of displaying whatever the current unit price is for the product being offered for sale. Mr. Dick Suiter (Richard Suiter Consulting), agreeing with Ms. Butcher, expanded upon her explanation by stating it is appropriate for “specification” requirements in NIST Handbook 44 to include terms such as “capable of” rather than be written as “hard” requirements.

The Committee agreed to maintain the Informational status of this item, noting that additional work was still needed to further develop the item. The Committee noted that it looks forward to future refinements of the item.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA received comments supporting the need for this item. The CWMA believes this item is sufficiently developed and recommended that the item be a Voting item. At the 2015 CWMA Annual Meeting, there were no comments heard on this item and the CWMA recommended it move forward as an Informational item.

WWMA 2014 Annual Meeting Open Hearings: The submitter of the item provided an update and stated that several changes have been made to address NIST OWM concerns. Several regulators commented that this may impact owners of devices that are currently in use and urged caution. The submitter provided several updates to the WWMA S&T Committee to address comments heard during Open Hearings. These changes were included on the addendum sheet prior to the voting session. The WWMA recommended this as an Information item to allow for additional review, comment and future consideration; including whether or not the retroactive dates should mirror the effective dates of similar paragraphs in the LMD code.

**S.1.3. Indicators.**

*S.1.3.6. Transaction Information. – 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, 20XX]*

*(Added 20XX)*

**S.1.4. For Retail Devices Only.**

*S.1.4.3. Zero-Set-Back Interlock for Retail Motor-Fuel Devices – A retail motor-fuel 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, 20XX]*

*(Added 20XX)*

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

**S.1.5.1. Display of Unit Price and Product Identity.** – In 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.~~

(a) A computing or money-operated device shall be able to display on each face the unit price at which the device is set to compute or to dispense.

(b) Except for dispensers used exclusively for fleet sales, 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 predelivery unit price information is exempt from (b)(1), provided the system complies with S.1.5.7. 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 purchaser: 1) using controls on the device; 2) through the purchaser'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, 20XX]

(Added 20XX)

#### S.1.5.4. 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, 20XX]

(Added 20XX)

S.1.5.5. 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.

[Nonretroactive as of January 1, 20XX]

(Added 20XX)

**S.1.5.6. Recorded Representations for Transactions Where a Post-Delivery Discount(s) is Provided. – Except for fleet sales and other price contract sales, a 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.**

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

**(Added 20XX)**

**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, 20XX]**

**(Added 20XX)**

**UR.2. Use Requirements.**

**UR.2.7. For Stationary Retail Computing Type Devices Only Installed After January 1, 20XX.**

**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 20XX)**

**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.1.6.4.1. 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 20XX)**

SWMA 2014 Annual Meeting: The SWMA was informed there was new language from the submitter and encouraged the NCWM S&T Committee to review this language. The SWMA recommended that this item be a Developing item.

NEWMA 2014 Interim Meeting: NEWMA did not receive comments on the item and recommended that it remain a Developing item due to concerns from NIST, OWM regarding some of the language in the proposal. At its 2015 Annual Meeting, NEWMA recommended this item remain an Informational item as work continues on Developing the proposal.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **332-2 D N.3. Test Drafts.**

**Source:**

Endress + Hauser Flowtec AG USA (2015)

**Purpose:**

Allow transfer standard meters to be used to test and place into service dispensers and delivery system flow meters.

**Item Under Consideration:**

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.**

**Background/Discussion:**

The use of transfer standards is recognized in the following NIST Handbook 44, Sections 3.34. Cryogenic Liquid-Measuring Devices Code; 3.38. Carbon Dioxide Liquid-Measuring Devices Code; and 3.39. Hydrogen Gas-Measuring Devices – Tentative Code. Field evaluation of LPG meters and CNG dispensers and LNG dispensers is very difficult using volumetric and gravimetric field standards and methods. The tolerances for these applications are such that using transfer meter standards are more efficient and safer. With CNG, LNG, and LPG applications, transfer standard meters are placed in-line with the delivery system as it is used to fill tanks and vehicles. The use of transfer standards eliminates return to storage issues. The use of transfer standard meters is easier and faster compared to the use of traditional field standards. The cost of using transfer standards and transporting them is much less than the cost of traditional field provers and standards. The submitter believes recognition in NIST Handbook 44 will enable states to allow transfer standard meters to place systems into service and for field enforcement.

Volumetric field provers and gravimetric field proving are susceptible to environmental influences. The State of Colorado uses a master meter to test propane delivery truck meters. The State of Nebraska has used a mass flow meter to test agricultural chemical meters.

In some applications, transfer standard meters are not more accurate than the meters used in the dispenser. For that reason, longer test drafts and possibly more tests need to be run.

The State of California is purported to have conducted a short study of master meters in the past. The conclusion did not lead to wide adoption of the practice. However, the State of California uses a mass flow meter as a master meter for carbon dioxide flowmeter enforcement.

Mass Flow Meters Code paragraph U.R.3.8. Return of Product to Storage, Retail Compressed Natural Gas Dispensers requires that the natural gas, which is delivered into the test container, must be returned to storage. This is difficult and most often not complied with when the test vessel contents are released to atmosphere. *[Technical Advisor's Note: Paragraph UR.3.8. also provides the option to the device owner or operator to otherwise safely dispose of the product. See paragraph UR.3.8. for details.]*

The Committee might also consider amending Sections 3.30. Liquid-Measuring Devices Code and 3.31. Vehicle-Tank Meters Code to allow the use of transfer standard meters.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee agreed to group together Agenda Items 330-2 and 337-3 since these items are related and announced that comments on both items would be taken together during the Open Hearings.

Mr. Michael Keilty (Endress + Hauser Flowtec AG USA), submitter of the item, presented a short 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. He stated that master meters are safer, more efficient, and provide a faster means of verifying meter accuracy. An additional benefit is that using a master meter eliminates the need to return product to storage because product can be dispensed through the master meter as part of the refueling procedure. He encouraged the recognition of master meters in NIST Handbook 44 for use as a transfer standard in testing.

Mr. Henry Oppermann (Weights and Measures Consulting, LLC) provided written comments to the Committee concerning this item, which he summarized in comments presented during the Open Hearings. Mr. Oppermann stated there are significant differences between a transfer standard and a field standard. It is necessary to consider the accuracy of these standards. Field standards must satisfy the Fundamental Considerations of NIST Handbook 44 Section 3.2. Tolerances for Standards, whereas transfer standards are recognized for use in some handbook device codes, but do not satisfy the one-third requirement specified in Section 3.2. (*Technical Advisors note: Section 3.2. of the Fundamental Considerations requires the combined error and uncertainty of any standard used in testing to be less than one-third the applicable tolerance applied to the device under test unless corrections are made*). Mr. Oppermann recommended keeping clear this distinction; noting the current proposal is incomplete if it doesn't include an additional tolerance when you test a device using a master meter (i.e., a transfer standard).

In response to Mr. Oppermann's comment regarding the need for an additional tolerance, Mr. Keilty stated that he isn't requesting a different tolerance be applied to the device under test. Current technology already enables the standard to comply.

Ms. Tina Butcher (NIST, OWM) acknowledged that development of alternative methods of testing is beneficial because there are many applications where the nature of the product makes current methods impractical. She stressed, however, that adding a paragraph to NIST Handbook 44, alone, doesn't provide recognition of a test method. There is a laundry list of pieces that need to be in place before a standard should be considered suitable for use in testing by providing traceable measurements including things such as:

- the accuracy of the standard (or the degree of accuracy that one can expect to achieve from using the standard) in relation to the tolerances that apply to the device being tested;
- NIST Handbook 44, Fundamental Considerations – Tolerances for Standards;
- proper training and procedures for using the standard;
- training of laboratory personnel and the capability of the labs to verify the adequacy of the standard for use in testing another device; and
- collection and analysis of data obtained from having used the standard repeatedly over time.

Ms. Butcher also noted that a USNWG has been assembled to review the different (alternative) test methods and this might be an appropriate group to review such equipment as resources allow. She also noted that the decision of whether or not to accept a particular method ultimately rests with the regulatory authority.

Mr. Dmitri Karimov (Liquid Control, LLC) noted that the Mass Flow Meters Code covers all applications where a mass flow meter is used. There are five measuring device codes within NIST Handbook 44. Simply adding language to recognize the use of a particular piece of test equipment doesn't necessarily ensure its use is acceptable in testing.

The decision of whether or not to use the test equipment resides with the regulatory authority where the meters are located.

The Committee agreed this item has merit and recommends the submitter of these items work with NIST, 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.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 332-2 and 337-3 and took comments on the two items simultaneously. The Committee heard comments both in support of and opposition to the proposals.

Mr. Michael Keilty (Endress + Hauser Flowtec AG USA), submitter of the item noted there is already an allowance for a field transfer standard in the Cryogenic Liquid-Measuring Devices Code, Carbon Dioxide Liquid-Measuring Devices Code, and in the Hydrogen Gas-Measuring Devices – Tentative Code. He asked there also be an allowance for a field transfer standard in the LPG and Anhydrous Ammonia Liquid-Measuring Devices Code and the Mass Flow Meters Code, noting there's already information in those codes to support using a transfer standard. He also requested the Committee consider moving these two items forward as Voting items.

Mr. Henry Oppermann (Weights and Measures Consulting, LLC) speaking on behalf of Seraphin Test Measure, Co. commented that there's a difference between a transfer standard and a field standard. Field standards must comply with the NIST Handbook 105 series. A transfer standard, in order to be used for testing another device, must be accurate and repeatable over the full range of how it will be used, to include temperature, flow rates, etc. Accuracy and repeatability must not change between times when it is used. He stated that Mr. Keilty is looking at a standard to meet the Fundamental Considerations of NIST Handbook 44; it is his (Mr. Oppermann's) view that it's a field standard and not a transfer standard.

Ms. Butcher commented stated NIST, OWM believes the development of alternative methods of testing commercial metering systems is an important issue. There are many applications in which using currently recognized test methods may not be feasible because of product characteristics, safety, cost, access to equipment, and other factors. NIST, OWM is not opposed to adding a paragraph to the two device codes as proposed, but by doing so, it wouldn't ensure approval of any proposed test method. The decision on whether or not to accept a particular test method for use in testing commercial weighing and measuring equipment ultimately rests with the regulatory authority.

There are a number of things that must be considered when selecting field standards and determining whether or not they are suitable and can be used to provide traceable measurements. These factors are sometimes referred to as the "essential elements of traceability." As noted by NIST, OWM during the 2015 NCWM Interim Meeting, the pieces need to be in place before a standard should be considered suitable for use in testing by providing traceable measurements include things such as:

- the accuracy of the standard (or the degree of accuracy that one can expect to achieve from using the standard) in relation to the tolerances that apply to the device being tested;
- NIST Handbook 44, Fundamental Considerations – Tolerances for Standards;
- proper training and procedures for using the standard;
- training of laboratory personnel and the capability of the labs to verify the adequacy of the standard for use in testing another device; and
- collection and analysis of data obtained from having used the standard repeatedly over time.

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 have also been raised by others during the Committee's Open Hearings.

NIST OWM established a USNWG to examine alternative test methods. A subgroup within that USNWG is presently working to establish uncertainties for selected different test methods. NIST, 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 WG 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 or not 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.

With regard to 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 Ms. Butcher 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 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.

**Regional Association Meetings:**

Interim 2014 Meeting: The CWMA received comments questioning the accuracy of a meter used as a mobile standard. CWMA forwarded the item to NCWM, recommending it as a Developing item. At the 2015 CWMA Annual Meeting, an official from Nebraska reported the state's use of a master meter (transfer standard). The CWMA again recommended moving the item forward as a Developing item.

WWMA 2014 Annual Meeting: The testimony was presented stating this type of technology would more easily facilitate inspections. However, it was also stated that a more comprehensive evaluation of the equipment and testing procedure, including the associated uncertainty, needs to be performed. The WWMA agreed that this type of technology would be useful. WWMA forwarded the item to NCWM and recommended that it be a Developing item to allow the submitter to provide a more complete analysis.

Annual 2014 Meeting: The SWMA heard questions and concerns that need to be addressed by the submitter. SWMA also recommended that NIST OWM continue to develop a standard for this type of equipment and other guidance documents necessary to recognize their use. Additionally, the SWMA recommended that the submitter work with

NIST, OWM to address these concerns. The SWMA recommended that Items 332-2 and 337-3 be combined into one agenda item since they are both related to test drafts. Comments were heard for both of these agenda items at the same time.

NEWMA 2014 Interim Meeting: NEWMA reported that it believed this item has merit but needs further Development before being sent to a vote. NEWMA forwarded the item to NCWM and recommended that it be a Developing item. NEWMA also recommended that this item be combined with Items 332-2 and 337-3 as a single agenda item. At the 2015 NEWMA Annual Meeting, a recommendation was made to Withdraw this item with the intent that it be resubmitted once clarification has been provided regarding the accuracy of the transfer standard meters. NEWMA agreed, however, to maintain the Developing status at the recommendation of NEWMA's S&T Committee so work could continue on the proposal.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### 337 MASS FLOW METERS

- 337-1 V Appendix D – Definitions: Diesel Liter Equivalent (DLE) and Diesel Gallon Equivalents (DGE) for Compressed Natural Gas and Liquefied Natural Gas; Definition of Gasoline Gallon Equivalent and Gasoline Liter Equivalent for Compressed Natural Gas; S.1.2. Compressed Natural Gas and Liquefied Natural Gas Dispensers; S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel; S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel; S.5.2. Marking of Diesel and Gasoline Volume Equivalent Conversion Factor; Compressed Natural Gas, S.5.3. Marking of Diesel Volume Equivalent Conversion Factor; Liquefied Natural Gas; UR.3.1.1. Marking of Equivalent Conversion Factor for Compressed Natural Gas; UR.3.1.2. Marking of Equivalent Conversion Factor for Liquefied Natural Gas; and UR.3.8. Return of Product to Storage, Retail Compressed Natural Gas and Liquefied Natural Gas**

(This item was returned to Committee for further consideration due to a split vote.)

**Source:**

Clean Vehicle Education Foundation (2014)

**Purpose:**

Since natural gas is sold in the retail market place as compressed natural gas (CNG) and liquefied natural gas (LNG), alternative fuels to gasoline and diesel fuel, the proposed additions and edits to NIST Handbook 44 will provide definitions for volume units of CNG and LNG that are the energy equivalents for diesel and/or gasoline gallons so that end users can readily compare cost and fuel economy. At present only equivalents for gasoline are included in NIST Handbooks 44 and 130 for CNG as an engine fuel. The proposal also includes modifications to NIST Handbook 44, Appendix D relative to the sale of LNG and CNG.

**Item Under Consideration:**

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

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

**(Added 20XX)**

Amend NIST Handbook 44, Appendix D definitions as follows:

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

(Added 1994) (Amended 20XX)

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

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

~~(Added 1994)~~

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

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

(Added 1994) (Amended 20XX)

### S.1.3. Units.

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

(Added 1994) (Amended 20XX)

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

(Added 20XX)

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

(Added 1994) (Amended 20XX)

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

(Added 20XX)

**UR.3.1.1. Marking of Equivalent Conversion Factors for Compressed Natural Gas.** – A device dispensing compressed natural gas shall have either the statement “1 Gasoline Gallon Equivalent (GGE) means 5.660 lb of Compressed Natural Gas” or “1 Diesel Gallon Equivalent

**(DGE) means 6.384 lb of Compressed Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.**

**(Added 20XX)**

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

**(Added 20XX)**

**UR.3.8. Return of Product to Storage, Retail Compressed and Liquefied Natural Gas Dispensers. –**

Provisions at the site shall be made for returning product to storage or disposing of the product in a safe and timely manner during or following testing operations. Such provisions may include return lines, or cylinders adequate in size and number to permit this procedure.

(Added 1998) **(Amended 20XX)**

### **Background/Discussion:**

The gasoline gallon equivalent (GGE) unit was defined by the NCWM in 1994 to allow users of natural gas vehicles to readily compare costs and fuel economy of light-duty, compressed natural gas-powered vehicles with equivalent gasoline powered vehicles. More background on this work 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 “Diesel Liter Equivalent” (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 CNG in a DLE and in a DGE, which is included in Appendix F.

***2013: A summary of actions that took place in 2013 appears in the box below.*** **January 2013 NCWM Interim Meeting:**

At the 2013 NCWM Interim Meeting, the Committee heard multiple comments in opposition and no comments in support of the proposal during its Open Hearings. Refer to the Committee’s 2013 Final Report to view specific comments and suggestions that were made and who provided them.

During its work sessions at the Interim Meeting, the S&T Committee met with the L&R Committee to discuss this item and related items on the two Committees’ Agendas; the corresponding items on the L&R Committee Agenda are Items 232-1 and 237-1. During the joint meeting, the L&R Committee advised the S&T Committee that it had decided to make the related item on their agenda Informational items to allow additional time for the community to study the issue and hear from other stakeholders in the community. A proposal was made to ask the FALS to deliberate on an appropriate equivalent value for each of the proposed “units.” However, the two Committees recognized that before asking the FALS to expend resources on further definitions, the questions and concerns raised in the Open Hearings regarding the appropriateness of recognizing such units should first be addressed. The Committees agreed to recommend to the NCWM Chairman that a small task group be established to further study this issue. The Committees each agreed to develop a list of tasks that they would ask such a task group to take on and to recommend possible members of the group to ensure balanced representation of stakeholders.

After discussion with the L&R Committee, the S&T Committee reviewed and summarized key comments made during the Open Hearings for S&T Committee Agenda Items 337-1 and 337-2:

- Are equivalent units necessary to promote consumer acceptance of this fuel?
- Is there a significant need for continued comparison to other fuels once you have purchased a vehicle? Does this justify the proliferation of “equivalent” values?

- The intent is to add this for medium- and heavy-duty vehicles such as trucks that operate on LNG. Trucks that operate on LNG are generally dedicated fuel vehicles that run only on a single fuel.
- Is the dispenser the appropriate place to make comparisons with other fuels or is a better place to make those comparisons via mechanisms such as pump toppers, websites, etc.?
- Striking the word “compressed” (in the changes proposed in Item 337-2) expands the proposal to LNG.
- California’s approval of LNG meters indicating in mass units was correct.
- What will the impact be on existing approval of LNG dispensers currently indicating in mass?
- There is much opposition to the proliferation of “equivalent units” for various types of fuels.
- The current recognition of GGE and GLE units has led to complaints about equivalent values from both industry and regulatory officials.
- Mass units should be considered for natural gas and other fuels.
- Will the establishment of equivalent values provide traceability to SI units?
- The community expends significant resources to achieve good meter performance and establishing “fuzzy” equivalent values seems to undermine these efforts.
- The factor for any “equivalent unit” will represent only an “estimate” of an equivalent value.
- There is disagreement amongst the industry regarding the appropriate equivalent value in this proposal. The report containing the data that is referenced as the basis for the proposal includes a disclaimer from Oakridge National Laboratory and U.S. Department of Energy regarding its validity for other than general use in the transportation industry.
- The S&T Committee only heard comments in opposition to the proposal.
- Harmonization with OIML requirements should be considered in the method of sale and associated device requirements.

With respect to Items 337-1 and 337-2, the Committee agreed to work collaboratively with the L&R Committee and to develop a small WG to decide: 1) whether or not DLE and DGE should be considered an acceptable method of sale for natural gas; and 2) if so, what the factor should be to determine their equivalents to gasoline. The Committee agreed the above list of key points and questions heard during its Open Hearings should be considered, along with other Open Hearing comments, by the chairs of both the L&R and S&T Committees in the development of a list of points to be addressed by the Task Group.

Prior to the 2013 Annual Meeting, NCWM Chairman, Mr. Steve Benjamin (North Carolina), appointed the “NCWM Natural Gas Steering Committee (NGSC),” which will be chaired by Mr. Mahesh Albuquerque (Colorado). The primary charge of the Committee is to educate the membership regarding the technical issues surrounding this application, the rationale for the proposed changes, and the anticipated impact of the proposed changes and issues related to their implementation. The Committee was asked to identify and address questions raised during the 2013 Interim Meeting as well as other venues in an effort to enable NCWM members to make informed decisions about proposals under consideration in this area.

Also prior to the 2013 Annual Meeting, the Committee received a proposal from Mr. Douglas Horne (Clean Vehicle Education Foundation) to modify the “Item Under Consideration.” Mr. Horne proposed separate definitions for CNG and LNG gallon equivalent values. The Committee suggested he work with the Steering Committee to further

refine the proposal and suggest changes to the item as appropriate. Mr. Horne's proposals were posted on the NCWM website with other documents relative to the Committee's final report. While submitted in an NCWM Form 15 template, Mr. Horne's proposal is not addressing a new issue, but rather providing comments on a current item (337-1) on the Committee's Agenda.

**July 2013 NCWM Annual Meeting:**

During its 2013 Annual Meeting Open Hearings, the Committee heard an update from the NGSC Chairman, Mr. Albuquerque. He reported that the NGSC met for the first time on Sunday, July 14 at the beginning of the Annual Meeting and gathered input from those in the audience. Comments indicated that consumers may find gallon equivalent information to be helpful, but the most equitable method for measuring and selling the product is based on mass measurement.

At that Meeting, the Committee heard comments on Items 337-1 and 337-2 jointly. Details of those comments are outlined below.

The S&T Committee heard overwhelming comments opposing the use of gallon equivalents and favoring the use of mass as the method of sale. The Committee also heard multiple comments indicating concern about the establishment of a value that would be an approximation of the actual equivalent for a given transaction. Mr. Horne reported that some states have already or are in the process of enacting defined "gasoline equivalent" values; some adopted earlier versions of the equivalent and some are considering new values as outlined in Mr. Horne's most recent proposal.

Ms. Kristin Macey (California) noted that the NCWM successfully adopted a method of sale for hydrogen fuel based on mass and suggested that the natural gas be held to the same standard. Mr. Michael Keilty (Endress + Hauser Flowtec AG USA) commented that sale of natural gas as a vehicle fuel has proliferated globally and those sales are based on mass units.

NIST, OWM acknowledged appreciation of the establishment of the Steering Committee to further study this issue. NIST, OWM encouraged the S&T Committee, the Steering Committee, and the weights and measures community to consider the points raised by OWM during the 2013 Interim Meeting as well as the following in their deliberations of Item 337-1 and Item 337-2:

In addition to discussing the proposals in Items 337-1 and 337-2, OWM requested that the Steering Committee specifically discuss and consider whether or not the continued use of the terms "GLE" and "GGE" are appropriate for commercial CNG metering applications. OWM makes this request based on many of the same points made by OWM at the 2013 Interim Meeting and also given that:

- (1) this market is well established and consumer confidence and acceptance of CNG and other alternative fuels are not contingent upon continued comparisons with gasoline;
- (2) there are other methods for comparing relative efficiency and costs with gasoline;
- (3) experience with feedback from the community indicates problems with the application and validity of these units with changing gas supplies;
- (4) the proposal in Items 337-1 and 337-2 proposes language which would address natural gas as a whole and it is, therefore, appropriate to raise the discussion of whether or not the continued use of non-traceable units is appropriate. Additionally, OWM suggests that a proposal to eliminate the use of the terms "GLE" and "GGE" in favor of indications in mass units be developed and considered by the NCWM to ensure commercial transactions for natural gas are based on NIST-traceable units of measurement; and

- (5) as the number of viable alternative fuel options increase, providing a relatively static comparison with only one alternative fuel will not serve the broad needs of consumers and will make it unlikely that the dispenser is the appropriate location to provide comparison information.

The Committee also heard a comment from Mr. Karimov suggesting that volume units be permitted as a method of sale for LNG.

While many people expressed an understanding of the need for consumers to make comparisons with gasoline, comments indicate that such comparisons would typically be made prior to the purchase of a vehicle and possibly for a short time while becoming accustomed to the vehicle. The Committee heard comments indicating that weights and measures officials would be amenable to permitting the posting or displaying of supplemental information regarding gallon equivalent values.

#### **January 2014 NCWM Interim Meeting:**

The Committee met with the L&R Committee to discuss the comments received on Items 337-1 through 337-5 and corresponding items on the L&R Committee's Agenda. Although there were three new proposals on the agenda, several appear to require clarification from the submitter on whether they are replacements for several carryover proposals. The two Committees heard an update from Mr. Albuquerque, speaking as Chairman of the NGSC on the work of the group.

Ms. Juana Williams (NIST, OWM) reviewed the following points prepared by NIST, OWM and suggested that the Committees consider these points in their deliberations on the proposals:

- OWM encourages the:
  - Efforts of the NGSC as it works to provide corresponding proposals to the L&R Committee and S&T Committee.
  - Collaboration with FALS on:
    - Fuel properties data
    - The final vetting of data, formulas, etc. used to arrive at any conversion factors that might be recognized for use in supplemental advertising/sales information
- NIST, OWM notes that some of the current wording in the 2012 and 2013 proposals is somewhat confusing, in part, because several paragraphs include previous conversion factors no longer under consideration.
- The latest proposal encourages a proliferation of equivalent units of measurement, at least six for the CNG and LNG RMFD applications.
- Measurement accuracy and traceability are not achieved through computation of the sale's information in equivalent quantity units since the conversion factor is an estimated value.
- NIST, OWM suggests input from stakeholders such as the CNG and LNG RMFD OEMs and agencies regulating other Sectors (such as the motor fuels taxation departments) in the natural gas infrastructure on the impact of any new proposal.
- NIST, OWM suggests the Committees consider that additional work might be necessary to further modify the code to fully recognize the LNG application. NIST has plans to outline an approach for a similar project.

The S&T Committee and L&R Committee agreed with the suggestions provided by the NGSC for addressing these items. As a result of these discussions, the S&T Committee agreed to the following regarding Items 337-1 through 337-5 on the Committee's 2014 Interim Agenda:

- Withdraw Items 337-1 and 337-4 and consolidate the remaining three items (Items 337-2, 337-3, and 337-5) into a single item.
- Ask that the NGSC rework its proposed changes to NIST Handbook 44 to reflect the comments heard during the Committee's Open Hearings and in writing.
- Designate the consolidated item as a Voting item in anticipation that the NGSC will present a revised version of the proposed changes to NIST Handbook 44 prior to the publication of the Committee's Interim Report.

If the revised version of the code is not presented prior to the publication date or agreement cannot be reached within the NGSC or the S&T Committee on the revised version, the Committee agreed to designate this consolidated item as an Information item.

#### **March 2014 NGSC Report to the L&R and S&T Committees:**

The NGSC was formed in July 2013 to help understand and educate the NCWM membership regarding the technical issues surrounding the proposed changes to NIST Handbooks 44 and 130 submitted by the Clean Vehicle Education Foundation (CVEF); the anticipated impact of the proposed changes; and issues related to implementation requirements when compressed natural gas (CNG) and liquefied natural gas (LNG) are dispensed and sold as a retail engine fuel in gallon equivalent units.

NCWM 2014 Interim Meeting: Mr. Albuquerque, Chair of the NGSC, provided the S&T and L&R Committees with an update from the NGSC, including proposed revisions to the proposals submitted by the CVEF. The NGSC heard comments from the floor related to the proposed revisions and requested additional time to further develop its recommendations. The S&T and L&R Committees agreed to allow the NGSC additional time to meet and develop alternative proposals to those on the S&T and L&R Committee's January 2014 Agendas, with the expectation that the NGSC recommendations would be ready for inclusion in NCWM Publication 16 and moved forward as a Voting item at the July 2014 NCWM Annual Meeting. Mr. Albuquerque provided the following summary of the NGSC discussions.

#### **Summary of NGSC Meeting Discussions:**

The NGSC met weekly following the January 2014 Interim Meeting and focused on modifying the Clean Vehicle Education Foundation's (CVEF's) 2013 proposals for the recognition of diesel gallon equivalent (DGE) units for CNG/LNG dispenser indications and the method of sale for these two natural gas alternative engine fuels. The NGSC reviewed multiple modifications to those proposals including:

- limiting sales to a single unit of mass measurement, enforceable by 2016;
- requiring indications in mass and gasoline and diesel gallon equivalents, while phasing in mass-only units;
- require sale by mass as the primary means, but allow for the simultaneous display of volume equivalent units, so long as the purchaser always had access to the mass (traceable) measurement; and
- a proposal from NIST OWM which would allow the posting of supplemental information to assist consumers in making value comparisons and for use by taxation/other agencies, but requiring the phase in of indications in mass.

The NGSC received:

- input from DOE on the latest edition of the DOE Transportation Energy Data Book: Edition 32, July 2013 available on the Oak Ridge National Laboratory website at: <http://cta.ornl.gov/data/index.shtml>;



- updates from CNG (3) and LNG (1) dispenser manufacturers indicating their dispensing systems comply with the requirements in the handbooks and have the capability to indicate a sale in a single unit of measurement, and any further input on adding displays to the cabinet for additional units would require further cost analysis; one OEM indicated use of their LNG RMFD in a fleet operation where indications are only in the DGE; and
- feedback from NGSC committee members related to the pros and cons of requiring the indication of sale in mass or gallon equivalent units, including traceability, equipment capabilities, marketplace considerations, and units used by state and federal agencies.

Also noted in the NGSC discussions were:

- how a gallon equivalent unit is derived using energy content, and that the gallon equivalent is defined and measured in terms of mass, not volume;
- for the last 20 years, NIST Handbooks 44 and 130 have required all dispensing equipment to indicate deliveries of natural gas in GGE units to consumers and in mass units for inspection and testing purposes. CNG RMFD equipment in most states comply with the requirements in the handbooks;
- international practices for indicating CNG and LNG engine fuel deliveries are predominantly mass; Canada requires LNG indications in the kilogram and the corresponding OIML R 139 “Compressed gaseous fuel measuring systems for vehicles” standard requires indication of the measured gas in mass;
- the variations in engine efficiency relative to a single conversion factor based on an averaged energy content for LNG;
- the primary focus of the driving public and fleets is on mileage rather than petroleum products no longer used to fuel their vehicles;
- the work ahead over the next year by ASTM committees to develop current CNG and LNG fuel quality standards which will need to be referenced in NIST Handbook 130;
- differences in the measurement of the gallon and kilogram -- since the gallon is a volume measurement and not an energy measurement;
- the NIST Handbook 44, Mass Flow Meters Code includes a requirement for volume-measuring devices with ATC used in natural gas applications to be equipped with an automatic means to make corrections, if the device is affected by changes in the properties of the product; it was also noted that U.S. gasoline and diesel dispensers are not required to have ATC, whereas ATC does occur in sales at the wholesale level;
- how traceability applies to the measurement results at each level of the custody chain (to include the determination of the uncertainty of all calibrations and use of an appropriate unit of measurement); and
- the capabilities of equipment in the marketplace.

A DOE representative supported the use of gallon equivalents and pointed out that they are used in the DOE Transportation Energy Data Book. The DOE representative also pointed out that other federal agencies including the IRS were requiring use of gallon equivalent units for reporting purposes.

Industry representatives on the NGSC indicated that they are actively campaigning to their state and federal offices, encouraging each government branch to recognize sales of CNG and LNG in gasoline and diesel volume equivalent units. Industry Sectors represented on the NGSC indicated that their customers are satisfied with the averaged fuel energy values that correspond to the conversion factors for CNG and LNG, with only one exception. The exception

was a truck stop chain indicating their customers would be amenable to a single conversion factor for both fuels. The CVEF also provided a comparison of GTI's 1992 study results and preliminary data from a 2013 study. The CVEF reported the constituents in natural gas as basically unchanged over 21 years since the NCWM first recognized the GGE. Industry unanimously opposed a recommendation for phasing in mass as the only unit of measurement, noting also that U.S. drivers would be confused by SI units while acknowledging that the United States is in the minority of countries, whereby delivery and sales are by equivalent units. At the conclusion of the NGSC deliberations NGV America provided the following statement:

One of the major advantages of the proposal as currently drafted with inclusion of the DGE and GGE units for natural gas is that this is a proposal that the natural gas industry can support. It further recognizes what is already the preferred practice for how natural gas is measured and dispensed. The latest proposal with DGE and GGE units provides a pathway forward toward a national consensus approach. If the proposal were to instead require use of kilograms or even pounds as the primary method of sale, industry would not support that proposal and likely would strongly oppose it this summer if NCWM were to consider it as a voting issue. Also, if NCWM finalizes on a standard that does not include DGE or GGE, industry is committed to pursuing adoption of an alternative standard on a state by state basis, which could lead to different treatment across the country. Several states have already introduced legislation to recognize the DGE standard (California, Illinois, Missouri, and Virginia) and I expect more will do so later this year. And, you know Colorado and Arkansas already have put in place standards that recognize the DGE units.

**NGSC Recommendations:**

- 1) After consideration of all of the above, the NGSC recommends alternate proposals to the L&R and S&T Committee Agenda Items which further modify and consolidate the Clean Vehicle Education Foundation 2013 proposals to include: requirements for measurement in mass and indication in gallon equivalent units (NIST Handbook 44, Paragraphs S.1.3.1.1. and S.1.3.1.2.; and NIST Handbook 130, Paragraphs 3.11.2.1. and 3.12.2.1.);
- 2) posting of a label that has both the GGE and DGE or the GLE and DLE for CNG applications (NIST Handbook 44, Paragraphs S.5.2., S.5.3., UR.3.1.1., and UR.3.1.2; and NIST Handbook 130, Paragraphs 3.11.2.2.2. and 3.12.2.2.2.);
- 3) expression of all equivalent conversion factors expressed in mass units to three significant places beyond the decimal point for consistency (NIST Handbook 44, Paragraphs S.5.2., S.5.3., UR.3.1.1., and UR.3.1.2 and Appendix D and NIST Handbook 130 Section 1, Paragraphs 3.11.2.2.2. and 3.12.2.2.2.);
- 4) correction of the temperatures in the LNG definition (NIST Handbook 130, Section 1);
- 5) addition of 16 CFR Part 309 for CNG automotive fuel rating (NIST Handbook 130 paragraph 3.11.2.2.5.); and
- 6) reference to NFPA 52 (NIST Handbook 130 paragraph 3.12.2.2.4.)

With regards to NIST Handbook 44, the NGSC recommends withdrawing S&T Agenda Items 337-1 and 337-4 and the consolidation of Agenda Items 337-2, 337-3, and 337-5 into a newly revised single Voting item designated as Item 337-2. The NGSC also recommends further modifications to corresponding NIST Handbook 130 proposals to align the definitions of related terms and method of sale with definitions, indicated delivery, and dispenser labeling requirements with those being proposed for NIST Handbook 44.

With regards to NIST Handbook 44, the NGSC also recommends consideration of new a Developing item addressing proposed changes to paragraph S.3.6. Automatic Density Correction designated as Item 360-4. This new proposal is consistent with the NGSC decision to encourage further work beyond the current scope of its work on the CVEF's proposals to fully address all LNG applications.

Representatives of the NGSC and the S&T and L&R Committees met in March 2014; all agreed on the course of action outlined above.

Additional Contacts: Clean Energy, Seal Beach, California; NGVAmerica, Washington, D.C.; and Clean Vehicle Education Foundation, Acworth, Georgia. Regional Association Comments: Fall 2013 input on the Committee's 2014 Interim Agenda Items 337-1 through 337-5.

Based on the NGSC's recommendation, the Committee agreed to modify the original proposal and present the following for a Vote at the 2014 NCWM Annual Meeting as shown below:

Amend NIST Handbook 44, Appendix D to include new definitions as follows:

**diesel gallon equivalent (DGE).** – means **6.380 pounds of compressed natural gas or 6.060 pounds of liquefied natural gas.** [3.37]

**(Added 20XX)**

**diesel liter equivalent (DLE).** – means **0.765 kilograms of compressed natural gas or 0.726 kilograms of liquefied natural gas.** [3.37]

**(Added 20XX)**

Amend NIST Handbook 44 Appendix D definitions as follows:

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

(Added 1994) **(Amended 20XX)**

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

(Added 1994) **(Amended 20XX)**

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

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

(Added 1994) **(Amended 20XX)**

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

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

(Added 1994) **(Amended 20XX)**

**S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel.** – **When liquefied natural gas is dispensed as an engine fuel, the delivered quantity shall be measured in mass and indicated in**

**“diesel liter equivalent (DLE) units” or “diesel gallon equivalent (DGE) units” (Also see definitions).**

**(Added 20XX)**

**S.5.2. Marking of Equivalent Conversion Factor for Compressed Natural Gas.** – A device dispensing compressed natural gas shall have either the statements “1 Gasoline Liter Equivalent (GLE) is **Approximately Equal to 0.678 kg of Compressed Natural Gas**” **and** “**1 Diesel Liter Equivalent (DLE) is Approximately Equal to 0.765 kg of Compressed Natural Gas**” or the statements “1 Gasoline Gallon Equivalent (GGE) is **Approximately Equal to 5.660 lb of Compressed Natural Gas**” **and** “**1 Diesel Gallon Equivalent (DGE) is Approximately Equal to 6.380 lb of Compressed Natural Gas**” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.

**(Added 1994) (Amended 20XX)**

**S.5.3. Marking of Diesel Volume Equivalent Conversion Factor for Liquefied Natural Gas.** – A device dispensing liquefied natural gas shall have either the statement “**1 Diesel Liter Equivalent (DLE) is Approximately Equal to 0.726 kg of Liquefied Natural Gas**” or “**1 Diesel Gallon Equivalent (DGE) is Approximately Equal to 6.060 lb of Liquefied Natural Gas**” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.

**(Added 20XX)**

**UR.3.1.1. Marking of Equivalent Conversion Factor for Compressed Natural Gas.** – A device dispensing compressed natural gas shall have either the statements “**1 Gasoline Liter Equivalent (GLE) is Approximately Equal to 0.678 kg of Compressed Natural Gas**” **and** “**1 Diesel Liter Equivalent (DLE) is Approximately Equal to 0.765 kg of Compressed Natural Gas**” or the statements “**1 Gasoline Gallon Equivalent (GGE) is Approximately Equal to 5.660 lb of Compressed Natural Gas**” **and** “**1 Diesel Gallon Equivalent (DGE) is Approximately Equal to 6.380 lb of Compressed Natural Gas**” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.

**(Added 20XX)**

**UR.3.1.2. Marking of Equivalent Conversion Factor for Liquefied Natural Gas.** – A device dispensing liquefied natural gas shall have either the statement “**1 Diesel Liter Equivalent (DLE) is Approximately Equal to 0.726 kg of Liquefied Natural Gas**” or “**1 Diesel Gallon Equivalent (DGE) is Approximately Equal to 6.060 lb of Liquefied Natural Gas**” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.

**(Added 20XX)**

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

**(Added 1998) (Amended 20XX)**

**July 2014 Annual Meeting:**

NCWM 2014 Annual Meeting: The Committee considered the revised proposal shown above. There were numerous comments both in opposition to and in support of the proposal as follows:

**Support:**

- Numerous letters of support by U.S. Senators and Governors with wide bipartisan support.
- Allows consumers who may be familiar with volumetric units to make value comparisons.
- Allows for cost comparison between multiple fuel types.
- Proposal is supported by those who build and supply the equipment, vehicle manufacturers, and producers and distributors of natural gas.
- If action isn't taken, the decision will be taken out of the Weights and Measures jurisdictions' hands at the state and local levels.
- The GGE has been in use and accepted for many years.
- If the primary method of sale is mass, it dictates price, sale, and advertising be in mass. Mass units are not consumer friendly. Consumers don't understand price per kilogram or pound for fuel sales.
- Industry stated that equivalent units are what consumers want.
- At least one company reported that all of their business is built around the DGE and they would need to retrofit their dispensers if required to measure in mass.
- Natural gas retail dispensers measure in mass and are inspected and tested using mass units.

**Opposition:**

- Use of the word approximate.
- This is marketing rather than a technical issue.
- Will there be potential for proliferation of other equivalent units for other alternative fuels?
- There are questions concerning the validity of the conversion values and whether adequate research has been done to develop the values.
- Including more than one equivalent value could lead to consumer confusion.
- Not aligned with how natural gas is being sold in the rest of the world.
- A jurisdiction stated that consumers hadn't been asked how they want it sold.
- Is there a need for ongoing value comparisons if a vehicle is dedicated to natural gas fuel?
- Measurement science needs to be based on traceable standards. "Equivalent units" are not traceable to NIST standards.
- Consumers may need to make comparisons with multiple different fuel types such as diesel, biodiesel, gasoline, fuel ethanol, electric, hydrogen, LNG, and others. What is the most appropriate means to provide sufficient information to customers attempting to make value comparisons?
- Equivalent units would be better provided as supplemental information rather than the basis for commercial transactions.

**Other technical points that were raised include the following:**

- NTEP certificates have already been issued for five LNG dispensers that measure and indicate in mass units only. How will the proposed changes affect this equipment?

The Committee received an alternative proposal from NIST that would require dispensers to measure, indicate, and calculate the total selling price based on mass units (pounds or kilograms), but permit the posting of supplemental information regarding approximate equivalents to other fuels for use by consumers when making value comparisons or for use by tax agencies. The proposed changes that appear in this alternative proposal are shown below; the Committee was also provided with a draft of the entire Section 3.37. Mass Flow Meters Code showing these changes incorporated into the code. This draft is available upon request from NIST, OWM.

**S.1. Indicating and Recording Elements.**

...

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

(Added 1994) (Amended 20XX)

**S.1.3. Units.**

**S.1.3.1. Units of Measurement.** – Deliveries shall be indicated and recorded in grams, kilograms, metric tons, pounds, tons, and/or liters, gallons, quarts, pints and decimal subdivisions thereof. The indication of a delivery shall be on the basis of apparent mass versus a density of 8.0 g/cm<sup>3</sup>. The volume indication shall be based on the mass measurement and an automatic means to determine and correct for changes in product density.

(Amended 1993 and 1997)

**S.1.3.1.1. ~~Compressed~~ Natural Gas Used as an Engine Fuel.** – When ~~compressed~~ natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated as follows:

(a) Effective and Nonretroactive as of January 1, 2016, the delivered quantity shall be indicated in mass units in terms of kilograms or pounds and decimal subdivisions thereof.

This paragraph will become retroactive on January 1, 2017.

(Added 20XX)

(b) For dispensers manufactured prior to January 1, 2016, the dispenser shall display the mass measured for each transaction, either continuously on an external or internal display accessible during the inspection and test of the dispenser, or display the quantity in mass units by using controls on the device. The delivered quantity shall be indicated in mass or in “gasoline liter equivalent (GLE) units” or “gasoline gallon equivalent (GGE) units.” (Also see ~~d~~Definitions.)

(Added 1994) (Amended 20XX)

Paragraph S.1.3.1.1.(b) will be removed in the 2017 edition of NIST Handbook 44 when paragraph S.1.3.1.1.(a) becomes retroactive.

S.1.3.1.2. Natural Gas Used as an Engine Fuel, Supplemental Information. – Dispensers of natural gas dispensed as an engine fuel may include supplemental information to assist

consumers in making value comparisons with gasoline and diesel fuel and for use by taxation departments and other agencies that may need an approximation thereof. Supplemental information shall not appear adjacent or in close proximity to the primary display and shall be positioned far enough from that display so as to ensure that the quantity, unit price, and total price for the transaction are clear and easily understood.

Supplemental units shall be clearly designated with the phrase “The following information is provided for comparison with other vehicle fuels and is not to be used as a basis for commercial transactions.”

Supplemental units shall be displayed using one or more of the following statements.

For compressed natural gas:

1 kg of Compressed Natural Gas is Equal to 1.4749 Gasoline Liter Equivalent (GLE)  
1 kg of Compressed Natural Gas is Equal to 0.3896 Gasoline Gallon Equivalent (GGE)  
1 kg of Compressed Natural Gas is Equal to 1.3072 Diesel Liter Equivalent (DLE)  
1 kg of Compressed Natural Gas is Equal to 0.3455 Diesel Gallon Equivalent (DGE)

1 lb of Compressed Natural Gas is Equal to 0.669 Gasoline Liter Equivalent (GLE)  
1 lb of Compressed Natural Gas is Equal to 0.177 Gasoline Gallon Equivalent (GGE)  
1 lb of Compressed Natural Gas is Equal to 0.593 Diesel Liter Equivalent (DLE)  
1 lb of Compressed Natural Gas is Equal to 0.157 Diesel Gallon Equivalent (DGE)

For liquefied natural gas:

1 kg of Liquefied Natural Gas is Equal to 1.3768 Diesel Liter Equivalent (DLE)  
1 kg of Liquefied Natural Gas is Equal to 0.3638 Diesel Gallon Equivalent (DGE)

1 lb of Liquefied Natural Gas is Equal to 0.625 Diesel Liter Equivalent (DLE)  
1 lb of Liquefied Natural Gas is Equal to 0.165 Diesel Gallon Equivalent (DGE)

...

#### S.1.3.3. Maximum Value of Quantity-Value Divisions.

- (a) The maximum value of the quantity-value division for liquids shall not be greater than 0.2 % of the minimum measured quantity.
- (b) Effective and nonretroactive as of January 1, 2016, the maximum value of the mass division for dispensers of natural gas used to refuel vehicles shall not exceed 0.001 kg or 0.001 lb.

Note: Paragraph S.1.3.3.(b) will become retroactive effective January 1, 2017.

- (c) For dispensers of ~~compressed~~ natural gas used to refuel vehicles and manufactured prior to January 1, 2016, the value of the division for the gasoline liter equivalent shall not exceed 0.01 GLE; the division for gasoline gallon equivalent (GGE) shall not exceed 0.001 GGE. The maximum value of the mass division shall not exceed 0.001 kg or 0.001 lb.

Note: Paragraph S.1.3.3.(c) will be removed in the 2017 edition of NIST Handbook 44 when Paragraph S.1.3.3.(b) becomes retroactive.

(Amended 1994 and 20XX)

...

**S.5. Markings. ...**

**S.5.2. Marking of Gasoline Volume Equivalent Conversion Factor. – ~~A device~~ Dispensers manufactured prior to January 1, 2016** dispensing compressed natural gas shall have either the statement “1 Gasoline Liter Equivalent (GLE) is Equal to 0.678 kg of Natural Gas” or “1 Gasoline Gallon Equivalent (GGE) is Equal to 5.660 lb of Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.

**As of January 1, 2017 devices must indicate as specified in S.1.3.1.1.(a) and any information providing equivalent units may only be included as supplemental information as specified in S.1.3.1.2.**

**Paragraph S.5.2. will be removed from the 2017 edition of NIST Handbook 44 when paragraph S.1.3.1.1.(a) becomes retroactive.**

(Added 1994) (~~Amended 20XX~~)

...

**UR.3. Use of Device.**

...

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

(Added 1998) (~~Amended 20XX~~)

Because many of these issues are dependent upon defining the proper method of sale, the Committee met jointly with the L&R Committee to discuss the comments received on the S&T and L&R items relating to natural gas.

The Committee identified the method of sale by mass versus equivalent volumetric units as the most significant concern based on comments heard on this proposal. In addition to support for this proposal, there were also concerns regarding the use of the word “approximately” for labeling purposes; “multiple equivalent units” labeled on the same dispenser; “tax issues;” and other less commonly expressed issues. The Committee decided to eliminate the labeling altogether and not delay the effective date, thereby, addressing all three concerns. Consequently, the Committee agreed to delete proposed Paragraphs S.5.3., UR.3.1.1., and UR.3.1.2. in their entirety from the proposal and existing paragraph S.5.2. from NIST Handbook 44.

Based upon the comments received and its deliberations, the Committee agreed to modify the Item Under Consideration shown in NCWM Publication 16 by deleting the following language:

~~**S.5.2. Marking of Equivalent Conversion Factor for Compressed Natural Gas. – A device dispensing compressed natural gas shall have either the statements “1 Gasoline Liter Equivalent (GLE) is Approximately Equal to 0.678 kg of Compressed Natural Gas” and “1 Diesel Liter Equivalent (DLE) is Approximately Equal to 0.765 kg of Compressed Natural Gas” or the statements “1 Gasoline Gallon Equivalent (GGE) is Approximately Equal to 5.660 lb of Compressed Natural Gas” and “1 Diesel Gallon Equivalent (DGE) is Approximately Equal to 6.384 lb of Compressed Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.**~~

~~(Added 1994) (~~Amended 2014~~)~~

~~**S.5.3. Marking of Diesel Volume Equivalent Conversion Factor for Liquefied Natural Gas. – A device dispensing liquefied natural gas shall have either the statement “1 Diesel Liter Equivalent (DLE)**~~



~~is Approximately Equal to 0.726 kg of Liquefied Natural Gas” or “1 Diesel Gallon Equivalent (DGE) is Approximately Equal to 6.059 lb of Liquefied Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.~~

~~(Added 2014)~~

~~UR.3.1.1. Marking of Equivalent Conversion Factor for Compressed Natural Gas. – A device dispensing compressed natural gas shall have either the statements “1 Gasoline Liter Equivalent (GLE) is Approximately Equal to 0.678 kg of Compressed Natural Gas” and “1 Diesel Liter Equivalent (DLE) is Approximately Equal to 0.765 kg of Compressed Natural Gas” or the statements “1 Gasoline Gallon Equivalent (GGE) is Approximately Equal to 5.660 lb of Compressed Natural Gas” and “1 Diesel Gallon Equivalent (DGE) is Approximately Equal to 6.384 lb of Compressed Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.~~

~~(Added 2014)~~

~~UR.3.1.2. Marking of Equivalent Conversion Factor for Liquefied Natural Gas. – A device dispensing liquefied natural gas shall have either the statement “1 Diesel Liter Equivalent (DLE) is Approximately Equal to 0.726 kg of Liquefied Natural Gas” or “1 Diesel Gallon Equivalent (DGE) is Approximately Equal to 6.059 lb of Liquefied Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.~~

~~(Added 2014)~~

The Item Under Consideration, absent the language that had been deleted by the Committee, was then offered for vote, but was returned to Committee for further consideration due to a split “Reports of the National Conference on Weights and Measures” Vote. The following proposal is that which was Voted on at the 2014 Annual NCWM Meeting and returned to Committee.

**Proposal presented for vote and returned to Committee at the 2014 NCWM Annual Meeting:**

Amend NIST Handbook 44, Appendix D to include new definitions as follows:

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

**(Added 20XX)**

**diesel liter equivalent (DLE). – means 0.765 kilograms of compressed natural gas or 0.726 kilograms of liquefied natural gas. [3.37]**

**(Added 20XX)**

Amend NIST Handbook 44, Appendix D definitions as follows:

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

(Added 1994) **(Amended 20XX)**

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

(Added 1994) **(Amended 20XX)**

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

**S.1.2. Compressed Natural Gas and Liquefied Natural Gas Dispensers.** – Except for non-retail fleet sales and other price contract sales, a compressed natural gas **and liquefied natural gas** dispensers used to

refuel vehicles shall be of the computing type and shall indicate the quantity, the unit price, and the total price of each delivery. The dispensers shall display the mass measured for each transaction either continuously on an external or internal display accessible during the inspection and test of the dispensers, or display the quantity in mass units by using controls on the device.

(Added 1994) (Amended 20XX)

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

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

(Added 1994) (Amended 20XX)

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

(Added 20XX)

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

(Added 1998) (Amended 20XX)

### **January 2015 – Separate Compromise Proposals Offered by the NGSC:**

In January 2015 and prior to the 2015 NCWM Interim Meeting, the Committee received a recommendation from the NGSC that the weights and measures community consider two separate proposals as alternatives to the proposal voted on at the 2014 NCWM Annual Meeting. The Steering Committee noted that the two proposals reflect compromises on viewpoints within the NGSC: (1) on the recognition of the LNG motor-fuel application; (2) to replace the term “equal” with the term “means” to establish the relationship of mass units to supplemental units; and (3) to eliminate from use liter equivalent units of measurement in natural gas motor-fuel applications since this is a newly created unit that is not recognized in jurisdictions using SI units.

The first compromise proposal titled “The Volume Equivalent Compromise Proposal” proposes modifications to NIST Handbook 44, Section 3.37. Mass Flow Meters (MFM) Code and corresponding NIST Handbook 130, Method of Sale (MOS) requirements to:

1. Recognize the indication of natural gas fuel sales in values of either volume equivalent units or mass units based on legislative policy within a jurisdiction;
2. Mandate labeling the equivalent unit conversion factor on a natural gas motor-fuel dispenser, and
3. No longer recognize SI mass units (e.g., kg) in favor of U.S. customary mass units (i.e., lb).

The second proposal, originally titled “Natural Gas Motor-Fuel Proposal to Phase-In Mass Indications While Recognizing Supplemental Fuel Information,” but later changed to “The Mass Compromise Proposal” is intended to replace the NIST OWM fall 2014 compromise proposal. This alternate proposal was a joint collaboration of work by Mr. Ron Hayes (Missouri) and NIST OWM to further modify the NIST Handbook 44, 3.37. Mass Flow Meters Code where this proposal:

1. Keeps the suggested *new* phase in period where mass indications for all sales of natural gas motor-fuel will be of a specified maximum value and required for all dispensers effective January 1, 2017, as shown in amended Paragraphs S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel, and S.1.3.3. Maximum Value of Quantity-Value Divisions;
2. Continues to recognize the use of *new* supplemental fuel information for use in making value comparisons and taxation purposes as well as prescribe the format for stating this information as shown in: (a) the proposed *new* Definition of “diesel gallon equivalent (DGE);” and (b) *new* paragraph S.1.3.1.2. Natural Gas Used as an Engine Fuel, Supplemental Information; and (c) modifications to paragraph S.5.2. Marking of Gasoline Volume Equivalent Conversion Factor. This information might be provided in the form of placards; on the kiosk; or as dispenser indications or labeling on the cabinet when it is clear that this is not the required transaction information; and
3. Recognizes the existing compressed natural gas motor-fuel application and includes the proposed *new* liquefied natural gas motor-fuel application as shown in modified Paragraphs S.1.2. Compressed Natural Gas Dispensers and UR.3.8. Return of Product to Storage.

Both proposals are included in their entirety in the boxes below.

***Proposal 1 – The Volume Equivalent Compromise Proposal:***

**NIST Handbook 44:**

Amend NIST Handbook 44, Appendix D to include new definitions as follows:

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

**(Added 20XX)**

Amend NIST Handbook 44, Appendix D – Definitions as follows:

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

(Added 1994) **(Amended 20XX)**

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

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

(Added 1994) **(Amended 20XX)**

**S.1.3. Units.**

**S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel.** – When compressed natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated in **“gasoline liter equivalent (GLE) units” or “gasoline gallon equivalent (GGE) units.” or diesel gallon equivalent units (DGE),**

**or in mass if required by the weights and measures authority having jurisdiction.** (Also see definitions.)

(Added 1994) **(Amended 20XX)**

**S.1.3.1.2. Liquefied Natural Gas Used as an Engine Fuel. – When liquefied natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated in diesel gallon equivalent units (DGE), or in mass if required by the weights and measures authority having jurisdiction (Also see definitions.)**

**(Added 20XX)**

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

(Added 1994) **(Amended 20XX)**

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

**(Amended 20XX)**

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

**(Added 20XX)**

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

**(Amended 20XX)**

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

(Added 1998) **(Amended 20XX)**

**NIST Handbook 130:**

Amend NIST Handbook 130, Uniform Engine Fuels and Automotive Lubricants Regulation as follows:

**1.XX. Diesel Gallon Equivalent (DGE). – Diesel Gallon Equivalent (DGE) means 6.384 pounds of compressed natural gas or 6.059 pounds of liquefied natural gas.**

**1.25. Gasoline Gallon Equivalent (GGE). – Gasoline Gallon Equivalent (GGE) means ~~to 2.567~~(5.660 lb of compressed natural gas.**

~~1.26. Gasoline Liter Equivalent (GLE). Equivalent to 0.678 kg (1.495 lb) of natural gas.~~

**1.35. Liquefied Natural Gas (LNG).** – Natural gas that has been liquefied at ~~– 126.4~~ 162 °C (~~– 259~~260 °F) and stored in insulated cryogenic tanks for use as an engine fuel.

**3.11. Compressed Natural Gas (CNG).**

**3.11.1. How Compressed Natural Gas is to be Identified.** – For the purposes of this regulation, compressed natural gas shall be identified by the term “Compressed Natural Gas” or “CNG.”

**3.11.2. Retail Sales of Compressed Natural Gas Sold as a Vehicle Fuel.**

**3.11.2.1. Method of Retail Sale.** – All CNG kept, offered, or exposed for sale or sold at retail as a vehicle fuel shall be either in terms of the gasoline ~~liter equivalent (GLE) or gasoline~~ gallon equivalent (GGE), the diesel gallon equivalent (DGE), or in mass if required by the weights and measures authority having jurisdiction.

**3.11.2.2. Retail Dispenser Labeling.**

**3.11.2.2.1. Identification of Product.** – Each retail dispenser of CNG shall be labeled as “Compressed Natural Gas.”

**3.11.2.2.2. Conversion Factor.** – All retail CNG dispensers shall be labeled with the conversion factor in terms of ~~kilograms or~~ pounds. The label shall be permanently and conspicuously displayed on the face of the dispenser and shall have either the statement ~~“1 Gasoline Liter Equivalent (GLE) is equal to 0.678 kg of Natural Gas or”~~ “1 Gasoline Gallon Equivalent (GGE) is equal to means 5.660 lb of Compressed Natural Gas,” or “1 Diesel Gallon Equivalent (DGE) means 6.384 lb of Compressed Natural Gas,” consistent with the method of sale used.

**3.11.2.2.3. Pressure.** – CNG is dispensed into vehicle fuel containers with working pressures of ~~16 574 kPa–~~20 684 kPa (3,000 psig), or 24 821 kPa (3,600 psig). The dispenser shall be labeled ~~16 574 kPa–~~20 684 kPa (3,000 psig), or 24 821 kPa (3,600 psig) corresponding to the pressure of the CNG dispensed by each fueling hose.

**3.11.2.2.4. NFPA Labeling.** – NFPA Labeling requirements also apply. (Refer to NFPA 52.)

**3.11.3. Nozzle Requirements for CNG.** – CNG fueling nozzles shall comply with ANSI/AGA/CGA NGV 1.

**3.12. Liquefied Natural Gas (LNG).**

**3.12.1. How Liquefied Natural Gas is to be Identified.** – For the purposes of this regulation, liquefied natural gas shall be identified by the term “Liquefied Natural Gas” or “LNG.”

**3.12.2. Retail Sales of Liquefied Natural Gas Sold as a Vehicle Fuel.**

**3.12.2.1. Method of Retail Sale.** – All LNG kept, offered, or exposed for sale or sold at retail as a vehicle fuel shall be in terms of the diesel gallon equivalent (DGE), or in mass if required by the weights and measures authority having jurisdiction.

**3.12.2.3. Labeling of Retail Dispensers of Liquefied Natural Gas Sold as a Vehicle Fuel Labeling.**

**3.12.23.1. Identification of Product.** – Each retail dispenser of LNG shall be labeled as “Liquefied Natural Gas.”

**3.12.3.2. Conversion Factor.** – **All retail LNG dispensers shall be labeled with the conversion factor in terms of pounds. The label shall be permanently and conspicuously displayed on the face of the dispenser and shall have the statement “1 Diesel Gallon Equivalent (DGE) means 6.059 lb of Liquefied Natural Gas.”**

**3.12.23.23. Automotive Fuel Rating.** – LNG automotive fuel shall be labeled with its automotive fuel rating in accordance with 16 CFR Part 306.

**3.12.23.34. NFPA Labeling.** – NFPA Labeling requirements also apply. (Refer to NFPA **5752**.)

**Proposal 2 – The Mass Compromise Proposal:**

Consider the following modifications to NIST Handbook 44, 3.37. Mass Flow Meters Code:

**S.1.3. Units.**

**S.1.3.1. Units of Measurement.**

...

**S.1.3.1.1. ~~Compressed~~ Natural Gas Used as an Engine Fuel.** – When ~~compressed~~ natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated **as follows:**

**(a) Effective and nonretroactive as of January 1, 2016, the delivered quantity shall be indicated in mass units in terms of kilograms or pounds and decimal subdivisions thereof.**

**This paragraph will become retroactive on January 1, 2017.**

**(Added 20XX)**

**(b) The dispenser shall display the mass measured for each transaction, either continuously on an external or internal display accessible during the inspection and test of the dispenser, or display the quantity in mass units by using controls on the device. The delivered quantity shall be indicated in mass or in “gasoline liter equivalent (GLE) units” or “gasoline gallon equivalent (GGE) units.” (Also see ~~d~~Definitions.)**

**(Added 1994) (Amended 20XX)**

**Paragraph S.1.3.1.1.(b) will be removed in the 2017 edition of NIST Handbook 44 when paragraph S.1.3.1.1.(a) becomes retroactive.**

**S.1.3.2. Numerical Value of Quantity-Value Divisions.** – The value of a scale interval shall be equal to:

...

**S.1.3.3. Maximum Value of Quantity-Value Divisions.**

(a) The maximum value of the quantity-value division for liquids shall not be greater than 0.2 % of the minimum measured quantity.

- (b) Effective and nonretroactive as of January 1, 2016, the maximum value of the mass division for dispensers of natural gas used to refuel vehicles shall not exceed 0.001 kg or 0.001 lb.

Note: Paragraph S.1.3.3.(b) will become retroactive effective January 1, 2017.

- (c) For dispensers of ~~compressed~~ natural gas used to refuel vehicles and manufactured prior to January 1, 2016, the value of the division for the ~~gasoline liter equivalent shall not exceed 0.01 GLE; the division for~~ gasoline gallon equivalent (GGE) shall not exceed 0.001 GGE. The maximum value of the mass division shall not exceed 0.001 kg or 0.001 lb.

Note: Paragraph S.1.3.3.(c) will be removed in the 2017 edition of NIST Handbook 44 when Paragraph S.1.3.3.(b) becomes retroactive.

(Amended 1994 and 20XX)

Include a new definition for the supplemental term diesel gallon equivalent as follows:

A Diesel Gallon Equivalent (DGE) means 6.384 pounds (2.895 kg) of CNG or 6.059 pounds (2.748 kg) of LNG.

(Added 20XX)

Add a new paragraph S.1.3.1.2. as shown below:

S.1.3.1.2. Natural Gas Used as an Engine Fuel, Supplemental Information. – Dispensers of natural gas dispensed as an engine fuel may include supplemental information to assist consumers in making value comparisons with gasoline and diesel fuel and for use by taxation departments and other agencies that may need an approximation thereof. Quantity, unit price, and total price for the transaction must be clearly designated and distinguished from any supplemental information to ensure that the customer understands the basis for the transaction.

Supplemental units shall be clearly designated with the phrase “The following information is provided for comparison with other vehicle fuels and is not to be used as a basis for commercial transactions.”

Supplemental units shall be displayed using one or more of the following statements.

For compressed natural gas:

1 kg of Compressed Natural Gas means 0.3896 Gasoline Gallon Equivalent (GGE)

1 kg of Compressed Natural Gas means 0.3455 Diesel Gallon Equivalent (DGE)

1 lb of Compressed Natural Gas means 0.177 Gasoline Gallon Equivalent (GGE)

1 lb of Compressed Natural Gas means 0.157 Diesel Gallon Equivalent (DGE)

A Gasoline Gallon Equivalent (GGE) means 5.660 pounds (2.567 kg) of CNG

For liquefied natural gas:

1 kg of Liquefied Natural Gas means 0.3638 Diesel Gallon Equivalent (DGE)

1 lb of Liquefied Natural Gas means 0.165 Diesel Gallon Equivalent (DGE)

A Diesel Gallon Equivalent means 6.059 pounds (2.748 kg) of LNG

Modify paragraph S.5.2. as follows:

S.5.2. Marking of Gasoline Volume Equivalent Conversion Factor. – A device dispensing compressed natural gas shall have either the statement “1 Gasoline Liter Equivalent (GLE) is Equal to 0.678 kg of

~~Natural Gas~~ or “1 Gasoline Gallon Equivalent (GGE) is ~~Equal to~~ means 5.660 lb of Natural Gas” permanently and conspicuously marked on the face of the dispenser according to the method of sale used.

Paragraph S.5.2. will be removed from the 2017 edition of NIST Handbook 44 when paragraph S.1.3.1.1.(a) becomes retroactive.

(Added 1994) (Amended 20XX)

Amend the following NIST Handbook 44, paragraphs as recommended in Fall 2014:

**S.1. Indicating and Recording Elements.**

...

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

(Added 1994) (Amended 20XX)

**UR.3. Use of Device.**

...

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

(Added 1998) (Amended 20XX)

The NGSC representatives ask that the “Natural Gas Motor Fuel Proposal to Phase-In Mass Indications While Recognizing Supplemental Fuel Information” shown above be considered on its merits for adhering to basic weights and measures philosophy and principles of measurement; that is, transactions are clear, transparent, verifiable, protect all consumers, and promote fair competition in the marketplace. This proposal is an opportunity for a uniform method of sale by mass units and is aligned with practices adhered to globally for this application. The proposal shown above might be made more palatable by including some corresponding NIST Handbook 130 language to address street price signage requirements; it is highly possible to develop, distribute, and vet a set of minimal modifications to HB 130 before July 2015, if deemed necessary.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The S&T and L&R Committees took comments on S&T Item 337-1 and L&R Items 232-4 and 237-1 collectively during a special joint open hearing session. There were two proposals offered for consideration concerning the appropriate method of sale (MOS) for natural gas and it was stated that comments would be taken on both to determine which proposal best represents the body of the NCWM. Proposal 1, titled “The Volume Equivalent Compromise Proposal” would require natural gas to be measured in mass and indicated in and sold by equivalent gallon units or mass. Proposal 2, titled “The Mass Compromise Proposal” would require natural gas to be measured and indicated in and sold by mass and supplemental equivalent information be displayed on the dispenser for value comparison only.

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. Albuquerque 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 are 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 in 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 standards 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.

Mr. Constantine Cotsoradis (Flint Hills Resources) commented that he would be opposed to moving forward to satisfy the marketing of one industry. He noted that Flint Hills Resources sells LNG by weight using a truck scale to weigh it. If equivalent units were required, the weight would need to be converted to equivalent gallon units. He suggested that Proposal 1 be modified to apply to retail stations rather than retail sales. However, when the Committee announced after the Open Hearings that it had modified Proposal 1 to allow natural gas to be sold by equivalent gallon units or mass as shown in Item Under Consideration, Mr. Cotsoradis indicated his concern had been satisfied.

Following the Open Hearings, the S&T and L&R Committees met jointly in an open work session to decide which proposal would be presented to the NCWM for vote given the comments heard during the Open Hearings. Several members of the NGSC were in attendance and provided feedback during the meeting. In considering this issue, two or three members of the S&T and L&R Committees led a discussion in favor of putting forward Proposal 1 for Vote by emphasizing that proposal’s flexibility in allowing jurisdictions to make the decision on which MOS is appropriate. Mr. Richard Harshman, NIST Technical Advisor to the S&T Committee, acknowledged that during the Open Hearings, the comments heard from industry representatives overwhelmingly supported Proposal 1, but industry representatives are not permitted to vote. Mr. Harshman pointed out that during Sunday’s joint meeting of the NGSC, S&T, and L&R Committees, it was stated that the goal for this Interim Meeting was to select the proposal that best represents the body of, and, therefore, most likely to be adopted by the NCWM. He also provided a count of the number of weights and measures officials who commented in support of each proposal during the Open Hearings, noting that they represented the group that could vote. Officials commenting in support of Proposal 2 numbered five. Officials commenting in support of Proposal 1 numbered two. It was then stated by Mr. Louis Sakin (Town of Hopkinton/Northbridge, Massachusetts), a member of the L&R Committee, that this tally was not a true representation of all in the room who could vote and that many who could vote had not spoken during the Open Hearings. Mr. Sakin concluded that most of these “silent officials” (i.e., officials who did not provide testimony during the Open Hearings) would be in favor of Proposal 1. Some others in the room agreed and consequently, the two Committees voted in favor of putting forth Proposal 1 for a July vote by NCWM.

There were mixed positions amongst the S&T Committee members as to the method of sale, but overall the Committee, in conjunction with the L&R Committee, elected to put forth a version of Proposal 1 (volume equivalents)

and recommend a Voting status for this version. The S&T Committee's modification to Proposal 1 included deleting the words "if required by the weights and measures authority having jurisdiction" in Paragraphs S.1.3.1.1. and S.1.3.1.2. The Committee also agreed to reinsert the current NIST Handbook 44 definition of "gasoline liter equivalent" shown as completely struck out into the Item Under Consideration with the understanding that the intent of the NGSC is to eliminate all references to "GLE" from NIST Handbook 44. The Committee recognizes that "GLE" is referenced throughout the Mass Flow Meters Code and that these references are an issue still needing to be addressed. A final action agreed to by the Committee was to add the following option for marking supplemental information in Proposal 2 of the two proposals considered at the 2015 NCWM Interim Meeting:

**A Diesel Gallon Equivalent means 6.059 pounds (2.748 kg) of LNG.**

The Item Under Consideration includes the Committee's modification to the S&T portion of Proposal 1 and replaces the previous Item Under Consideration proposal that was voted on and returned to Committee during the 2014 NCWM Annual Meeting due to a split vote.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The S&T and L&R Committees took comments on S&T Item 337-1 and L&R Items 232-4 and 237-1, collectively, during a special joint open hearing session. There were comments in both support of and opposition to the proposal. Multiple people provided oral comments and Mr. Mahesh Albuquerque (Colorado), Chairman of the S&T Committee, reported that there were over 10 letters in support of the proposal, which had been posted on NCWM's website. Much of the testimony, whether it be in support or opposition, were iterations of points that had been made in previous NCWM Conference Meetings beginning from the time this item first appeared on the Committee's Agenda.

The following are some examples of comments heard in support of the proposal:

- Equivalent units have been used since 1994 without issue. We can't undo what was accepted over 20 years ago.
- Equivalent units are what customers and fuel retailers desire.
- Users of natural gas are truckers and the American truckers, as well as the retailers, are on board with respect to the current proposal.
- Equivalent units are necessary for taxation purposes (it was reported that 26 states currently have adopted a DGE standard for taxation and 10 states recognize DGE as a method of sale).
- Equivalent units provide value comparison with gasoline and diesel.
- Dispensers indicating in mass units and street sign advertising indicating in volume equivalent units would conflict with some laws requiring both units be identical.
- The country needs a single standard.
- Volume equivalent values are derived from mass units. Testing will be in mass units and everyone will be using the same factor to compute mass units to a volume equivalent values.

The following are some examples of comments heard in opposition of the proposal:

- A mistake was made in 1994 allowing volume equivalent values in the marketplace for CNG. Proliferation of "equivalent units" is a real concern. When a mistake is made, it should be fixed, not allowed to continue.
- Volume equivalent units are not clear and transparent to the consumer.

- Volume equivalent units are not traceable units.
- Under the current proposal, fuel retailers may sell by volume equivalent units in one location and mass units in another (or even in another state) lending to inequity in the marketplace for businesses and confusion for consumers.
- If gallon equivalents are necessary for taxation, then the taxation agencies can use the values they deem necessary to approximate the indicated mass values to gallon equivalents.
- Customers will have already researched the value of natural gas during their decision-making process *before* purchasing a natural gas powered vehicle. Thus, they will not need to make ongoing comparisons to other types of fuel when making purchases of natural gas.
- Customers will calculate the cost per mile of operation of a natural gas powered vehicle versus a gasoline or diesel powered vehicle, thus, the need to attempt direct comparison of natural gas sold by mass to gasoline or diesel gallon equivalents is not needed.
- Natural gas being sold by mass vs. by gasoline or diesel gallon equivalents is attempting to compare “apples to oranges.”

Ms. Tina Butcher (NIST, OWM) provided an overview of OWM’s analysis of the current proposal and explained that a more complete analysis had been provided in writing to the Committee. A copy of OWM’s complete written analysis of this item is included in Appendix G of this report.

It was also reported during the special joint open hearing that there is currently a pending legislative item before the U.S. Congress specifying a slightly different conversion factor for DGE (6.06 lb) than that contained in the Item Under Consideration (6.059 lb), essentially rounding off to two significant digits after the decimal point instead of three. Voting on the legislation is pending, awaiting the outcome of the action taken by NCWM at this Annual Conference on adopting a conversion factor. In response to this reported information, Mr. Ron Hayes (Missouri), Chairman of the Natural Gas Steering Committee (NGSC), stated that we shouldn’t be selecting a number just because there are bills out there using another number. He reported that the NGSC could not reach consensus on a conversion factor for DGE because no data could be found that supports any factor. He further noted gasoline has a variation in energy content. Diesel, too, varies. The hard part then becomes selecting the right number (conversion factor). If we were selling gasoline and diesel fuel by mass, energy content is consistent; this is not the case on a gallon basis.

During the Committee’s work session, several Committee members acknowledged the comments heard were both in favor of and in opposition to the proposal and many of those comments were the same as those heard in previous open hearing sessions. The Committee agreed to recommend the item be presented for Vote unchanged.

#### **Regional Association Meetings:**

**CWMA 2014 Interim Meeting:** The CWMA reported that a segment of the industry supports this item. The majority of the regulatory body does not support the item as written. Based on the comments received, the CWMA recommended that the item be an Informational item. The CWMA also recommends that the commodity shall be measured in mass units and indicated in mass units. Equivalency units may be included as supplemental information. At the 2015 CWMA Annual Meeting, the following comments were received during a joint session of the CWMA L&R and S&T Committees:

It was recommended that comments for this item along with CWMA L&R Items 237-1 and CWMA S&T Item 337-1 be heard together. A state regulator from Missouri commented that Item 237-1 should be considered separately. Item 237-1 focuses on language relevant to the Method of Sale section, so it should be removed from the bundle of three items and considered separately. An industry representative from National Association of Convenience Stores and the Society of Independent Gasoline Marketers of America (NACS-SIGMA) rose in support of marketing and selling natural gas as a road fuel by equivalency, but be measured for accuracy by mass that would be posted on the dispenser along with a voluntary marketing statement, which includes the equivalency price. He stated the objective of the Conference is equity in the

market, which fundamentally means consumers get what they bargain for in a transaction. He also believes it is essential that we get products to the market in terms people understand. Retailers stock and sell what consumers want to buy – not the other way around. So, customers for compressed natural gas have approached the fuel retailers and have expressed a desire to purchase their product in diesel gallon equivalencies. He commented that no one wants to buy “pounds” of natural gas. He believes some fleets prefer purchasing in diesel gallon equivalencies. He asked why we should we sell a product in a language that consumers don’t understand, even if over time they will understand it. He encouraged the Conference to consider allowing diesel gallon equivalency as a method of sale for both compressed and liquid natural gas. He is concerned that our inability to come up with a preferred method of sale is an obstacle to selling this fuel. He further commented that in actual terms, all weights and measures are arbitrary. By not adopting this proposal, regulators will fail in their objective to provide equity in the market. If they do not pass it, a different body will set standards. A regulator from Missouri and also a member of the Natural Gas Steering Committee commented that the Committee proposed two items – one was to sell natural gas on a volumetric method; the second (considered a compromise) is to market or advertise the products in equivalency values, but measure for compliance using mass, and display that value on dispensers. Nothing would preclude a retailer from displaying a gallon equivalency value on an advertising sign as long as the mass weight is posted on the dispenser along with that equivalency value. He further commented that he is opposed to selling in diesel gallon equivalents. He said natural gas equivalencies will vary so much for every diesel vehicle that the equivalency information will be more misleading than informative. He provided several examples of this. He concluded his comments by saying the Conference made a mistake by establishing the gasoline gallon equivalent method of sale twenty years ago, but that should not be a precedent to make another mistake by passing an equivalency value again. The industry representative commented that all states should check in with their states’ attorneys general, because he believes if an advertising sign posts an equivalency amount, it has to be posted that way on the dispenser – otherwise it is a deceptive practice. An industry representative from Flint Hills Resources commented that they sell LNG in bulk to the end user, so it is considered a retail sale. He supports the compromise the Natural Gas Steering Committee came up with, which would allow for the posting of an equivalency value, but would also require the product be measured by mass. With the compromise, jurisdictions can decide for themselves if they want to post equivalencies or if they want to sell by mass. A regulator from Minnesota has changed her mind from supporting sales strictly in mass to support sales by equivalence.

Primarily for taxing considerations, state officials and policy makers in her state want the Conference to provide a measurement in mass, pick an equivalency number for diesel gallons, and standardize the process. A second regulator from Missouri commented that a taxing unit is different from weights and measures work. He believes that the science of weights and measures is absolute, and there should be no exceptions. The NACS-SIGMA representative again commented that states are currently developing a patchwork of policies addressing this issue because there is no standard in place today, and if the Conference does not pass a standard, Congress will take the decision out of the hands of the Conference, because people who market natural gas nationally won’t want to deal with a patchwork of varying policies and procedures. A regulator from Kansas expressed a concern that a DGE and a GGE price per gallon equivalency at the same station could result in a different price per pound, which would result in confusion for the consumer. The first Missouri regulator rose to remind the Conference that if this proposal fails, GGE does not go away. Currently, LNG is being taxed at the diesel rate calculated on a mass basis. A state regulator from Iowa asked for clarity as to whether there was a method of sale in NIST Handbook 130 based on weight for compressed natural gas. There is a method of sale for CNG based on GGE. A NIST representative commented that she thought this proposal addresses a method of sale for LNG. An industry representative from Gilbarco indicated their natural gas customers are requesting GGE’s and DGE’s. They already measure in mass and make the conversion. However, Gilbarco cannot serve the needs of their customers because they cannot sell an NTEP certified device reflecting these equivalency values. He commented that no one is asking for a display in mass, nor for a dual display. He supports the diesel gallon equivalency method for natural gas sales. The Minnesota regulator commented that they have a current scenario where a retailer in their state needs an NTEP certified device, and they are not yet available. A Missouri regulator asked if Gilbarco were displaying the sale price of natural gas in pounds, and their customers made a request to see it in an equivalency mode, would they respond to their customer’s request. The Gilbarco individual answered that if their customer wants supplemental labeling, it would be possible. Beyond that he cannot predict what is possible or likely, but there currently are no plans to develop dual-display devices to his knowledge. The

NACS-SIGMA representative commented again that dispenser manufacturers are working on other issues beyond this one.

This item was presented for a Vote during the L&R voting session and passed by a margin of one vote. The CWMA recommended this item move forward as a Voting item.

WWMA 2014 Annual Meeting: During the Open Hearings, an update on the NGSC was provided and comments were heard (pro and con) for this item, similar to what has been offered previously. The WWMA agrees that this topic needs to be addressed and resolved; therefore, it should remain as an Information item on the NCWM Agenda. The WWMA S&T Committee offers the recommendations of: 1) consideration of the NIST Proposal; 2) possibility of a customer selectable unit; and 3) determination of GGE to low-volume sales and DGE to high-volume sales. During the S&T Committee voting session, it was motioned, seconded, and approved that comments presented during the L&R Committee voting session be adopted. The comments included a call for Vote by those in support of sale in mass versus those in support of sale by equivalent unit. A show of hands was recorded by the Parliamentarian and indicated those in favor of mass to be 23 and those in favor of equivalent unit to be 12.

SWMA 2014 Annual Meeting: The SWMA recommended deferring to the NGSC which will provide recommendations at the 2015 NCWM Interim Meeting.

NEWMA 2014 Interim Meeting: NEWMA recommended that NEWMA S&T Items 337-1 and 232-3 and NEWMA L&R Item 237-1 remain Information items pending final language from the NGSC at the NCWM 2015 Interim Meeting. It was further recommended that the NGSC consider changing the method of sale to mass and that the NIST proposal to modify Section 3.37. Mass Flow Meters in NIST Handbook 44 (2014 edition) be considered. It was noted that the draft NIST proposal was posted on the NEWMA website as a supporting document. At the 2015 NEWMA Annual Meeting, this item was grouped with L&R Agenda Items 237-1 and 237-3. There were comments heard in both support of and opposition to these items as follows:

A Maine official reported that the State of Maine believes mass is the appropriate unit of measure for this product. Maine will not support any proposal with an equivalency measure because it is not a traceable unit. A county official from New York asked how many states had proposed or accepted new laws with equivalencies. NGSC Chair Mr. Ethan Bogren (Westchester County Weights and Measures), in response to the question, indicated there were six states that had adopted equivalency language or something similar. Several other states were also moving in that direction. A retired official from New York suggested reviewing the model law of Uniform Weights and Measures – while directors can determine and issue regulations regarding method of sale, it is not the directors who should initiate the unit of measure. Buyers and sellers should determine the unit for the method of sale. He stated that he believes the weights and measures community has an obligation to listen to the stakeholders, who have made it clear they want equivalency units.

The NEWMA S&T Committee's recommendation to the region was that S&T Agenda Item 337-1 be a Voting item on the NCWM's Agenda. A motion was made to accept this recommendation, but not seconded; therefore, the item was returned to the Committee.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **337-2 W S.3.6. Automatic Density Compensation.**

(This item was Withdrawn.)

**Source:**

NCWM Natural Gas Steering Committee (NGSC) (2014 Interim Meeting)

This is a new item (2014) that originated from the NCWM NGSC as a result of its deliberations January through March 2014 on Agenda Item 337-1 (an alternative proposal for defining and establishing legal metrology requirements for quantity indications and markings on a device when CNG and LNG are dispensed and sold as engine fuel in volume equivalent units). The NGSC recommended the proposal as a Developing item to allow additional time for the NCWM NTEP Measuring Sector and Measuring Laboratories to fully vet the proposed modifications to NIST Handbook 44, Mass Flow Meters Code Paragraph S.3.6. Automatic Density Correction.

**Purpose:**

Provide a starting point for work identified in March 2014 by the NGSC and the S&T Committee that is necessary to fully address legal metrology requirements for LNG retail and wholesale applications.

**Item Under Consideration:**

Amend NIST Handbook 44, 3.37. Mass Flow Meters Code Paragraph S.3.6. as follows:

**S.3.6. Automatic Density Correction.**

- (a) An automatic means to determine and correct for changes in product density shall be incorporated in any mass flow metering system that is affected by changes in the density of the product being measured.
- (b) Volume-measuring devices with automatic temperature compensation used to measure liquefied natural gas as a motor vehicle engine fuel shall be equipped with an automatic means to determine and correct for changes in product density due to changes in the temperature, ~~pressure, and composition~~ of the product.

(Amended 1994 ~~and~~ 1997, and 20XX)

**Background/Discussion:**

After the January 2014 NCWM Interim Meeting, the NGSC and the S&T Committee received input from Mr. Dmitri Karimov (Liquid Controls Corporation, LLC and a member of the NGSC), who proposed to differentiate between CNG and LNG in the requirements of paragraph S.3.6 “Automatic Density Correction” when using volumetric devices. Mr. Karimov indicated that density calculations of LNG when measured using a volumetric device, require temperature determination only. CNG devices will not be allowed to use indirect mass measurement in Mr. Karimov’s proposal.

Mr. Karimov provided the NGSC and S&T Committee with the following points as rationale for the proposed changes to paragraph S.3.6.:

- The requirements for volume-measuring devices were developed in 1994 and 1997 for CNG based on Hydrocarbon Gas Vapor-Measuring Devices Code. (See the NCWM final reports from those years for additional details.)
- The concerns might be valid for CNG, but not for LNG. For LNG, only a temperature input is required to calculate a mass value.
- Based on the most recent changes to the Mass Flow Meters Code by the NGSC, indirect mass measurement is proposed to be allowed for LNG, but not CNG; so, S.3.6. needs to be modified.
- CNG and LNG mass flow meters (Coriolis) with automatic density correction will be covered by paragraph S.3.6.(a)
- LNG volume-measuring devices (such as orifice plate and turbine meters) will be covered by paragraph S.3.6.(b) since indirect mass measurement for CNG is no longer allowed under the proposal by the NGSC.

- CNG (being gas) is very compressible, so pressure is a significant influence factor in density calculations. “Pressure” was added to S.3.6.(b) in 1997 because, at that time, the paragraph was relied upon only for CNG.
- On the other hand, LNG is measured at very low pressure and, being liquid, is not compressible at the pressures at which it is measured. The pressure effect on density of LNG is therefore negligible. See the table below where Mr. Karimov generated data on LNG density changes using the NIST REFPROP database.
- Per documentation received by the NGSC from the Clean Vehicle Education Foundation, the composition of natural gas remained virtually unchanged over the last 21 years. Therefore, volumetric devices for LNG could use fixed composition in density calculations as per ASTM D4784 Clause 2.1 (see below).
- Finally, indirect mass measurement volumetric devices undergo type evaluation, and only those devices meeting accuracy requirements through proper density calculations are approved.

**Supporting documentation:**

**ASTM D4784 – 93 (Reapproved 2010) Standard Specification for LNG Density Calculation Models**  
 ASTM D4784 provides models for density calculation.

<b>2. Significance and Use</b>	
<b>2.1 The models in this specification can be used to calculate the density of saturated liquid natural gas in the temperature range 90 to 120 K. The estimated uncertainty for the density calculations is ± 0.1 %. The restrictions on composition of the liquefied natural gas are:</b>	
<b>methane</b>	<b>60 % or greater</b>
<b>nitrogen</b>	<b>less than 4 %</b>
<b><i>n</i>-butane</b>	<b>less than 4 %</b>
<b><i>i</i>-butane</b>	<b>less than 4 %</b>
<b>pentanes</b>	<b>less than 2 %</b>

Mr. Karimov also referenced excerpts from past NCWM Final Reports from 1994 and 1997; see those reports for additional details.

Listed below is the table Mr. Karimov generated on LNG density changes using the NIST REFPROP database. Mr. Karimov noted that density changes to LNG are negligible at 120 K with changes in pressure from the base pressure of 27.765 psi up to 200 psi.

<b>Density Changes to LNG</b>			
<b>Temperature<sup>1</sup> (K)</b>	<b>Pressure (psia)</b>	<b>Density (lb<sub>MASS</sub>/gal)</b>	<b>% Density Difference<sup>2</sup></b>
120	27.765	3.4208	0.000%
120	30	3.4209	– 0.003%
120	35	3.4213	– 0.015%
120	40	3.4216	– 0.023%
120	45	3.4219	– 0.032%
120	50	3.4222	– 0.041%
120	55	3.4225	– 0.050%



<b>Density Changes to LNG</b>			
<b>Temperature<sup>1</sup> (K)</b>	<b>Pressure (psia)</b>	<b>Density (lb<sub>MASS</sub>/gal)</b>	<b>% Density Difference<sup>2</sup></b>
120	60	3.4229	- 0.061%
120	65	3.4232	- 0.070%
120	70	3.4235	- 0.079%
120	75	3.4238	- 0.088%
120	80	3.4241	- 0.096%
120	85	3.4245	- 0.108%
120	90	3.4248	- 0.117%
120	95	3.4251	- 0.126%
120	100	3.4254	- 0.134%
120	105	3.4257	- 0.143%
120	110	3.4261	- 0.155%
120	115	3.4264	- 0.164%
120	120	3.4267	- 0.172%
120	125	3.427	- 0.181%
120	130	3.4273	- 0.190%
120	135	3.4276	- 0.199%
120	140	3.428	- 0.210%
120	145	3.4283	- 0.219%
120	150	3.4286	- 0.228%
120	155	3.4289	- 0.237%
120	160	3.4292	- 0.246%
120	165	3.4295	- 0.254%
120	170	3.4298	- 0.263%
120	175	3.4302	- 0.275%
120	180	3.4305	- 0.284%
120	185	3.4308	- 0.292%
120	190	3.4311	- 0.301%
120	195	3.4314	- 0.310%
120	200	3.4317	- 0.319%

<sup>1</sup>120 K (- 153 °C) (- 243 °F)

<b>Density Changes to LNG</b>			
<b>Temperature<sup>1</sup></b> <b>(K)</b>	<b>Pressure</b> <b>(psia)</b>	<b>Density</b> <b>(lbMASS/gal)</b>	<b>% Density Difference<sup>2</sup></b>
<sup>2</sup> Percent difference in product (pure methane) density is based on calculated variations to the base pressure of 27.765 psi using NIST REFPROP			

Initially Mr. Karimov presented his proposal to his colleagues on the NGSC. During the NGSC's deliberation on the Clean Vehicle Education Foundation's proposed changes to other Mass Flow Meters Code paragraphs (see Agenda Item 337-1), the NGSC also considered Mr. Karimov's proposal. The NGSC agreed to encourage further work beyond the current scope of their work on the Clean Vehicle Education Foundation's proposals. Admittedly, many of the NGSC members indicated not fully comprehending the technical rationale for the Mr. Karimov's proposal. After discussions with the S&T Committee, both Committees agreed that the proposal should be vetted by the NCWM NTEP Measuring Sector and Measuring Laboratories to ensure the community understands the intent and impact of the proposed changes to paragraph S.3.6. Additionally, NIST, OWM plans to consult with its Cryogenics Group on the proposal. Based on its discussion with the S&T Committee, both Committees believe the proposal has merit and should be included in the S&T Committee's Interim Meeting report as a separate new item with Developing status.

**2014 NCWM Annual Meeting:**

NCWM 2014 Annual Meeting: At the Annual Meeting there were numerous comments suggesting the proposal remain in a Developing status. Consequently, the Committee agreed to recommend this item remain Developing.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee agreed to Withdraw this item from its agenda at the request of the item's submitter.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA did not receive comments on this item and recommended that it be an Information item.

WWMA 2014 Annual Meeting: During the Open Hearings a member of the NGSC offered testimony that the submitter requested this item be Withdrawn. WWMA agreed to recommend this item be Withdrawn.

SWMA 2014 Annual Meeting: The SWMA recommended this item to be Withdrawn from the agenda at the request of the submitter.

NEWMA 2014 Interim Meeting: NEWMA recommended that this item remain Developing. It was noted that further clarification is needed as to the intent to move forward with this item from the submitter.

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

**337-3 D N.3. Test Drafts.**

**Source:**

Endress + Hauser Flowtec AG USA (2015)

**Purpose:**

Allow transfer standard meters to be used to test and place into service dispensers and delivery system flow meters.

**Item Under Consideration:**

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 two minutes at its maximum discharge rate.**

#### **Background/Discussion:**

The use of transfer standards is recognized in the following NIST Handbook 44, Sections 3.34. Cryogenic Liquid-Measuring Devices Code; 3.38. Carbon Dioxide Liquid-Measuring Devices Code; and 3.39. Hydrogen Gas-Measuring Devices – Tentative Code. Field evaluation of LPG meters and CNG dispensers and LNG dispensers is very difficult using volumetric and gravimetric field standards and methods. The tolerances for these applications are such that using transfer meter standards are more efficient and safer. With CNG, LNG, and LPG applications, transfer standard meters are placed in-line with the delivery system as it is used to fill tanks and vehicles. The use of transfer standards eliminates return to storage issues. The use of transfer standard meters is easier and faster compared to the use of traditional field standards. The cost of using transfer standards and transporting them is much less than the cost of traditional field provers and standards. The submitter believes that recognition in NIST Handbook 44 will enable states to allow transfer standard meters to place systems into service and for field enforcement.

Volumetric field provers and gravimetric field proving are susceptible to environmental influences. The State of Colorado uses a master meter to test propane delivery truck meters. The State of Nebraska has used a mass flow meter to test agricultural chemical meters.

In some applications, transfer standard meters are not more accurate than the meters used in the dispenser. For that reason, longer test drafts and possibly more tests need to be run.

The State of California is purported to have conducted a short study of master meters in the past. The conclusion did not lead to wide adoption of the practice. However, the State of California uses a mass flow meter as a master meter for carbon dioxide flowmeter enforcement.

Mass Flow Meters Code paragraph U.R.3.8. Return of Product to Storage, Retail Compressed Natural Gas Dispensers requires that the natural gas, which is delivered into the test container, must be returned to storage. This is difficult and most often not complied with when the test vessel contents are released to atmosphere. *[Technical Advisor's Note: Paragraph UR.3.8. also provides the option to the device owner or operator to otherwise safely dispose of the product. See Paragraph UR.3.8. for details.]*

The S&T Committee might also consider amending Sections 3.30. Liquid-Measuring Devices Code and 3.31. Vehicle-Tank Meters Code to allow transfer standard meters.

#### **2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee agreed to group together Agenda Items 330-2 and 337-3 since these items are related and announced that comments on both items would be taken together during the Open Hearings. Refer to Agenda Item 330-2 for a summary of the comments heard concerning these two items. The Committee agreed this item has merit and recommends the submitter of these items work with OWM by providing data for the NIST USNWG on Alternative Test Methods to consider in determining the suitability of the master meter transfer standard as a standard in testing another device.

#### **2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 332-2 and 337-3 and take comments on the two items simultaneously. See Agenda Item 332-1 for a summary of comments heard on these two items. In consideration of the comments heard in support of the two agenda items, the Committee agreed to maintain the Developing status of both items.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA received comments questioning the accuracy of a meter used as a mobile standard. The CWMA forwarded the item to the NCWM, recommending it as a Developing item. At the 2015 CWMA Annual Meeting Open Hearings, Mr. Robert Murnane (Seraphin Test Measure Co.) questioned the validity of transfer standards and the purpose of this item. He also stated that he believed the item was too general in scope. CWMA agreed to recommend this item move forward as a Developing item noting it supported the item's continued development.

WWMA 2014 Annual Meeting: Testimony was presented that this type of technology would more easily facilitate inspections. However, it was also stated that a more comprehensive evaluation of the equipment and testing procedure, including associated uncertainties, be performed. The WWMA agreed that this type of technology would be useful, but it should be a Developing item to enable the submitter to provide a more complete analysis.

SWMA 2014 Annual Meeting: The SWMA heard questions and concerns that needed to be addressed by the submitter. The SWMA also recommended that NIST, OWM continue to develop a standard for this equipment to development standards and other guidance documents necessary to recognize their use. Additionally, the SWMA recommended the submitter work with NIST, OWM to address these concerns. The SWMA recommended that Items 332-2 and 337-3 be combined into one agenda item since they are both related to test drafts. Comments were heard for both of these agenda items at the same time.

NEWMA 2014 Interim Meeting: NEWMA reported at its that it believed his item has merit but needs further vetting and development before being sent to a Vote. NEWMA forwarded the item to the NCWM and recommended that it be a Developing item. NEWMA also recommended this item be combined with Items 332-2 and 337-3 as a single agenda item. At the 2015 NEWMA Annual Meeting, a recommendation was made to Withdraw this item with the intent that it be resubmitted once clarification has been provided regarding the accuracy of the transfer standard meters. However, at the recommendation of NEWMA's S&T Committee, NEWMA agreed to leave this item Developing while work continues on the proposal.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**354 TAXIMETERS**

**354-1 V S.1.1.1. Recording Elements.**

(This item was Adopted.)

**Source:**

NIST USNWG on Taximeters (2015)

**Purpose:**

Ensure that customers can receive a printed receipt detailing charges for taximeters put in service after a specified date.

**Item Under Consideration:**

Amend NIST Handbook 44, 5.54. Taximeter Code as follows:

**S.1.1. General.** – A taximeter shall be equipped with a primary indicating element ~~and may be equipped with a recording element.~~  
(Amended 1988 and 2015)

**S.1.1.1. Recording Elements. – A receipt providing information as required in S.1.9. Recorded Representations shall be available from a taximeter or taximeter system through an integral or separate recording element for all transactions conducted.**

**[Nonretroactive January 1, 2016]**

**(Added 2015)**

**Background/Discussion:**

Transactions involving “for-hire” vehicles may include multiple charges and, as a result, be somewhat complex. Total charges resulting from taxi services in some jurisdictions can include the fare based on time and distance traveled as well as extras and other additional charges. Those extras and additional charges may include charges for additional passengers, transportation of luggage, tolls, surcharges, and taxes. In some locations, passenger(s) are presented with offers for other services unrelated to the taxi service during the trip, such as the purchase of tickets for theater shows or other events. If purchased, the cost of these services may be included as part of the overall charge in the transaction.

The USNWG on Taximeters has noted that, in many instances, the interchange between passenger and the taxi driver is brief and the passenger may not immediately comprehend fully all the details regarding a transaction. With a potential total cost to the passenger comprised of numerous charges, it is considered important that the customer (passenger) be able to receive a record of those charges as evidence of what was paid for. Requiring that a form of receipt (printed or electronic) be made available to the passenger when desired, will help to ensure that the customer is provided a record of expenses paid for and as necessary documentation in cases where charges may be disputed.

Amending paragraph S.1.1. as shown will remove the existing *optional* provision for a recording element associated with a taximeter and the addition of a new S.1.1.1. will require a form of receipt capable of being produced by the taximeter system for all transactions (non-retroactively). Taximeter systems manufactured and placed in service prior to the effective date of the new paragraph S.1.1.1. will still be permitted and will not be required to include a recording element; however, those manufactured and placed into service after the effective date will be required to make a receipt available to the customer. It is intended that the non-retroactive status will provide device manufacturers ample time to comply with the proposed requirement.

Requiring receipts from all taximeters may be considered onerous to taxi owners/operators that operate in areas that have very simple rate structures and where the total charges to the customer would possibly only include a fare based on distance and/or time. This burden will be mitigated, however, by the non-retroactive status of the proposed new requirement.

**2015 NCWM Interim Meeting**

NCWM 2015 Interim Meeting: The Committee agreed to group together all of the “354” Taximeter Items (i.e., Agenda Items 354-1 through 354-6, inclusive) since it considered these items related and announced that comments on all six items would be taken together during the Open Hearings.

Ms. Tina Butcher (NIST, OWM) noted that Taximeter Items 354-1 through 354-5, inclusive, were submitted by the USNWG on Taximeters to address the emergence of new technology associated with taximeters by amending some current requirements and developing new requirements where needed. Because they are related, NIST, OWM agrees with the regional associations that these items could be combined into a single Voting item. Ms. Butcher also summarized the following update concerning Item 354-6, which was provided to the Committee in NIST, OWM’s analysis of the item:

**Update from the NIST Technical Advisor to the USNWG on Taximeters:**

During the same time period that the USNWG on Taximeters was being formed, reports from regulatory officials in the United States were being received that described transportation-for-hire services using cellular telephone software applications (“apps”) in conjunction with global positioning satellite (GPS) service to calculate fare charges for their passengers. The USNWG, which had been formed to update NIST Handbook 44, Taximeters Code in response to advances in taximeter design and operation, agreed also to include in the NIST Handbook 44 update the use of GPS service as a commercial source of time and distance measurement in conjunction with the use of cellular telephone apps.

Since the use of GPS in a commercial type of application had not been addressed previously, there were numerous technical and practical issues to be considered in the development of standards and regulatory policies. This was the motivation for the formation of a Subcommittee from within the USN WG that would focus specifically on the use of “smart-phone” apps and GPS. This GPS Subcommittee would be responsible for analyzing the many issues involved with the use of these technologies in a legal metrology context and report their conclusions to the USN WG on Taximeters. The USN WG would then assemble the data from the GPS Subcommittee to develop possible changes to NIST Handbook 44 that would allow the existing NIST Handbook 44, Taximeters Code to be applied to GPS-based services or possibly to conclude that the use of GPS in this manner would best be regulated under a separate NIST Handbook 44 code.

Very shortly after the formation of the GPS Subcommittee, the Chair position of that Subcommittee was vacated. The loss of the Chair created a situation where the work of the Subcommittee was suspended indefinitely due to the loss of that leadership role. The GPS Subcommittee was dormant for an extended period until NIST, OWM was able to fill the Chair position again. This position was filled in September 2014 with a NIST contractor.

On November 20, 2014, the GPS Subcommittee met via web-conference to revive its efforts. Since this meeting included some changes in the subcommittee’s membership roster, the focus of the meeting was to establish the scope and the mission of the Subcommittee and to provide an orientation for new members. Subsequent meetings are being planned and are expected to be held at regular intervals (every two to three months) in the form of web-conferences, teleconferences, or simply through e-mail exchanges among the members. A report to the USN WG on Taximeters will be made by the GPS Subcommittee following the Subcommittee meetings and whenever significant conclusions or revelations are made that will impact the efforts of the USN WG.

Mr. James Cassidy (Cambridge, Massachusetts), a member of the USN WG on Taximeters, stated he supported the proposals (Items 354-1 through 354-5) moving forward as Voting items.

Mr. Ross Andersen (New York, Retired) expressed concern regarding use of the term “Advancement of Indicating Elements” in Agenda Item 354-2 as it applies to “flat rate” fares. He noted that when a fare is based on a flat rate, there is no advancement of the indicating elements as there is with the measurements associated with time and distance. For this reason, it would be inappropriate to address charges associated with a flat rate fare in Paragraph S.1.2. Advancement of Indicating Elements. With regard to Item 354-5, he reported that in the State of New York there are unregulated taxis that are not equipped with ticket printers. These taxis simply charge a “fare” and “extras.” A New York ordinance allows for this (i.e., to operate with no ticket printer and charges based on a “fare” with “extras” added).

With respect to Item 354-6, Ms. Kristin Macey (California) urged the USN WG to develop a new code to address GPS-based systems if it’s determined that requirements applicable to these systems can’t be inserted into the existing NIST Handbook 44, Taximeters Code. She also requested the USN WG not prevent these systems from calculating fare on time and distance at the same time. She reported that California is currently evaluating software provided by the company, “Lyft.”

Mr. Jim Truex (NTEP) noted that there may be an issue concerning the effective date of nonretroactive requirements. The issue has to do with basing the application of nonretroactive requirements on the date of manufacture **or** the date of NTEP certification and may necessitate a change to G-A.6. Nonretroactive Requirements.

With respect to this particular Item 354-1, the Committee agreed to assign the effective enforcement date of January 1, 2016, to the proposed new paragraph S.1.1.1. Recording Elements and recommend the item for Vote at the July NCWM Annual Meeting.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 354-1 through 354-5 and 360-3 and take comments simultaneously on these six items.

Ms. Tina Butcher (NIST, OWM) reported that the USNWG on taximeters is requesting Items 354-1 and 354-2 be downgraded to an Informational status due to concerns raised regarding these two items at NEWMA's May 2015 Annual Meeting. She noted that following the NEWMA Meeting, the WG considered various options for revising the two proposals and believes any revisions to sufficiently mitigate those concerns would require more than minor editorial changes. NIST, OWM believes the change in status is appropriate and would allow time for additional work by the USNWG. Ms. Butcher also noted that the NIST Handbook 44 code reference currently appearing beneath the definition of "point-of-sale" in Appendix D of NIST Handbook 44 is missing from the definition shown in Item Under Consideration for Agenda Item 360-3 and needs to be added to the proposal.

Mr. Russ Vires (Mettler-Toledo, LLC) speaking on behalf of the SMA reported that the SMA supports Agenda Item 360-3.

Mr. Ross Andersen provided the following comments in opposition to Agenda Item 354-1:

- The concept of requiring a printed receipt for every transaction is a major step and many NIST Handbook 44 codes do not require there to be a printed receipt. One code that does require a printed receipt is the Vehicle-Tank Meters (VTM) Code; the reason being, in 95 % of the cases, the buyer is not present to witness the delivery transaction. This is not the case with taximeters; one hundred percent of the time, the customer is present to witness the transaction.
- In some cases, involving taximeters, weights and measures officials share regulatory authority with a taxi commission. The local taxi commission needs to address this concern; not weights and measures. The requirement to issue a receipt should be a user requirement legislated by the taxi commission.

Mr. Mike Sikula (New York) stated that he supported the recommendation of the USNWG to downgrade Agenda Items 354-1 and 354-2 to Informational items.

Mr. John Barton (NIST, OWM), Technical Advisor to the USNWG on Taximeters, reported that the USNWG recognizes that printers are not required under NIST Handbook 44 standards yet, but noted that taxi displays in general provide very limited information; for example, no display of measured mileage, charge per mile, etc. Typically, the information displayed by the taximeter is limited to the accrued monetary charge and an average passenger is not able to determine if those charges have been applied correctly.

Ms. Joanne Rausen (New York City Taxi and Limousine Commission) agreed with Mr. Barton and expanded on his comments by stating in an age of transparency this information, as a baseline, is needed. Rates applied for taxi services vary widely from one jurisdiction to another. Therefore, it is unlikely that a passenger visiting an unfamiliar area would be knowledgeable about the rates being applied. Additionally, providing a receipt to the passenger would give them the documentation needed to seek recourse if details of a transaction were to be questioned. Because crucial transaction details are not normally displayed on the taximeter, that information should be available by providing it on a receipt.

One official, commenting in support of the items, indicated receipts are needed for reimbursement of travel expenses. Another official commented that she supported the block of items as written.

During the Committee's work session, members of the Committee considered whether or not to downgrade Agenda Items 354-1 and 354-2 as recommended by the USNWG. Several members of the Committee stated they believed these items had been sufficiently developed by the USNWG, were being recommended for Vote by the USNWG, and that ample opportunity had been provided by the USNWG to provide input into the development of these proposals. They viewed the concerns being raised by one state as "last minute" issues should have been addressed well before the NCWM Annual Meeting. Members noted that the comments heard during the Open Hearings suggested the USNWG still supported these two proposals as written. Consequently, the Committee agreed to recommend the two items be presented for Vote, but agreed to exclude them from the Voting Consent calendar to allow them to be voted on as stand-alone items.

During the voting session, when asked if there were any comments on Agenda Item 354-1, Mr. Andersen rose to make a recommendation that the item be downgraded to an Information status to allow the USN WG time to further develop it. He stated that proposed paragraph S.1.1.1. Recording Elements does not provide enough clarity for a person to interpret it correctly. In his view, those reading the paragraph could only interpret it to mean a ticket printer is required. He noted the taxi companies that are already equipped with printers are primarily located in larger cities and smaller companies, which will also be impacted by the proposed change, haven't been given an opportunity to review and comment on those changes. Mr. Andersen further stated these smaller companies are regulated primarily through local regulations, which have been vetted by those companies.

Mr. Sikula requested an interpretation of the paragraph, asking "If the proposal is adopted, will all taxis be required to have a printer?"

Mr. Ryan Wanttaja (New York City Taxi and Limousine Commission), a member of the USN WG, in response to Mr. Sikula's question, stated the proposed paragraph is a "Specification" requirement, not a "User Requirement." The paragraph is simply saying that taxis must have the capability of providing a receipt.

Ms. Rausen expanded upon Mr. Wanttaja's comment by stating that the interpretation of the proposed changes by the USN WG is that a taximeter must be capable of accepting a printer *and* that a taximeter provides a receipt, if a jurisdiction requires it. Mr. Barton voiced agreement with the interpretation provided.

A Vote on the item was then taken and the item adopted.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA S&T Committee received comments supporting further development of this item. It was noted that this item has been under development for two years by the NIST USN WG on Taximeters. Multiple jurisdiction voiced support for this item. The CWMA thinks this is sufficiently developed and forwarded the item to the NCWM, recommending it as a Voting item. No comments were received on this item during the 2015 CWMA Annual Meeting Open Hearings. The CWMA recommended this item move forward as a Voting item.

WWMA 2014 Annual Meeting: During Open Hearings, a member of the USN WG on Taximeters reported this item has been in development for three years and is ready to be moved forward for Vote. Further, he stressed it is imperative that these changes be adopted to ensure the weights and measures community stay current with today's environment. No opposition to this item was presented. The WWMA recognizes the amount of work that has been done on this item and forwarded it to the NCWM, recommending that it be a Voting item. Further, the WWMA recommends that 2014 WWMA S&T Committee Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into one proposal.

SWMA 2014 Annual Meeting: The SWMA did not hear any comments in opposition to this item. The SWMA recommended that Items 354-1 through 354-5 be combined into one Agenda item since they are all related to taximeters. Comments were heard for all five of these agenda items at the same time. The SWMA forwarded this item to the NCWM, recommending it as a Voting item.

NEWMA 2014 Interim Meeting: NEWMA received comment from a member of the USN WG on Taximeters that the language has been cleaned up in the Taximeters Code as new technology and point-of-sale systems are becoming more prevalent in all the states. There was no opposition to this item, and it was recommended that it move forward for a Vote. It was suggested that related Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into a single item. NEWMA forwarded the item to NCWM recommending it as a Voting item.

NEWMA 2015 Annual Meeting: The NEWMA S&T Committee agreed to group together Taximeter Items 354-1 through 354-5 since it considered all of these items related. Comments were received in support of the 354 group of items by members of the USN WG on Taximeters. With respect to Item 354-1, Mr. Ross Anderson expressed concern regarding the need to include a printed receipt as part of the NIST Handbook 44 code. With respect to Item 354-2, Mr. Andersen commented that he does not believe flat fares would advance the indicating element. In response to Mr. Andersen's comments associated with Item 354-1, a member of the USN WG on Taximeters stated that printed receipts are absolutely needed and should be made available to customers. NEWMA agreed to recommend Taximeter Agenda Items 354-1 through 354-5 move forward for Vote.



Following completion of the voting session at the 2015 NEWMA Annual Meeting, the NEWMA S&T Committee was approached by Mr. Mike Sikula, who raised two concerns regarding the proposals to amend the Taximeters Code as follows.

1. With respect to Agenda Item 354-1, the concern noted was it is not clear whether or not the proposed paragraph would allow printed receipts to be mailed to customers rather than require they be provided to them at time of transaction. An additional related concern was that proposed paragraph S.1.1.1. should be a “User Requirement” instead of a “Specifications” requirement because the intent of the paragraph is that customers be provided a receipt at time of transaction. After questioning a member of the USNWG on Taximeters regarding the differences in a taximeter and taximeter system, the NIST Technical Advisor noted that he did not believe mailing a printed receipt to the customer would satisfy what is required by proposed paragraph S.1.1.1. The Committee agreed that proposed paragraph S.1.1.1. should appear as a “Specifications” requirement in NIST Handbook 44 because it addresses the design of equipment (i.e., the proposed paragraph would require a taximeter or taximeter system to provide transaction information on a receipt). The Committee noted, if the intent of the USNWG is to require a receipt be provided to customers, it should consider proposing a new “User Requirement” to address this concern.
2. With regard to Agenda Item 354-2, the concern noted was that proposed subparagraph S.1.2.(d) is in conflict with the title of paragraph S.1.2. Advancement of Indicating Elements in that flat rate transactions are not based on any advancement of the indicating elements. It was also noted the current Taximeters Code Paragraph S.2. requires fares to be based on distance traveled, time elapsed, or a combination of both.

The NEWMA S&T Committee suggested to Mr. Sikula that he participate in an upcoming tele-conference with the USNWG (scheduled to take place shortly after the NEWMA Annual Meeting) to make known his concerns in order that the USNWG could address them. NEWMA’s S&T Committee indicated it believed there was still sufficient time for the USNWG to propose changes to the items prior to being presented for Vote at the upcoming NCWM Annual Meeting.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **354-2 I S.1.2. Advancement of Indicating Elements.**

**Source:**

NIST USNWG on Taximeters (2015)

**Purpose:**

Allow for the advancement of fare indication by the input of a flat rate where the local authority permits the use of flat rates and provide clarification that charges displayed on the taximeter other than fare may occur by a manual input or by an automatic means.

**Item Under Consideration:**

Amend NIST Handbook 44, 5.54. Taximeter Code as follows:

**S.1.2. Advancement of Indicating Elements.** – Except when a taximeter is being cleared, the **fare charges displayed on the** primary indicating and recording elements shall **advance** ~~be susceptible of advancement~~ only by:

- (a) the movement of the vehicle;
- (b) by the time mechanism;
- (c) **the movement of the vehicle and by the time mechanism but shall not occur by both of these means operating simultaneously (see also S.4. Interference).; or**

**(d) the entry of a monetary amount associated with a flat rate or negotiated rate where permitted.**

**Advancement of the indications for charges, other than fare may occur through manual or automatic means.**

(Amended 1988, **and 20XX**)

**Background/Discussion:**

The USNWG on Taximeters has determined that in some jurisdictions alternative types of fare charges such as flat rate-based fares are permitted by local authorities. These flat rate charges are not dependent on the calculation of distance and/or time via a taximeter but are based instead on established fixed amounts charged for trips between common origins and destinations (e.g., airports, hotels, and business districts). The intent of this proposed amendment is to allow for the advancement of fare indication by the input of a flat rate where the local authority permits the use of flat rates. Where the use of flat rates (and negotiated flat rates) is permitted, a display of the flat rate on the taximeter provides the passenger with verification of the charge applied to the service.

In addition, while this type of rate is not based on calculations by the taximeter, in some cases, taxi companies will track transactions and revenue by way of the data processed through the taximeter. These companies will, therefore, want all transactions to be processed through the taximeter as a means to account for all activities of the taxi.

The existing requirement in paragraph S.1.2. only allows the primary indications of a taximeter to be advanced through the motion of the vehicle or by the time mechanism and does not allow for the fare indication to be advanced by the input of a flat rate amount. This proposed amendment clarifies that the requirement only specifies the means of advancement for the indication of *fare* charges and *not* extras charges or other displayed indications. Because other types of charges that will be displayed on the taximeter (i.e., extras and additional charges) can be either entered manually into the taximeter or may be automatically entered, the proposed amendment also provides clarification that charges displayed on the taximeter other than fare may occur by a manual input or by an automatic means.

The reformatting of the existing paragraph through the use of bullets (a-d) is believed to improve the structure and the clarity of the requirement.

**2015 NCWM Interim Meeting:**

During the 2015 NCWM Interim Meeting, the Committee agreed to group together all of the “354” Taximeter Items (i.e., Agenda Items 354-1 through 354-6, inclusive) since it considered these items related and announced that comments on all six items would be taken together during the Open Hearings. See Agenda Item 354-1 for a summary of comments received during the Open Hearings relating to these items.

With respect to this particular Item 354-2, the Committee agreed to replace the language in the original proposal (shown in the box below), with that recommended by the SWMA, shown in “Item Under Consideration,” and recommend the item for Vote at the July NCWM Annual Meeting.

**Original Proposal:**

**S.1.2. Advancement of Indicating Elements.** – Except when a taximeter is being cleared, the **fare charges displayed on the** primary indicating and recording elements shall be susceptible of advancement only by:

- (a) the movement of the vehicle;
- (b) by the time mechanism;
- (c) **a combination of both a) and b\*); or**
- (d) **the entry of a monetary amount associated with a flat rate or negotiated rate where permitted.**

**Advancement of the indications for charges, other than fare may occur through manual or automatic means.**

**\*The advancement of fare may occur by either the movement of the vehicle or by the time mechanism but shall not occur by both of these means operating simultaneously (see also S.4. Interference).**

(Amended 1988, **and 20XX**)

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 354-1 through 354-5 and 360-3 and take comments simultaneously on these six items. See Agenda Item 354-1 for the summary of comments provided on these items.

Although grouped by the Committee with the other “taximeter” items, the Committee agreed during its work session to make this item a stand-alone Voting item due to comments heard during the Open Hearings recommending this item be downgraded to Informational.

During the voting session, when asked if there were any comments on Agenda Item 354-2, Ms. Kristin Macey (California) rose to request that the Committee downgrade this item to Informational. She noted that members of the USNWG are the experts, and they had recommended this action to allow time for the group to continue working on the proposal.

Mr. Ross Andersen (New York, retired) also recommended the item be downgraded to Informational. He stated that a flat fare is not associated with the advancement of the indicating elements and, therefore, should not be a part of paragraph S.1.2. Advancement of Indicating Elements.

Mr. Mike Sikula (New York) noted that a “flat rate” does not meet the definition of “fare” in Appendix D of NIST Handbook 44 in that the word “fare,” according to the definition, is calculated through the operation of the distance and/or time mechanism of a taximeter. A flat rate is not calculated by distance or time.

The Committee took a short recess to consider the comments heard during the Voting session. In consideration of those comments, the Committee agreed to downgrade this item to Informational.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA S&T Committee received comments supporting further development of this item. It was noted that this item has been under development for two years by the NIST USNWG on Taximeters. Multiple jurisdictions voiced support for this item. The CWMA thinks this is sufficiently developed and forwarded the item to the NCWM, recommending it as a Voting item. No comments were received on this item during the 2015 CWMA Annual Meeting Open Hearings. The CWMA recommended this item move forward as a Voting item.

WWMA 2014 Annual Meeting: At the Open Hearings, a member of the USNWG on Taximeters reported that this proposal has been in development for three years and is ready to be a Voting item. Further, he stressed that it is imperative that these changes be adopted to ensure the weights and measures community stay current with today’s environment. No opposition to this item was presented. The WWMA recognizes the amount of work that has been done on this item and forwarded it to the NCWM, recommending that it be a Voting item. Further, the WWMA recommends that 2014 WWMA S&T Committee Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into one proposal.

SWMA 2014 Annual Meeting: The SWMA did not hear any comments in opposition to this item and made recommendations based on confusion during review of the item. The Committee recommended that Items 354-1 through 354-5 be combined into one Agenda item, since they are all related to taximeters. Comments were heard for all five of these agenda items at the same time. The SWMA forwarded this item to the NCWM, recommending it as a Voting item as amended below:

**S.1.2. Advancement of Indicating Elements.** – Except when a taximeter is being cleared, the **fare charges displayed on the** primary indicating and recording elements shall ~~advance~~ ~~be susceptible of advancement~~ only by:

- (a) the movement of the vehicle;
- (b) by the time mechanism;
- (c) **the movement of the vehicle and by the time mechanism but shall not occur by both of these means operating simultaneously (see also S.4. Interference).; or**
- (d) **the entry of a monetary amount associated with a flat rate or negotiated rate where permitted.**

**Advancement of the indications for charges, other than fare may occur through manual or automatic means.**

(Amended 1988, **and 20XX**)

NEWMA 2014 Interim Meeting: NEWMA received comment from a member of the USNWG on Taximeters that the language has been cleaned up in the NIST Handbook 44 Taximeters Code as new technology and point-of-sale systems are becoming more prevalent in all the states. It was suggested that related Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into a single item. Since there was no opposition to this item, NEWMA agreed to forward the item to the NCWM, recommending it as a Voting item.

NEWMA 2015 Annual Meeting: The NEWMA S&T Committee agreed to group together Agenda Items 354-1 through 354-5 and take comments simultaneously on all these items since it considered them related. Refer to Agenda Item 354-1 to view the comments received by the Committee on this group of agenda items. NEWMA agreed to recommend Taximeter Agenda Items 354-1 through 354-5 move forward for vote.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **354-3 VC S.1.3.3. Passenger Indications.**

(This item was Adopted.)

**Source:**

NIST USNWG on Taximeters (2015)

**Purpose:**

Require that when a supplementary customer display is present in a taxi: (1) the accruing total charge shall be evident to the passenger; and (2) an itemized listing of the details for charges incurred is made available to the customer.

**Item Under Consideration:**

Amend NIST Handbook 44, 5.54. Taximeters Code as follows:

**S.1.3.3. Passenger's Indications. – A supplementary indicating element installed in a taxi to provide information regarding the taxi service to the passenger, shall clearly display the current total of all charges incurred for the transaction. The accruing total of all charges must remain clearly visible on the passenger's display (unless disabled by the passenger) at all times during the transaction.**

**S.1.3.3.1. Additional Information – Additional information shall be displayed or made available through a passenger's indicating element (as described in S.1.3.3. Passenger's Indications) and shall be current and reflect any charges that have accrued. This additional information shall include:**

- (a) **an itemized account of all charges incurred including fare, extras, and other additional charges; and**

**(b) the rate(s) in use at which any fare is calculated.**

**Any additional information made available must not obscure the accruing total of charges for the taxi service. This additional information may be made accessible through clearly identified operational controls (e.g., key pad, button, menu, touch-screen).**

**S.1.3.3.2. Fare and Extras Charges – The indication of fare and extras charges on a passenger’s indicating element shall agree with similar indications displayed on all other indicating elements in the system.**

**[Nonretroactive as of January 1, 2016]**

**(Added 2015)**

**Background/Discussion:**

The USNWX on Taximeters recognizes supplementary indicating elements that are installed in the passenger’s area in a taximeter are becoming more prevalent. At this time, there are no specific requirements that to address this type of device (sometimes referred to as passenger information monitors or PIMs) although they are being installed in taximeter systems in increasing numbers. Because these devices are commonly used to provide the passenger with details and information pertaining to the taxi service, the USNWX agreed that there must be appropriate requirements in NIST Handbook 44 that address the manner in which this information is presented.

The addition of the proposed new requirements S.1.3.3., S.1.3.3.1., and S.1.3.3.2. in the Taximeters Code provides specification requirements for this type of indicating element. These new paragraphs provide manufacturers with design criteria for new devices and provide regulatory authorities with requirements to ensure that the passenger is supplied with sufficient information necessary to verify the cost of the transportation service provided.

The USNWX considered the most important single data item for the passenger to be the accruing total of all charges during the trip. In this proposal, this information is required to be clearly visible on the passenger’s display at all times during the trip. Itemized details of individual charges and other information of importance must be made available to the passenger via these passenger’s indicating elements. In consideration of the limited size of the typical display area on this type of device, information other than the accruing total of charges need not be displayed constantly but must be available to the customer by clearly marked means through the operational controls on the device.

Because the primary indicating element in a system (the taximeter) will display the fare and extras indications, any supplemental device, which also displays these indications, must be in agreement with the taximeter. To address this, the proposed new S.1.3.3.2. would require that the display of fare and extras charges is in agreement with those same indications as displayed on other indicating elements in the system.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee agreed to group together all of the “354” Taximeter Items (i.e., Agenda Items 354-1 through 354-6, inclusive) since it considered these items related and announced that comments on all six items would be taken together during the Open Hearings. See Agenda Item 354-1 for a summary of comments received during the Open Hearings relating to these items.

With respect to this particular item (354-3), the Committee agreed to assign an effective, nonretroactive enforcement date of January 1, 2016, to proposed new paragraph S.1.3.3. Passenger’s Indications and to recommend the item for Vote at the July NCWM Annual Meeting.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 354-1 through 354-5 and 360-3 and take comments simultaneously on these six items. See Agenda Item 354-1 for the summary of comments provided on these items.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: During the meeting the CWMA S&T Committee received comments supporting further development of this item. It was noted that this item has been under development for two years by the NIST USNWX on Taximeters. Multiple jurisdictions voiced support for this item. The CWMA thinks this is sufficiently developed and forwarded the item to the NCWM, recommending it as a Voting item. No comments were received on

this item during the 2015 CWMA Annual Meeting Open Hearings. The CWMA recommended this item move forward as a Voting item.

WWMA 2014 Annual Meeting: During Open Hearings, a member of the USNWG on Taximeters reported that this proposal has been in development for three years and is ready to be a Voting item. Further, he stressed that it is imperative that these changes be adopted to ensure the weights and measures community stay current with today's environment. No opposition to this item was presented. The WWMA recognizes the amount of work that has been done on this item and forwarded it to NCWM, recommending that it be a Voting item. Further, the WWMA recommended that 2014 WWMA S&T Committee Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into one proposal.

SWMA 2014 Annual Meeting: The SWMA did not hear any comments in opposition to this item. The SWMA recommended that Items 354-1 through 354-5 be combined into one agenda item since they are all related to taximeters. Comments were heard for all five of these agenda items at the same time. The SWMA forwarded this item to the NCWM and recommended it as a Voting item.

NEWMA 2014 Interim Meeting: NEWMA received comment from a member of the USNWG on Taximeters that the language has been cleaned up in the NIST Handbook 44 Taximeters Code as new technology and point-of-sale systems are becoming more prevalent in all the states. It was suggested that related Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into a single item. Since there was no opposition to this item, NEWMA agreed to forward the item to the NCWM, recommending it as a Voting item.

NEWMA 2015 Annual Meeting: The NEWMA S&T Committee agreed to group together Agenda Items 354-1 through 354-5 and take comments simultaneously on all of these items since it considered them related. Refer to Agenda Item 354-1 to view the comments received by the Committee on this group of agenda items. NEWMA agreed to recommend Taximeter Agenda Items 354-1 through 354-5 move forward for Vote.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

#### **354-4 VC S.1.8. Protection of Indications.**

(This item was Adopted.)

**Source:**

NIST USNWG on Taximeters (2015)

**Purpose:**

Update specifications to reflect present day technology.

**Item Under Consideration:**

Amend NIST Handbook 44, 5.54. Taximeters Code as follows:

**S.1.8. Protection of Indications.** – All indications of fare and extras shall be ~~displayed through and entirely protected by glass or other suitable transparent material securely attached to the housing of the taximeter~~ protected from unauthorized alteration or manipulation.

**(Amended 2015)**

**Background/Discussion:**

This requirement was drafted when taximeters consisted of mechanical-type meters whose displays were much more susceptible to manipulation and today are rarely (if ever) found to be still in service. The proposed amendment to Paragraph S.1.8. serves to update this requirement with respect to current technology. Paragraph S.1.8. requires that taximeter indications should be protected from manipulation (accomplished relatively easily on mechanical-type

indications) through physical means. Electronic/digital type indications are less subject to physical manipulation although; those indications could potentially be manipulated through electronic means.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: During the meeting, the Committee agreed to group together all of the “354” Taximeter items (i.e., Agenda Items 354-1 through 354-6, inclusive) since it considered these items related and announced that comments on all six items would be taken together during the Open Hearings. See Agenda Item 354-1 for a summary of comments received during the Open Hearings relating to these items.

With respect to this particular Item (354-4), the Committee agreed to recommend the item for Vote at the July NCWM Annual Meeting.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 354-1 through 354-5 and 360-3 and take comments simultaneously on these six items. See Agenda Item 354-1 for the summary of comments provided on these items.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA’s S&T Committee received comments supporting further development of this item. It was noted that this item has been under development for two years by the NIST USNWG on Taximeters. Multiple jurisdiction voiced support for the item. CWMA thinks this is sufficiently developed and forwarded the item to NCWM, recommending it as a Voting item. No comments were received on this item during the 2015 CWMA Annual Meeting Open Hearings. The CWMA recommended this item move forward as a Voting item.

WWMA 2014 Annual Meeting: During the Open Hearings, a member of the USNWG on Taximeters reported that this proposal has been in development for three years and is ready to be a Voting item. Further, he stressed that it is imperative these changes be adopted to ensure the weights and measures community stay current with today’s environment. No opposition to this item was presented. The WWMA recognizes the amount of work that has been done on this item and forwarded it to NCWM, recommending that it be a Voting item. Further, the WWMA recommends that 2014 WWMA S&T Committee Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into one proposal.

SWMA 2014 Annual Meeting: The SWMA did not hear any comments in opposition to this item. SWMA recommended that Items 354-1 through 354-5 be combined into one Agenda item since they are all related to taximeters. Comments were heard for all five of these agenda items at the same time. SWMA forwarded this item to NCWM and recommended it as a Voting item.

NEWMA 2014 Interim Meeting: NEWMA received comment from a member of the USNWG on Taximeters that the language has been cleaned up in the Taximeter Code as new technology and point-of-sale systems are becoming more prevalent in all the states. As there was no opposition to this item, it was recommended that the item move forward to a Vote. It was suggested that related Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into a single item. NEWMA forwarded the item to NCWM recommending it as a Voting item.

NEWMA 2015 Annual Meeting: The NEWMA S&T Committee agreed to group together agenda Items 354-1 through 354-5 and take comments simultaneously on all of these items since it considered them related. Refer to Agenda Item 354-1 to view the comments received by the Committee on this group of agenda items. NEWMA agreed to recommend Taximeter Agenda Items 354-1 through 354-5 move forward for Vote.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### 354-5 VC S.1.9. Recorded Representation.

(This item was Adopted.)

**Source:**

NIST USNWG on Taximeters (2015)

**Purpose:**

Ensure that taximeter systems can generate receipts with the clear detail of the various charges.

**Item Under Consideration:**

Amend NIST Handbook 44, 5.54. Taximeter Code as follows:

***S.1.9. Recorded Representation.*** – *A printed receipt issued from a taximeter, whether through an integral or separate recording element, shall include as a minimum, the following information when processed through the taximeter system:*

- (a) *date;*
- (b) *unique vehicle identification number, such as the medallion number, taxi number, vehicle identification number (VIN), ~~or~~ permit number, or other identifying information as specified by the statutory authority.\**
- (c) *start and end time of trip;\**
- (d) *distance traveled, maximum increment of 0.1 kilometer (0.1 mile);\**
- (e) *fare in \$;*
- (f) *~~for multi-rate taximeters,~~ each rate at which fare was computed and the associated fare at that rate;\**
- (g) *additional charges in \$, where permitted, such as extras, any surcharges, ~~telephone use telecommunications charges, tip~~ and taxes shall be identified and itemized; ~~\*and~~*
- (h) *total fare charge for service in \$ (~~total charge inclusive of fare, extras, and all additional charges~~);\**
- (i) *trip number, if available;\*\* and*
- (j) *telephone number (or other contact information) for customer assistance.\*\**

***Note:*** *When processed through the taximeter or taximeter system, any adjustments (in \$) to the total charge for service including discounts, credits, and tips shall also be included on the receipt\*\**

*[Nonretroactive as of January 1, 1989] \*[Nonretroactive as of January 1, 2000] \*\*[Nonretroactive as of January 1, 2016]*

(Added 1988) (Amended 1999 **and 2015**)

**Background/Discussion:**

Upon reviewing the existing requirement, S.1.9. Recorded Representation, the USNWG on Taximeters agreed that additional information provided on a receipt issued by a taximeter or taximeter system would be a benefit by providing more detail for the passenger to interpret charges for that type of service or to provide assistance to the passenger in the case of any disputed charges involved in a transaction.



The WG also recognized that there may be some details involved in a transaction that may not be processed through the taximeter or taximeter system. An example of this could be when the charge for taxi service is paid by credit card and the passenger elects to give the driver a cash tip afterwards. Another example could be when a credit or discount is accepted but the taximeter is not capable of processing the adjustment to the total charge. To account for this type of alteration of charges, the proposed amendment specifies that information required to be included on the receipt must be information that is capable of being processed through the taximeter or taximeter system.

Other proposed changes include the allowance for the statutory authority to specify other information needed to positively identify a particular vehicle, the deletion of extraneous language (e.g., for multi-rate taximeters), and the replacement of obsolete language with more relevant terms (i.e., telecommunications charges). Also added to the list of required information was contact information for the passenger to seek customer assistance.

### **2015 NCWM Interim Meeting**

NCWM 2015 Interim Meeting: The Committee agreed to group together all of the “354” Taximeter Items (i.e., Agenda Items 354-1 through 354-6, inclusive) since it considered these items related and announced that comments on all six items would be taken together during the Open Hearings. See Agenda Item 354-1 for a summary of comments received during the Open Hearings relating to these items.

With respect to this particular item (354-5), the Committee agreed to assign an effective, nonretroactive enforcement date of January 1, 2016, to those portions of the paragraph identified using two asterisks (\*\*) and recommend the item as shown in “Item Under Consideration” for Vote at the July NCWM Annual Meeting.

### **2015 NCWM Annual Meeting**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 354-1 through 354-5 and 360-3 and take comments simultaneously on these six items. See Agenda Item 354-1 for the summary of comments provided on these items.

### **Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA S&T Committee received comments supporting further development of this item. It 2014 was noted this item has been under development for two years by the NIST USNWG on Taximeters. Multiple jurisdictions voiced support for this item. The CWMA thinks this is sufficiently developed and forwarded the item to the NCWM, recommending it as a Voting item. No comments were received on this item during the 2015 CWMA Annual Meeting Open Hearings. The CWMA recommended this item move forward as a Voting item.

WWMA 2014 Annual Meeting: During the Open Hearings, a member of the USNWG on Taximeters reported that this proposal has been in development for three years and is ready to be a Voting item. Further, he stressed that it is imperative that these changes be adopted to ensure the W&M community stay current with today’s environment. No opposition to this item was presented. The WWMA recognizes the amount of work that has been done on this item and forwarded it to NCWM, recommending that it be a Voting item. Further, the WWMA recommends that 2014 WWMA S&T Committee Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into one proposal.

SWMA 2014 Annual Meeting: The SWMA did not hear any comments in opposition to this item. The SWMA recommended that Items 354-1 through 354-5 be combined into one agenda item since they are all related to taximeters. Comments were heard for all five of these agenda items at the same time. The SWMA forwarded this item to the NCWM and recommended it as a Voting item.

NEWMA received comment from a member of the USNWG on Taximeters that the language has been cleaned up in the NIST Handbook 44 Taximeters Code as new technology and point-of-sale systems are becoming more prevalent in all the states. It was suggested that related Items 354-1, 354-2, 354-3, 354-4, and 354-5 be combined into a single item. Since there was no opposition to this item, NEWMA agreed to forward the item to the NCWM, recommending it as a Voting item.

NEWMA 2015 Annual Meeting: The NEWMA S&T Committee agreed to group together Agenda Items 354-1 through 354-5 and take comments simultaneously on all of these items since it considered them related. Refer to

Agenda Item 354-1 to view the comments received by the Committee on this group of Agenda items. NEWMA agreed to recommend Taximeter Agenda Items 354-1 through 354-5 move forward for Vote.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **354-6 D USNWG on Taximeters – Taximeter Code Revisions and Global Positioning System-Based Systems for Time and Distance Measurement**

*Note: This item was originally titled “Item 360-5, S.5. Provision for Security Seals” in the Committee’s 2013 Interim Agenda. At the 2013 NCWM Interim Meeting, the Committee combined that item with “Item 354-1 Global Positioning Systems for Taximeters” and “Item 360-6 Global Positioning Systems for Taximeters” to create this new, consolidated item to address the development of recommendations on multiple topics related to taximeters and GPS-based time and distance measuring systems.*

**Source:**

NIST USNWG on Taximeters

**Purpose:**

Develop recommendations for modifying the existing 5.54. Taximeters Code to reflect current technology (including requirements for sealing, display requirements, and other features) and to examine GPS-based time and distance measuring systems to determine how to best address these measuring systems in NIST Handbook 44 to ensure accuracy and transparency for passengers and businesses.

**Item Under Consideration:**

This item is under development. Comments and inquiries may be directed to Mr. John Barton (NIST, OWM) at (301) 975-4002 or [john.barton@nist.gov](mailto:john.barton@nist.gov).

The USNWG is considering proposals to modify the sealing requirements in the Taximeters Code to reflect more advanced sealing methods (see 2012 NCWM Final S&T Report); to amend the Taximeters Code to specifically recognize GPS-based time and distance measuring systems; and to amend other sections of the Taximeters Code to reflect current technology and business practices while ensuring accuracy and transparency for customers and a level playing field for transportation service companies.

**Background/Discussion:**

The Committee has received multiple proposals over the past several years related to updating the current NIST Handbook 44, Taximeters Code to reflect current technology as well as a request to establish criteria for GPS-based time and distance measuring systems. In April 2012, NIST OWM established a USNWG to work on these issues. The USNWG has met multiple times since it was established. For details of those meetings as well as the current proposals being developed by the USNWG, please contact Mr. Barton as noted in the “Item Under Consideration” above.

Additional background information and updates on the progress associated with this item can be found in the Committee’s 2014 and earlier final reports.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee agreed to group together all of the “354” Taximeter Items (i.e., Agenda Items 354-1 through 354-6, inclusive) since it considered these items related and announced that comments on all six items would be taken together during the Open Hearings. See Agenda Item 354-1 for a summary of comments received during the Open Hearings relating to these items.

With respect to this particular item (354-6) the Committee agreed to assign it a Developing status based on the update provided by the NIST Technical Advisor to the USNWG on Taximeters indicating the item is still being developed.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: During the Open Hearings, the Committee heard comments from several officials voicing concern about the limited amount of progress being made by the WG to develop requirements to address GPS-based time and distance measuring systems and the need for those requirements. Mr. Jimmy Cassidy (City of Cambridge, Massachusetts), a member of the USNWG on Taximeters, reported that this item needed to be revived and that the USNWG needed fresh ideas on how best to proceed.

Mr. John Barton (OWM), NIST Technical Advisor to the USNWG reported that there is a large amount of proprietary information involved in the development of this type of system that the manufacturers of these systems are not willing to share. This is a major challenge for the USNWG to overcome in order to move forward in this effort.

Ms. Kristin Macey (California) suggested developing proposed requirements that are performance based. She assured those concerned that testing can be accomplished and indicated that California is currently type evaluating a GPS-based device. She suggested possibly downloading the taxi service provider's application onto an iPhone or iPad and verifying the accuracy of the system over a track as is currently done when testing a conventional taximeter in accordance with NIST Handbook 44 test procedures.

Mr. Ross Andersen (New York, retired) commented that current taximeter tests may not be appropriate in that it specifies the track should be straight. He noted that GPS based systems are more sensitive side-to-side than to changes in elevation. He also questioned the factors being used by the service providers to determine a customer's rate and suggested more work is needed in this area. A final suggestion was that the USNWG concentrate efforts on developing methods of testing system performance.

The Committee agreed to maintain the Developing status of this item and looks forward to future refinements by the submitter.

**Regional Associations Meetings:**

CWMA 2014 Interim Meeting: The CWMA did not receive comments on this item at its Interim Meeting or the 2015 Annual Meeting and agreed at both meetings to recommend that the item be forwarded to NCWM as a Developing item.

WWMA 2014 Annual Meeting: During the WWMA Open Hearings, a NIST representative stated that NIST is currently in the process of contracting a chair for the Sub-committee. The WWMA recommends that this item remain as a Developing item to allow more work to be completed in this area.

SWMA 2014 Annual Meeting: The SWMA expressed support for the work of the USNWG on Taximeters and agreed to recommend this item move forward as a Developing item.

NEWMA 2014 Interim Meeting: NEWMA received comments from members of the USNWG that an updated proposal was near completion. NEWMA recommended that this item remain a Developing item. At the 2015 NEWMA Annual Meeting, NEWMA noted that no comments were received and agreed to recommend the item be forwarded to NCWM as a Developing item.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

## 358 MULTIPLE DIMENSION MEASURING DEVICES

### 358-1 W Measurement of Bulk Material in Open-Top Truck and Trailer Units

(This item was Withdrawn.)

**Source:**

LoadScan U.S. (2014)

**Purpose:**

Develop a standardized testing protocol for a non-contact volumetric measurement instrument designed to measure loads of bulk loose solids in open-top truck and trailer units.

**Item Under Consideration:**

Develop new language for type classification, accuracy classification, and test methodology for load volume scanning devices.

**Background/Discussion:**

Laser technology allows for accurate volume measurement of bulk materials loaded on open-top truck and trailer bodies. Standard industry practice is to count loader buckets or convert from weight, both highly variable and inaccurate ways of measuring cubic volume.

Contacts: Mr. Peter Russell, LoadScan U.S., Tel: (603) 831-6014 or e-mail: [peter.russell@loadscan.us](mailto:peter.russell@loadscan.us); and Mr. Adrian Ruthe, Loadscan Ltd., Tel: +64 7-847-5777 or e-mail: [adrian@loadscan.com](mailto:adrian@loadscan.com).

NCWM 2014 Interim Meeting: Mr. Peter Russell (LoadScan, Ltd.) and Mr. Adrian Ruthe (LoadScan, Ltd.) provided a joint presentation regarding the operation of a device that uses a scanner to measure the volume of product loaded into open-top truck and trailer units. Mr. Russell and Mr. Ruthe indicated that they were not familiar with the procedures of how to go about adding new requirements into NIST Handbook 44; nor did they know where in NIST Handbook 44 requirements intended to apply to their equipment would best fit. They asked the Committee for guidance on how best to proceed concerning these issues.

The Committee acknowledged that there is not yet a specific proposal to consider and that additional information and input is needed for the development of this item. The Committee agreed to designate this item as a Developing item on its agenda to allow time for the issue to be further developed by the submitter. The Committee noted that a specific proposal outlining recommended changes to NIST Handbook 44 is needed in order for the item to advance through the process.

While the Committee is not certain if the MDMD Code is the most appropriate code for addressing these devices, the Committee suggested that the MDMD WG might be willing to consider this issue and provide input on further development of draft NIST Handbook 44 language. Alternatively, or in addition, the submitter may wish to contact the NTEP Weighing Sector to determine if the Sector or its members might be able to provide additional assistance.

The Committee received a document from the submitter (titled "Load Volume Scanner, Proposals for Integration into NIST Handbook 44") that provided additional information and supporting arguments for addressing this issue, along with some recommended changes to NIST Handbook 44. The Committee included these documents as Appendices F and G in its 2014 Final Report (NIST SP 1193, "Report of the 99<sup>th</sup> National Conference on Weights and Measures").

NCWM 2014 Annual Meeting: The NIST Technical Advisor reported he had contacted LoadScan, Ltd. and was provided the following update:

LoadScan, Ltd. in New Zealand is aware that the NCWM Annual Meeting is coming up. Unfortunately, the reality is we have not had the resources to be able to pursue our case this year and will not be making any submissions at the moment. We plan to engage the services of local experts within the USA to pursue this

matter for us over the next year. We are also completing further background work with Weights & Measures authorities in New Zealand and Australia which we hope will support our drive for approval in the U.S.A. At this stage we request only to retain our ‘Developing item’ status.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: No one was present to provide an update on the development of this item. NIST, OWM reported that the submitter of the item had not been in contact with NIST, OWM for more than a year; nor had any Committee members been contacted. In summarizing NIST, OWM’s analysis of the item, Ms. Tina Butcher (NIST, OWM) reported that NIST, OWM believes the “LoadScan” equipment measures volume, which is different from a multiple dimensioning measuring device, which measures dimensions to calculate volume. Mr. Darrell Flocken (NTEP) reported that the MDMD WG, in considering this item during its November 2014 meeting, considered the device a “profiler” (i.e., it provides a volume measurement by profiling the load) and not a “dimensional measuring device.”

There were a couple of comments heard in support of continuing development of the item. There were also comments expressing concern over the potential cost of making the reference standards that would be needed to test the device and the minimum value of its increment.

The Committee agreed to Withdraw the item because it had remained on its agenda for more than a year with no progress being reported on its development by the submitter. In withdrawing the item, members of the Committee agreed that the submitter could always submit a new proposal for future consideration should he decide to do so.

**Regional Associations Meetings:**

CWMA Interim 2014 Meeting: The CWMA received comments indicating that the submitter will continue developing this item. The CWMA supported the continued Development of this item.

WWMA 2014 Annual Meeting: During the Open Hearings, a regulator expressed concern over the accuracy of these types of devices in certain weather conditions (fog and rain). Based on background information in the agenda, it was noted that the item is still developing. The WWMA recommends that this item remain a Developing item to allow the submitter time to address concerns of the weights and measures community.

SWMA 2014 Annual Meeting: The SWMA agreed to recommend the item move forward as a Developing item and noted it looks forward to further development of the item by the submitter.

NEWMA 2014 Interim Meeting: NEWMA reported that it believes that further development is necessary to specify the logistics of how test standards would be developed for this type of device. NEWMA recommended that the item remain as a Developing item.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

## **360 OTHER ITEMS**

### **360-1 W Appendix D – Definitions: batching system.**

(This item was Withdrawn.)

**Source:**

KSI Conveyors Inc. (2015)

**Purpose:**

Eliminate some confusion in the marketplace and aid field officials in making appropriate decisions on the classification of devices they encounter.

**Item Under Consideration:**

Amend NIST Handbook 44, Appendix D – Definitions as follows:

**batching system. – One in which raw materials are measured in pre-determined quantities by weight and/or liquid measure. The value of the final product may be determined on the basis of the measurement of some or all of the raw material. The unit of measure for the final product may be different from any of the units of measure for the raw materials.**

**Background/Discussion:**

KSi Conveyors Inc. manufactures and distributes systems for treating agricultural seed in 31 states and 3 provinces. The system weighs hybrid seed, applies treatment chemicals, and delivers a finished product that is normally sold on the basis of seed count. Because the system utilizes hopper scale(s) that typically make multiple drafts of a predetermined quantity one state tried to categorize the systems as an automatic bulk weighing system under NIST Handbook 44, Section 2.22. Automatic Bulk Weighing Systems. It is the submitter’s contention that the system is really a batch weighing system and should fall under NIST Handbook 44, Section 2.20. Scales Code. Even though there are numerous NTEP Certificates of Conformance for systems that perform batch weighing functions (including KSi’s) there is no definition for a “batching system” in NIST Handbook 44.

There are a variety of systems used in commerce that provide a finished product based on the measurement of raw materials. The raw materials may be weighed or measured directly by the system, such as a ready mixed concrete batching system. Others may have some raw material measured by devices separate from the batch weighing system such as the drugs added to feed produced by a livestock feed batching system. The final unit of measure for the finished product may be in different terms than that used to measure the raw materials. Charges may be based on a formula for the final product and not actually on the measurements of each ingredient in the recipe.

As examples, a ready mixed concrete system will weigh the aggregate, sand, and cement. Water added to the mix may be weighed or measured. In some cases, other concrete additives, such as hardeners or drying agents are also added. The various amounts of raw materials needed are determined by a “recipe” or the desired end product. Regardless of how the raw materials are measured, the final sale of concrete is based on a measurement of cubic yards that is transferred from the system into a ready mix truck for delivery. The seed treatment system weighs seed that is fed into a treatment drum where treatment chemicals are applied based on the recipe for the desired end product. The treated seed is then transferred into a conveyance means (truck, wagon, or seed box) for delivery to the farmer. The final transaction is based on the number of seeds delivered.

There are numerous NTEP Certificates of Conformance, including those held by KSi for systems that operate as batch weighing systems. Some examples were provided to the Committee for reference.

Adding a definition for “batch weighing systems” will help eliminate some confusion in the marketplace and will aid field officials in making appropriate decisions on the classification of devices they encounter.

Some states evaluate the weighing systems used in the determination of the final quantity delivered by a batch weighing system even though the final product is delivered in a different unit of measure. Testing the weighing elements provides a reasonable assurance of the accuracy of the final product without having to measure the actual cubic yards (in the case of concrete) or counting the seeds (in the case of the seed treatment systems).

Just as the concrete consumer is only interested in the cubic yards of concrete received, the agricultural consumer is actually interested in the count of the seeds received, not the weight. Modern equipment plants seeds by population per acre based on count and not by weight.

In 1985, the Specifications and Tolerances Committee, in its final report, reminded the Conference that the Automatic Bulk Weighing Systems Code does not apply to batching systems, for which the Scales Code applies.

The USDA affirms that when seed is treated it is no longer considered “grain,” and there is a separate definition for treated seed.:

**2015 NCWM Interim Meeting:**

The Committee agreed to group Agenda Items 320-1, 324-1, 330-1, and 360-1 together since these items are related and announced that comments on all four items would be taken together during the Open Hearings. The Committee agreed to Withdraw these items in consideration of the comments and analysis that were provided. Refer to Agenda Item 320-1 for a summary of the comments provided concerning these four items and the reasons why they were Withdrawn.

**Regional Association Meetings:**

**CWMA 2014 Interim Meeting:** An industry representative suggested this item be moved forward as a Voting item. Regulatory officials agreed that the item has merit, but would like to include a definition for “batch scale.” It was noted that there is a definition for “batch meter.” The CWMA forwarded the item to the NCWM, recommending it as a Voting item. The submitter plans to add references to Sections 2.20, 2.22, and 3.30.

**Annual 2014 Meeting:** The SWMA did not hear any comments in opposition to this item and recommended merging Items 320-1, 324-1, 330-1, and 360-1 since they are all related. Comments were heard for all four of these agenda items at the same time. The SWMA forward the item to the NCWM, recommending that it be a Voting item.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

**360-2 D Appendix D – Definitions: calibration parameter and multi-point calibrated device.****Source:**

NCWM Multi-Point Calibration Group (MPCG) (2015)

**Purpose:**

Update the definitions in NIST Handbook 44, Appendix D to reflect advances in device calibration technology.

**Item Under Consideration:**

Amend NIST Handbook 44, Appendix D – Definitions as follows:

**calibration parameter.** – Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy, e.g., span adjustments, linearization factors, and coarse zero adjustments. [2.20, 2.21, 2.24, 3.30, 3.31, 3.32, 3.34, 3.35, 3.37, 5.56(a)]

**Background/Discussion:**

The Committee was asked to consider the following definitions for “calibration parameter” and “multi-point calibrated device.”

**calibration parameter.** – Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy, e.g., span adjustments, linearization factors, and coarse zero adjustments. [2.20, 2.21, 2.24, 3.30, 3.31, 3.32, 3.34, 3.35, 3.37, 5.56(a)]

**multi-point calibrated device. – A device equipped with means to electronically program linearization factors at multiple measurement points.**

**Calibration parameter.** – In 2006, the term “calibration parameter” was added in Sections 3.31., 3.32., 3.34., and 3.35.; these sections now need to be added to the reference string in the definition of “calibration parameter”

**Multi-point calibrated device.** – New technology makes it possible to use linearization factors to optimize accuracy at multiple measurement points on devices such as meters, weighing devices, and other devices. This new technology requires a term so that devices capable of being optimized at multiple measurement points can be distinguished from

devices with single point calibration. The term is used in proposals already before the Committee, and if those proposals are adopted, the term should be included in the definitions. Multi-point calibrated devices are increasingly used as commercial scales and meters. Whether or not the current meter proposals are adopted, the Conference will need to have a term to describe these devices.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: Agenda Items 330-3, 331-1, and 360-2 were grouped together and comments taken simultaneously since the Committee considered them related. See Agenda Item 330-3 for a summary of the comments heard on all three of these agenda items.

The Committee agreed this item should move forward as a Developing item based on the comments received and the submitter's recommendation that it remain Developing because additional work is needed.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 330-3, 331-1, and 360-2 and take comments on these items simultaneously. Mr. Russ Vires (Mettler-Toledo, LLC) speaking on behalf of the SMA reported that the SMA was opposed to the definition being proposed for "multi-point calibrated device" in Agenda Item 360-2. Ms. Julie Quinn (Minnesota), submitter of all the items in the group recommended Items 330-3 and 331-1 be Withdrawn in their entirety. She also recommended that the Committee delete the definition of "multi-point calibrated device" in this item and maintain its Developing status because further updates to the Handbook 44 Code references beneath the current Handbook 44 definition of "calibration parameter" were planned.

Hearing no comments in support of Agenda Items 330-3 and 331-1 and a recommendation by the submitter to withdraw them, the Committee agreed to withdraw these items. The Committee also agreed to delete the proposed definition of "multi-point calibrated device" from Agenda Item 360-2 and maintain its Developing status to allow the submitter of the item additional time to develop the proposal. This change is reflected in the "Item Under Consideration" above.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA heard a presentation intended to clarify the purpose of this item. The CWMA noted that it believes the item is sufficiently developed and forwarded the item to the NCWM, recommending it as a Voting item. During the 2015 CWMA Annual Meeting, the submitter of the item indicated that the item was still being developed. Mr. Lou Straub, speaking on behalf of the SMA noted that the SMA opposes the current definition, but supports the continued development of this item. The CWMA agreed to recommend this item move forward as a Developing item.

WWMA 2014 Annual Meeting: Testimony was presented at the 2014 WWMA Annual Meeting by a member of the Multi-Point Calibration Group, stating that the item is fully developed and ready to be a Voting item. No opposition was heard during the WWMA Open Hearings. The WWMA agreed that the item was sufficiently developed and agreed to forward the item to NCWM, recommending that it be a Voting item.

SWMA 2014 Annual Meeting: The SWMA S&T Committee recommended the item be withdrawn based on concerns that, if adopted, it would result in extensive additional work required by inspectors; increased downtime for businesses; questionable gain when compared to existing tolerances; and result in the approval of devices for each product type. The Committee noted it doesn't believe the Handbooks are the proper place for examples. Based on the Committee's recommendation, the SWMA did not forward this item to the NCWM; recommending instead, that it be withdrawn.

NEWMA 2014 Interim Meeting: NEWMA combined Agenda Items 330-3, 331-1, and 360-2 as one agenda item. NEWMA reported it believes the item has merit but required more information before any further judgment could be made on it. NEWMA forwarded the item to the NCWM and recommended it as an Information item. NEWMA agreed to combine Agenda Items 360-2, 330-3, and 331-1 at its 2015 Annual Meeting. The SMA opposed the current proposed definition of "multi-point calibrated device," but noted it looked forward to further changes by the WG. NEWMA agreed to recommend this item move forward as a Developing item as the WG amends language in the proposal.



Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### 360-3 VC Appendix D – Definitions, point-of-sale-system.

(This item was Adopted.)

**Source:**

NIST USNWG on Taximeters (2015)

**Purpose:**

Clarify the term “point-of-sale system” by providing a more detailed definition in NIST Handbook 44, Appendix D.

**Item Under Consideration:**

Amend NIST Handbook 44, Appendix D – Definitions as follows:

**point-of-sale system.** – 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. **The system components, when operated together must be capable of the following:**

- 1. determining the weight or measure of a product or service offered;**
- 2. calculating a charge for the product or service based on the weight or measure and an established price/rate structure;**
- 3. determining a total cost that includes all associated charges involved with the transaction; and**
- 4. providing a sales receipt.**

**(Amended 20XX)**

**Background/Discussion:**

Stand-alone type of devices is becoming less prevalent in weighing and measuring applications and are evolving into more sophisticated weighing and measuring *systems*. Many different types of devices are now being connected to other components to create systems that are capable of performing all functions required to conduct a complete transaction.

While this proposed amendment does not remove any of the elements listed as *required* components in the existing definition for a POS, the USNWG on Taximeters agreed that the use of the wording “and may also be equipped with a scanner” in the existing definition is archaic, unnecessary, and a specific reference to small capacity weighing systems and, therefore, should be removed.

The USNWG on Taximeters could not agree upon the terms of classifying various assortments of components as point-of-sale systems (POS) when they are installed in taxis due to the type of components that comprise those systems when compared to the current definition of POS. The difficulty was largely due to the existing definition's description of a POS as being a collection of specific pieces of hardware rather than placing more emphasis on what functions are performed when the system's components operate as a system.

The current NIST Handbook 44, Taximeters Code provides an option for, but does not require that a taximeter be capable of issuing a printed receipt. Because of this, some taximeter systems (that do not include a recording element) would not meet the existing definition of a POS. A taximeter may, however, be connected to a sophisticated indicating element referred to as a passenger information monitor (PIM) located in the passenger's area that can be capable of displaying an itemized account of the transaction and may also provide a means to complete the transaction via integral credit card reader. Even though this arrangement did not include a recording element, it was considered by some of

the USNWG to constitute a POS. According to the definition, the taximeter and indicating element with a credit card reader as described above would not be considered to be a POS. This proposal would clarify that only when a system of interconnected components is capable of performing all of the functions listed in the amended definition, is it appropriate for that system to be defined as a POS.

The WG agreed that a POS should be capable of performing at a minimum, the four basic functions listed in the proposal. Rather than describing the hardware components of a POS, the USNWG's proposed method of defining the POS was considered to be more generic and more readily applied to all types of weighing and measuring systems irrespective of the various components that are included within the system.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: The Committee heard no comments on this item. The Committee agreed to replace the language in the original proposal (shown in the box below) with that recommended by the SWMA as shown in "Item Under Consideration" and recommend the item for Vote at the July 2015 NCWM Annual Meeting.

**Original Proposal:**

Amend NIST Handbook 44, Appendix D – Definitions as follows:

**point-of-sale system.** – An assembly of interactive 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. The system components, when operated together must be capable of the following:

1. determining the weight or measure of a product or service offered;
2. calculating a charge for the product or service based on the weight or measure and an established price/rate structure;
3. determining a total cost that includes all associated charges involved with the transaction;
4. providing a sales receipt.

(Amended 20XX)

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: The Committee agreed to group together Agenda Items 354-1 through 354-5 and 360-3 and take comments simultaneously on these six items. See Agenda Item 354-1 for the summary of comments provided on these items.

**Regional Association Meetings:**

CWMA 2014 Interim Meeting: The CWMA did not receive comments on this item. The CWMA S&T Committee noted that the item has been under development for two years by the NIST USNWG on Taximeters. The CWMA indicated it believes the item is sufficiently developed and forwarded the item to the NCWM, recommending it as a Voting item.

NEWMA 2015 Annual Meeting: At the Open Hearings, Mr. Lou Straub (Fairbanks Scales, Inc.) speaking on behalf of the SMA supported the item, as did Ms. Fran Elson-Houston (Ohio). The CWMA agreed to recommend the item move forward for Vote.

WWMA 2014 Annual Meeting: During the Open Hearings at the 2014 WWMA Annual Meeting, a member of the USNWG on Taxi Meters reported this item has been in development for three years and is ready to be a Voting item. Further, he stressed that it is imperative that these changes be adopted to ensure the weights and measures community stay current with today's environment. No opposition to this item was presented. The WWMA recognizes the amount of work that has been done on this item and agrees that it is developed. The WWMA forwarded the item to the NCWM and recommended that it be a Voting item.

SWMA 2014 Annual Meeting: The SWMA reported it supports the work of the USNWG on Taximeters and no comments were heard in opposition of this item. The SWMA suggested reversal of the proposed changes in the main paragraph of the definition noting that proposed changes in this section may have unintended consequences for other Sectors. The SWMA forwarded the item to the NCWM and recommended it as a Voting item as amended below:

**point-of-sale system.** – 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. **The system components, when operated together must be capable of the following:**

- 1. determining the weight or measure of a product or service offered;**
- 2. calculating a charge for the product or service based on the weight or measure and an established price/rate structure;**
- 3. determining a total cost that includes all associated charges involved with the transaction; and**
- 4. providing a sales receipt.**

**(Amended 20XX)**

NEWMA 2014 Interim Meeting: NEWMA heard support for this item from industry and regulators. NEWMA agreed to recommend the item be forwarded to the NCWM as a Voting item. At NEWMA’s 2015 Annual Meeting, the SMA supported this item. NEWMA recommended the item move forward as a Voting item.

Additional letters, presentations, and data may have been part of the Committee’s consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **360-4 D Appendix D – Definitions: Remote Configuration Capability**

**Source:**

NTEP Grain Analyzer Sector (2013)

**Purpose:**

Expand the scope of definition to cover instances where the “other device,” as noted in the current definition, may be necessary to the operation of the weighing or measuring device or which may be considered a permanent part of that device.

**Item Under Consideration:**

This item is under development. Comments and inquiries may be directed to NIST Office of Weights and Measures.

A proposal to modify the definition for “remote configuration capability” as follows is under consideration:

**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)**

**Background/Discussion:**

Removable digital storage devices can be used in GMMs as either data transfer devices that are not necessary to the operation of the GMM or as data storage devices which are necessary to the operation of the GMM. If removable, data storage devices are necessary to the operation of the device, they are not covered by the current definition of “remote configuration capability.”

A USB flash drive is most likely to be used as a data transfer device. In a typical data transfer application, the USB flash drive is first connected to a computer with access to the GMM manufacturer's website to download the latest grain calibrations that are then stored in the USB flash drive. The USB flash drive is removed from the computer and plugged into a USB port on the GMM. The GMM is put into remote configuration mode to copy the new grain calibration data into the GMM's internal memory. When the GMM has been returned to normal operating (measuring) mode, the USB flash drive can be removed from the GMM.

Although a Secure Digital (SD) memory card could also be used as a data transfer device it is more likely to be used as a data storage device. In a typical "data storage device" application, the SD memory card stores the grain calibrations used on the GMM. The SD memory card must be plugged into an SD memory card connector on a GMM circuit card for the GMM to operate in measuring mode. To install new grain calibrations, the GMM must be turned "off" or put into a mode in which the SD memory card can be safely removed. The SD memory card can either be replaced with an SD memory card that has been programmed with the new grain calibrations or the original SD memory card can be re-programmed with the new grain calibrations in much the same way as that described in the preceding paragraph to copy new grain calibrations into a USB flash drive. In either case, the SD memory card containing the new calibrations must be installed in the GMM for the GMM to operate in measuring mode. In that regard, the SD memory card (although removable) can be considered a permanent part of the GMM in that the GMM cannot operate without it.

**Note:** In the above example the SD memory card could be any removable flash memory card such as the Secure Digital Standard-Capacity; the Secure Digital High-Capacity; the Secure Digital Extended-Capacity; and the Secure Digital Input/Output, which combines input/output functions with data storage. These come in three form factors: the original size, the mini size, and the micro size. A Memory Stick is a removable flash memory card format, launched by Sony in 1998, and is also used in general to describe the whole family of Memory Sticks. In addition to the original Memory Stick, this family includes the Memory Stick PRO; the Memory Stick Duo; the Memory Stick PRO Duo; the Memory Stick Micro; and the Memory Stick PRO-HG.

At its 2011 Grain Analyzer Sector Meeting the Sector agreed by consensus that the following changes to Table S.2.5. of NIST Handbook 44, Section 5.56.(a) should be forwarded to the S&T Committee for consideration:

- Add a note to Table S.2.5. to recognize the expanded scope of remote capability.
- Delete "remotely" from the second paragraph of Category 3 requirements that begins, "When accessed remotely ..." to make it clear that the requirements of Category 3 apply whether accessed manually using the keyboard or accessed by remote means.
- Add the modified second paragraph of Category 3 requirements to Categories 3a and 3b to make it clear that these requirements apply to all the subcategories of Category 3.

Because a change to the definition of "remote configuration capability" will apply to other device types, NIST, OWM recommended the changes to Table S.2.5. approved by the Sector in 2011 be separated into two independent proposals. One proposal would deal with the changes to Category 3 and its subcategories. The second would recommend a modification of the definition of "remote configuration capability" appearing in Appendix D of NIST Handbook 44 to recognize the expanded scope of remote capability; this proposal would be an alternative to adding a note to the bottom of Table S.2.5. to expand the definition for remote configuration for grain moisture meters (as shown in this proposal).

At its 2012 Meeting, the Grain Analyzer Sector agreed to separate its original proposal into two separate proposals and agreed to forward this proposal to change the definition of "remote configuration capability" to the S&T Committee for consideration. Also see the August 2012 NTEP Grain Analyzer Sector Summary, Item 5.

See the Committee's 2013 and 2014 Final Reports for additional background information and to review the different proposals considered by the Committee to address security of equipment, the metrological parameters of which can be changed by use of some form of removable digital storage device.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: At the S&T Open Hearings, Ms. Tina Butcher (NIST, OWM) requested that the Committee reassign this item to OWM noting that the issue identified by the Grain Analyzer Sector had not been resolved. Ms. Butcher noted that a gap still exists concerning the sealing of equipment in which the sealable parameters of that equipment can be changed by use of a removable digital storage device. She stated that members of NIST, OWM's Legal Metrology Devices Program (LMDP) have agreed to take up this issue after the 2015 Interim Meeting in hopes of being able to develop a proposal that addresses the issue and be able to report on its progress at the next NCWM Conference.

Mr. Michael Keilty (Endress + Hauser Flowtec AG USA) stated he too would be willing to work with OWM on a proposal to address this issue.

The SMA commented that it looks forward to further clarification of this item.

The Committee agreed to reassign this item to OWM for additional development based on NIST, OWM's assessment there remains an unresolved issue involving the sealing of equipment using removable digital storage devices.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: Ms. Tina Butcher (OWM) provided an update to the Committee on OWM's progress in developing this item. Ms. Butcher noted that OWM's Legal Metrology Devices Program (LMDP) had met several times since the 2015 Interim Meeting to work on this issue. Rather than attempting to modify current sealing requirements, which never envisioned this method of adjustment, the LMDP proposes creating a separate set of sealing requirements for this technology. Members of the LMDP developed a draft General Code paragraph they believe will address the sealing of devices using this technology to make adjustments. The LMDP requests the following draft General Code paragraph be included in this item to begin generating feedback to assist in further development of this item:

**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.)**

Ms. Butcher also noted that OWM plans to propose modifications to a number of the individual device codes in NIST Handbook 44 to reference the new General Code sealing requirement. The following draft example requirement was developed by the LMDP and included in NIST OWM's written analysis of this item to provide an indication of how some of the device codes in NIST Handbook 44 will need to be amended that this type of sealing can be addressed:

Proposed changes to Scales Code paragraph S.1.11. Provision for Sealing:

**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)

As final comment regarding this item, Ms. Butcher indicated that devices using other means to access adjustments would continue to be addressed by current sealing requirements.

**Regional Association Meetings:**

Interim 2014 Meeting: The CWMA did not receive any comments on this item and believes the item is sufficiently developed. The CWMA recommended that the item be a Voting item on the NCWM Agenda. During the 2015 CWMA Annual Meeting, the SMA reported that it looks forward to the further clarification of this item, yet it has concerns about changing metrological parameters without proper re-sealing. The CWMA agreed to recommend the item move forward as a Developing item, noting that it supported the continued development of this item.

WWMA 2014 Annual Meeting: During Open Hearings at Annual Meeting, an industry representative questioned whether or not this item would affect definitions for other device types. An NCWM representative expressed the opinion that it does affect other devices. The WWMA recommended that this item remain as a Developing item to allow additional input and consideration.

SWMA 2014 Annual Meeting: The SWMA recommended that this item be withdrawn, noting it believes this item is not necessary and the existing definition in Appendix D of NIST Handbook 44 is adequate.

NEWMA 2014 Interim Meeting: NEWMA recommended this item be withdrawn, noting it believes the existing definition in Appendix D of NIST Handbook 44 is adequate.

NEWMA 2015 Annual Meeting: No comments were received on this item. NEWMA agreed to recommend the item move forward as a Developing item as OWM continues its work on the proposal.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

### **360-5 VC Electric Vehicle Fueling and Submetering**

(This item was adopted.)

**Source:**

Submitted by California Department of Food and Agriculture Division of Measurement Standards and developed by the USNWG on Electric Vehicle Fueling Systems (2014)

**Purpose:**

Keep the weights and measures community apprised of work to develop standards for Electric Vehicle Fueling and Submetering (EVF&S) and to encourage their participation in this work.

**Item Under Consideration:**

The following changes are proposed to NIST Handbook 44:

Adopt the proposed new code for Electric Vehicle Fueling Systems shown in Appendix H as a tentative code in NIST Handbook 44.

Adopt the proposed modifications to Section 5.55. Timing Devices Code shown in Appendix I.

The USNWG for Electric Vehicle Fueling and Submetering has developed a draft code including proposed specifications, tolerances, and other technical requirements for Electric Vehicle Fueling Systems for addition to NIST Handbook 44. This draft is found in Appendix H. This draft replaces earlier versions of the draft code that were circulated for comment (and included in the Committee's 2014 Annual Report).

The USNWG also developed proposed changes to NIST Handbook 44, Section 5.55. Timing Devices Code shown in Appendix I. These proposed changes are intended to address timing mechanisms found on some electric vehicle recharging systems that are used to determine charges for services (e.g., parking) in addition to the charges for electrical energy.

The appendices referenced above reflect those versions of the USNWG's proposals which were circulated to the regional associations in Fall 2014 and include additional updates agreed to by the Committee at the July 2015 Annual Meeting. The latter changes are described in more detail under the heading of "2015 NCWM Annual Meeting" below.

**Background/Discussion:**

In 2013, the NCWM adopted a uniform method of sale for retail electrical energy sold as a vehicle fuel. Adding specifications, tolerances, and other technical requirements for equipment that measures electricity as a motor fuel are necessary to provide consumer confidence that measurement of electricity is accurate and that there is sufficient information for the selection of charging equipment, (Levels I, II, and III), and price to pay.

The U.S. National Work Group on Measuring Systems for Electric Vehicle Fueling and Submetering (USNWG EVF&S) discussed a number of challenges to field inspection and testing of EVSE systems. Utility companies and at least one U.S. weights and measures jurisdiction have established test procedures and test equipment specifications for utility-type and submetering electrical energy metering applications.

The USNWG EVF&S was formed to develop proposed requirements for commercial electricity-measuring devices (including those used to measure and sell electricity commercially delivered as vehicle fuel and those used in submetering electricity at residential and business locations) and to ensure that the prescribed methodologies and standards facilitate measurements that are traceable to the International System of Units (SI).

The "West Coast Electric Highway" is a project with an extensive network of electric vehicle DC fast charging stations located every 25 to 50 miles along Interstate 5 and other major roadways in the Pacific Northwest. In California alone, there are currently 1387 electric charging stations and over and over one million plug-in electric vehicles (PEV) are projected to be on California roads by 2020. The development of standards for PEV charging equipment is needed to provide consumers with fueling experiences and expectations similar to those at traditional gasoline dispensers.

Additionally, these standards, once they are developed and adopted, will be used to provide training and education to weights and measures officials about testing and regulating these devices, and support uniform standards and enforcement of these standards throughout the United States.

Additional background information, including updates on the progress associated with this item can be found in the Committee's 2014 Final Report.

Following the 2014 Annual Meeting, the USNWG developed a revised draft code for Electric Vehicle Fueling Systems to replace earlier drafts of the proposed code. The USNWG also developed proposed changes to NIST Handbook 44, Section 5.55. Timing Devices Code to address timing mechanisms found on some electric vehicle recharging systems used to determine charges for services (e.g., parking) in addition to the charges for electrical energy. The USNWG submitted these proposed changes to the regional weights and measures associations and the NCWM for consideration. The submitter has requested that these documents replace earlier proposals in the Item Under Consideration.

**2015 NCWM Interim Meeting:**

NCWM 2015 Interim Meeting: At the Open Hearings the Committee received a request from the USNWG to replace the previous versions of the proposed NIST Handbook 44, Tentative Code for Electric Vehicle Fueling Systems and the proposed changes to NIST Handbook 44, Section 5.55. Timing Devices Code with versions of these proposals that were circulated to the regional weights and measures association in fall 2014. The Committee heard comments from officials and industry alike that the Tentative Code was ready for adoption as a tentative code in NIST Handbook 44 as were the proposed changes to the Timing Devices Code. Consequently, the Committee agreed to recommend this item for Vote at the July 2015 NCWM Annual Meeting.

**2015 NCWM Annual Meeting:**

NCWM 2015 Annual Meeting: At the Open Hearings, several officials and industry members voiced support of adopting the Electric Vehicle Fueling Systems Code as a tentative code. There were no comments heard in opposition. The Committee acknowledged receipt of a letter from the USNWG on EVSE recommending the following changes to the draft code appearing in 2015 NCWM Publication 16, S&T Agenda Appendix H as follows:

1. Correct the spelling of the word requirements in proposed new paragraph S.2.5.1. as follows:

**S.2.5.1. Money-Value Divisions Digital.** – An EVSE with digital indications shall comply with the requirements of . . . based on quantities not exceeding 0.5 MJ or 0.1 kWh.

2. Clarify the record of the transaction format may be made available “either in printed or electronic” format in the first sentence of corresponding Paragraphs S.2.6. and UR.3.3., delete the redundant information about the format that also appears in the last paragraph of UR.3.3., and give each paragraph the same title EVSE Recorded Representation as follows:

**S.2.6. EVSE Recorded Representations. – a receipt, either printed or electronic, providing the following information shall be available through a built-in or separate element at the completion of all transactions:**

**UR.3.3. ~~Printed Ticket~~ EVSE Recorded Representations. – a receipt, either printed or electronic, providing the following information shall be available at the completion of all transactions: . . .**

- (i) the business location.

**~~For systems equipped with the capability to issue an electronic receipt, the customer may be given the option to receive the receipt electronically (e.g., via cell phone, computer, etc.).~~**

3. Clarify that in paragraph N.5.2.(b) Accuracy Testing; For DC Systems the test load is as determined from the digital communication message from the EVSE to the test standard rather than from a pilot signal as shown below:



(b) For DC systems (see note):

(1) Accuracy test of the EVSE system at a load of not less than 85 % of the maximum deliverable current (MDA) as determined from the ~~pilot signal digital communication message from the DC EVSE to the test standard~~ for a total energy delivered of at least twice the minimum measured quantity (MMQ).

(2) Accuracy test of the EVSE system at a load of not more than 10 % of the maximum deliverable current (MDA) as determined from the ~~pilot signal digital communication message from the DC EVSE to the test standard~~ for a total energy delivered of at least the minimum measured quantity (MMQ).

4. Delete the terms from the definition section of the proposal that apply to electric utility meters but *not* to electric vehicle fueling applications; to include proposed modifications to 15 existing NIST Handbook 44 terms and removing from consideration 23 new terms listed below:

active power, apparent power, balanced load, basic lightning impulse insulation level, burden, central location, connection line impedance, electricity meter, element, form designation, instrument transformer ratio, line service, load service, percent error, point-of-sale system, primary wattour constant, reactive power, revolution equivalent, root mean square, tenant, test block, voltage transformer, and wattour – test constant;

Additionally, the USNWG recommends the following minor modifications to 2015 NCWM Publication 16, S&T Agenda Appendix H:

5. Change the title of proposed new EVSE code to ~~Electricity Measuring Devices~~ Vehicle Fueling Systems- Tentative Code; and
6. Renumber Table S.3.4. Categories of Device and Method of Sealing to Table S.3.3 so that the designation corresponds with related paragraph S.3.3. Provision for Sealing.

During the Committee's work session, the Committee agreed to amend the draft code as requested by the USNWG EVF&S and to recommend the item be presented for a Vote.

#### **Regional Association Meetings:**

**CWMA 2014 Interim Meeting:** The CWMA received comment from a regulatory official who indicated that the Committee continues to develop this item. The CWMA believes this is sufficiently developed and recommended that it be a Voting item. During the 2015 CWMA Annual Meeting, Ms. Carol Hockett (NIST, OWM) reported there is a need to provide a tentative code that can be applied to EVSE. Ms. Julie Quinn (Minnesota) agreed. Ms. Fran Elson-Houston voiced concern regarding potential safety and liability issues with electrical meters. The CWMA agreed to recommend the item move for as a Voting item.

**WWMA 2014 Annual Meeting:** During the Open Hearings of the 2014 WWMA Annual Meeting, several regulators voiced support of this item and stated that it is fully developed and should be a Voting item. The WWMA agrees with this opinion and appreciates the amount of work completed that has been completed. Due to the size of the revision, the tentative code will be posted to the NCWM website as an accompanying document for consideration by the NCWM Specifications and Tolerances Committee along with another document with proposed changes to the Timing Device Code. The WWMA recommended this item as a Voting item.

**SWMA 2014 Annual Meeting:** The Committee commended the work of the USNWG on EVSE and recommended incorporation of the proposed new code for Electric Vehicle Fueling Systems into NIST Handbook 44 as tentative code. The SWMA agreed to recommend that this item move forward for vote.

**NEWMA 2014 Interim Meeting:** NEWMA commended the USNWG on its hard work of this timely item and agreed with members of the USNWG that the tentative code is fully developed. NEWMA recommended that the item be a

Voting item. Hearing only comments in support of adopting the Electric Vehicle Fueling Systems Code as a tentative code and no opposition to the item, NEWMA agreed, at its 2015 Annual Meeting, to recommend this item move forward for vote.

Additional letters, presentations, and data may have been part of the Committee's consideration. To review the supporting documentation, please refer to the *Report of the 99<sup>th</sup> National Conference on Weights and Measures* (SP1193, 2014).

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Mr. Mahesh Albuquerque, Colorado | Committee Chair  
Ms. Rachelle Miller, Wisconsin | Member  
Ms. Jane Zulkiewicz, Town of Barnstable, Massachusetts | Member  
Dr. Matthew Curran, Florida | Member  
Mr. Ivan Hankins, Iowa | Member  
Mr. Luciano Burtini, Measurement Canada | Canadian Technical Advisor  
Mr. Clark Cooney, NIST, OWM | NIST Technical Advisor  
Mr. Rick Harshman, NIST, OWM | NIST Technical Advisor  
Mr. Darrell Flocken, NCWM | NTEP Technical Advisor

**Specifications and Tolerances Committee**

## **Appendix A**

### **Item 310-2:**

#### **G-UR.4.1. Maintenance of Equipment**

##### **Background Information Provided by Mr. Henry Oppermann, Technical Director, Seraphin Test Measure Company, A Division of Pemberton Fabricators, Inc.**

To promote a greater understanding and to raise awareness of variables that can affect the test results of meters in retail motor fuel devices, Mr. Oppermann provided the following excerpts from a draft training manual, “Introduction to Liquid Measuring Devices,” prepared for the NIST Office of Weights and Measures. This training material explains various sources of temperature effects on the test results for meters, the magnitude of these potential effects, the critical importance to stabilize the temperatures of the product, meter and standard before conducting a test, and the seasonal effects of temperature on the test results. The magnitude of these potential effects on the test results must be considered when assessing the test results for predominance of errors.

#### **The Effects of Temperature**

The effects on temperature on test results for liquid measuring systems are, by far, the largest effects in the test process. Four ways in which temperature affects test results are:

1. The temperature effect on the capacity of the standard;
2. Temperature changes of the fuel from the meter to the volume standard;
3. The lack of a stable temperature of the product in the dispenser and the test system may mean that the initial test of a meter may not be valid indication of meter accuracy; and
4. Seasonal temperature effects on the meter and the test process.

The last three of these effects are related, but there are unique aspects of each effect and how the effects can or cannot be addressed. Consequently, each effect is discussed separately.

#### **Temperature Effect on the Capacity of the Standard**

Below are correction values for provers of different capacities and temperatures.

### Temperature Corrections for Stainless Steel Standards

5-gal		100-gal		1500-gal	
Temp Range (°F)	Adjust prover reading by (in3)	Temp Range (°F)	Adjust prover reading by (in3)	Temp Range (°F)	Adjust prover reading by (in3)
31.5 to 39.5	– 0.75	31.5 to 39.5	– 15	24.7 to 30.0	– 300
				30.1 to 35.4	– 250
39.6 to 47.7	– 0.5	39.6 to 47.7	– 10	35.5 to 40.9	– 200
				41.0 to 46.3	– 150
47.8 to 55.9	– 0.25	47.8 to 55.9	– 5	46.4 to 51.8	– 100
				51.9 to 57.2	– 50
56.0 to 64.0	0	56.0 to 64.0	0	57.3 to 62.7	0
				62.8 to 68.1	50
64.1 to 72.2	0.25	64.1 to 72.2	5	68.2 to 73.6	100
				73.7 to 79.0	150
72.3 to 80.4	0.5	72.3 to 80.4	10	79.1 to 84.5	200
				84.6 to 89.9	250
80.5 to 88.6	0.75	80.5 to 88.5	15	90.0 to 95.3	300
				95.4 to 100.8	350
88.7 to 96.7	1	88.6 to 96.7	20	100.9 to 104.6	400
96.8 to 104.9	1.5	96.8 to 104.9	25		

### Temperature Change of the Fuel

This section will address the situation when the temperature of the product is **not** stabilized before a test is conducted and show how variations in temperature during a test affects the test results. The apparent seasonal effects on test results will be discussed in the next section. The discussions will focus on RMFD meters when tested with 5-gal standards, because considerable data are available to show how temperature changes in the fuel affect the test results. The effects of temperature changes are more apparent in the test of RMFD meters, because the test draft is relatively small. The temperature effects (due to a lack of temperature stability) observed for 5-gal tests of RMFD meters also apply to tests of larger meters, but the larger test drafts tend to reduce these temperature effects.

The Nebraska and Kansas weights and measures programs conducted nine consecutive tests on one day per week on several dispensers over one-year periods. As a result, tests were performed throughout the year under a wide range of air temperatures. The product temperature changed throughout the year as well. The first six 5-gal tests on each meter were fast-flow tests. The last three tests were slow-flow tests. The Nebraska inspectors took the temperature of the fuel in the prover for the first fast-flow test and for the sixth fast-flow tests. The Kansas inspectors took the temperature of the fuel in the prover for each test draft. The meters were not adjusted during these two studies. There were a couple of instances where meters were adjusted near the end of the one-year test period, but the data after the meters were adjusted were not included in the analysis.

Below is a simple diagram of the main components of the major service station components that can influence the temperature of the gasoline or diesel fuel when the meter in the dispenser is tested for accuracy.

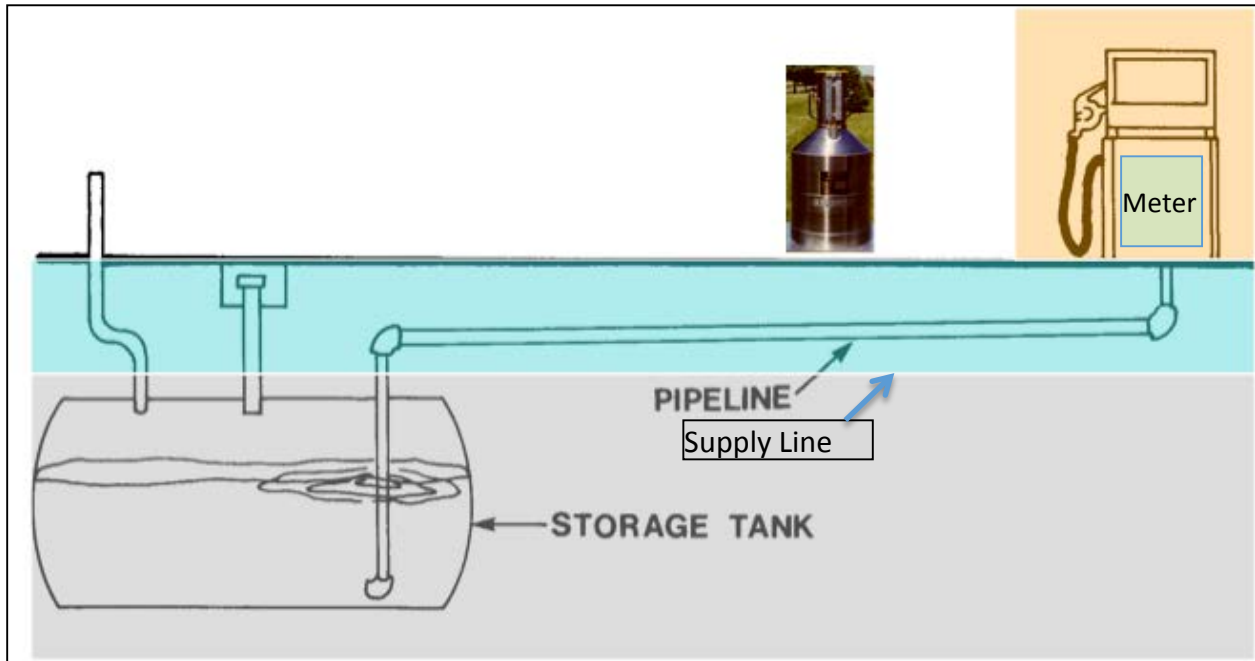


Diagram 6 Modified from the NIST OWM training material for retail motor-fuel devices.

Most service stations have underground storage tanks, but some stations have aboveground storage tanks. There are supply lines that run from the storage tank to each dispenser. The fuel enters the dispenser through the meter, which is usually in the bottom half of the dispenser. The dispenser will have internal piping from the meter, which feeds the fuel to the discharge hose. The fuel is then discharged into the volume standard that is used to test the accuracy of the meter.

It is critical to understand the following:

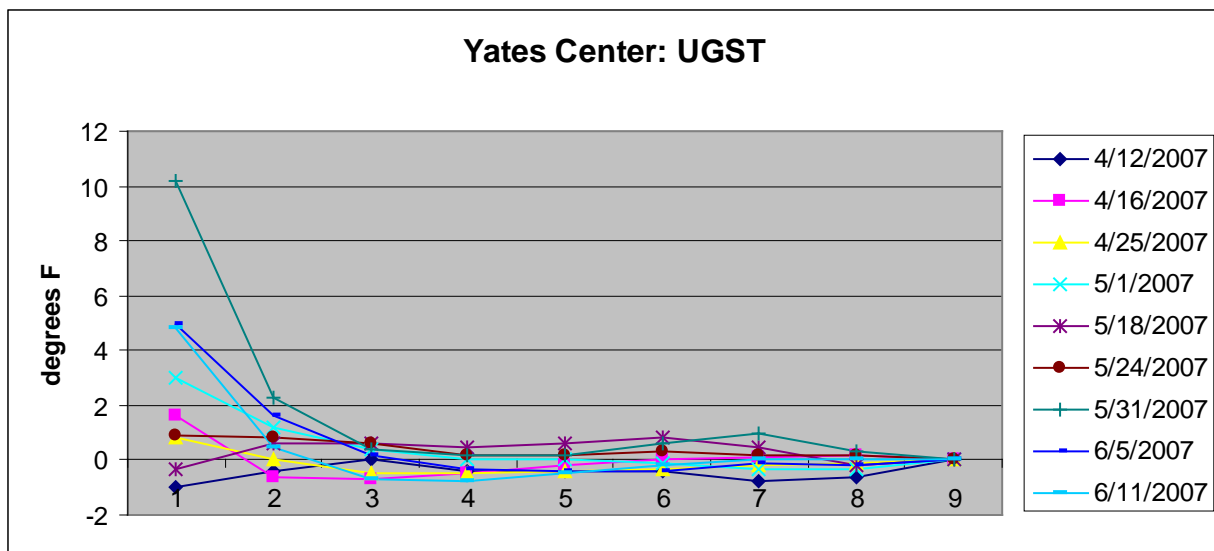
- The temperature of the fuel in the storage tank is usually different from the temperature of the fuel in the supply lines.
- The temperature of the fuel in the supply lines may then be different from the temperature of the fuel that passes through the meter, since the meter is affected by the temperature of the air inside the dispenser shell.
- After the meter measures the fuel, the fuel passes through the internal piping of the dispenser and the discharge hose before the fuel is delivered into the volume standard.
- The temperature of the volume standard may be different from the temperature of the fuel delivered through the discharge hose.
- The temperature of the fuel in the storage tank and the temperature of the air affect the amount of temperature change that the fuel experiences as it passes through all the components of the delivery system.
- Since gasoline and diesel fuel (and LPG) have rather large coefficients of cubical expansion, small changes in temperature of the fuel from the meter to the standard will

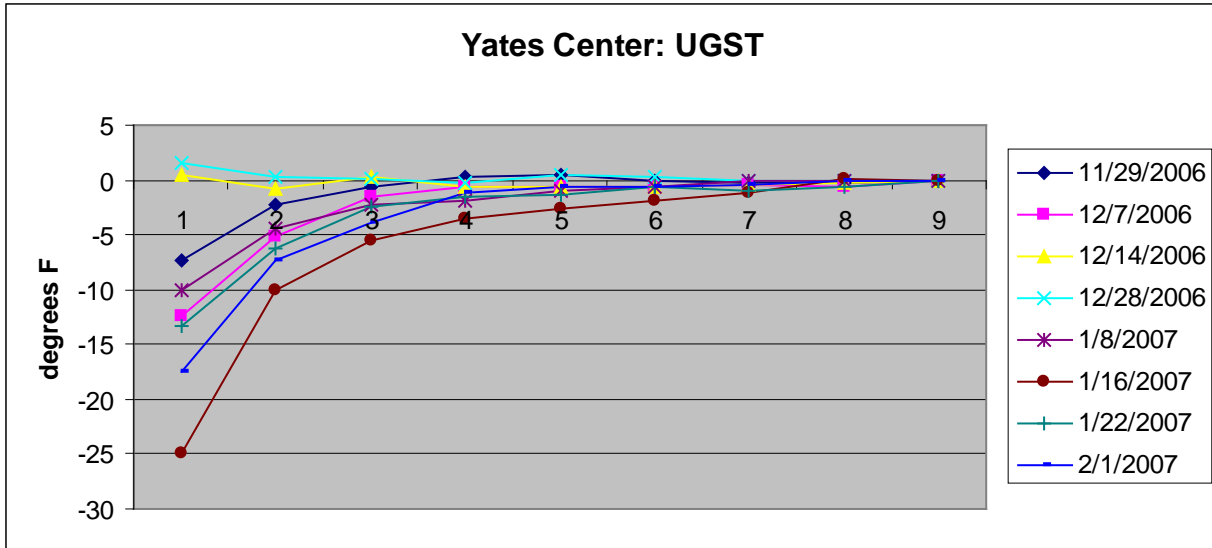
have significant effects on the volume of the fuel that was measured by the meter and the volume of fuel that is ultimately delivered into and measured in the volume standard.

- The amount of temperature change in the fuel is greatly affected by the air temperature around the dispenser and the volume standard and the air temperature inside the dispenser shell. These effects are most noticeable in very warm and very cold weather, that is, when the difference in the temperature of the air and the product are greatest. Furthermore, the time that the dispenser sits idle between deliveries, especially in very warm or very cold weather, affects the extent to which these temperature differences affect the volume of the fuel as it passes through the dispenser into the volume standard.

A 1 °F change in the temperature of 5 gallons of gasoline changes the volume of the gasoline by 0.8 in<sup>3</sup>. For diesel fuel, a 1 °F change in the temperature causes a change of about 0.55 in<sup>3</sup> in a 5-gal test draft. The temperature changes during a 5-gal test draft and between consecutive 5-gal test drafts for RMFDs can be very large, which causes large variations in test results from one test draft to the next consecutive test draft. It is important to verify test results to ensure that the test results are valid, especially when test results are at or near the tolerance limit or when enforcement action is considered for a predominance of errors. It is critical that actions are taken to ensure that temperature changes are reduced as much as possible to comply with the Handbook 44 test notes. These temperature effects are greatest in very warm and very cold weather when the temperatures of the air and the fuel are very different.

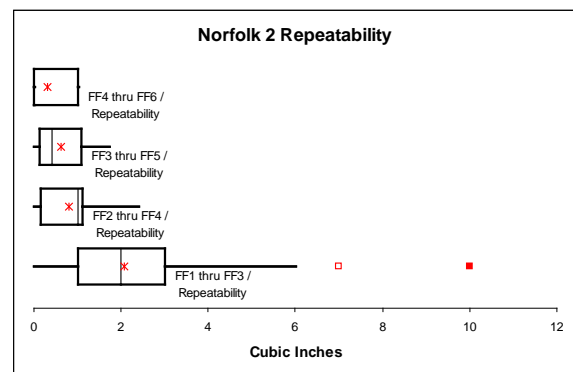
When Kansas Weights and Measures conducted their 52-week survey, the inspectors took the temperatures of the fuel in the 5-gal provers for each consecutive test draft. The charts below show the extent to which the temperatures of the fuel change during the test drafts and between test drafts. The changes in temperature during the initial test drafts of meters can be surprisingly large, especially when tests are conducted in very hot and very cold air. Consequently, these temperature changes cause large variations in the test results.





One can see that the temperature changes are greatest for the first test draft in hot and cold weather (based upon the dates when the tests were conducted). If the dispenser has been sitting idle for some time between deliveries, the hot and cold temperatures can cause changes to the temperatures of the meter, the piping in the dispenser, the discharge hose and the fuel inside these components. If the standard has also been sitting idle and is at a temperature significantly different from the temperature of the fuel used in the test, then the temperature of the fuel will change considerably during a delivery. Furthermore, if the dispenser has been idle for a considerable time in hot or cold weather, it may take several 5-gal deliveries to stabilize the temperature of the fuel, the meter, the dispenser piping, the discharge hose and the volume standard before consistent test results are obtained.

The effect of changing temperatures during three consecutive tests can have a large impact on the repeatability of the meter. The chart at the right shows that the lack of temperature stability for the first test of a meter can have a large impact on the repeatability tests of the first three tests of a RMFD meter. However, if the first test draft is excluded, the repeatability performance is much better for the subsequent sets of three tests.

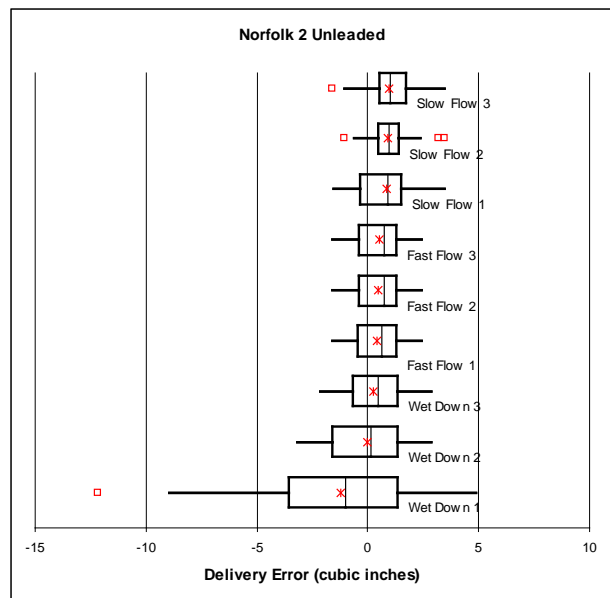


These temperature effects are most observable in 5-gal test drafts used to test RMFD meters, because the sizes of the test drafts are relatively small. When VTMs and loading-rack meters are tested, test drafts must be of volumes equal to at least one minute of the maximum discharge rate of for the meter. Because the sizes of the test drafts are much larger for VTMs and loading-rack meters, the effect of the temperature changes in the first “few” gallons of the test draft are relatively small compared to the total size of the test draft. Consequently, the temperature change on the total volume of the test draft is usually much smaller for large test drafts; however, these relatively small temperature changes can still have a significant effect on the test results. Hence, inspectors must make corrections for any temperature changes

that are observed when the temperature of the fuel can be taken at the meter and when filled prover. Since VTMs usually deliver fuel through a long discharge hose, these temperature differences can be significant. The length of discharge pipe from loading-rack meters to the end of the discharge pipe will vary from installation to installation, so inspectors must be aware of possible changes in the temperature of the fuel temperature from the meter to the prover.

Even if the temperatures of the fuel, the meter, the discharge piping, the discharge hose and the volume standard are stabilized before performing accuracy tests, be aware that when there are significant differences in the temperatures of the fuel and the air during a delivery, the temperature of the fuel can still change as the fuel moves from the meter to the volume standard. If the time periods for and between consecutive tests are consistent, say three consecutive fast-flow tests, the temperatures for the three consecutive tests may be nearly the same. However, it is possible that the temperature of the fuel still changed as it moved from the meter to the volume standard due to the difference in the temperatures of the air and the fuel. Unless an inspector can take the temperature of the liquid at the meter and in the prover, these consistent changes in the temperature of the fuel may not be observable, especially when testing uncompensated meters, since uncompensated meters are not required to have thermometer wells at the meter. It is important that inspectors understand the effects that temperature differences for the air and the fuel can have on test results, especially when there are large differences in the temperature of the air and the fuel.

The box-and-whisker graph is effective to illustrate the variations in the test results of the consecutive tests due to the lack of stabilization of temperature in the tests. The chart at the right shows the results for each of the nine tests conducted on the meter over the course of one year. The width the box and the length of the whiskers indicate the amount of variation in the test results. Obviously, the results of the first test show the greatest variation and the variations are large compared to the maintenance tolerance for the meter. The variations in the test results are much less after the first 5-gal test.



**Recommendation:** It isn't possible to correct for the effects of the lack of temperature stability, so the best course of action is to try to stabilize the temperature of the fuel, the meter, the dispenser piping, the discharge hose and the standard before accuracy tests are conducted. While the best approach is to run a preliminary draft of 5 gal on each meter before conducting an accuracy test, this would significantly increase the time it would take to test RMFD meters at each service station. Hence, the recommendation is that inspectors should repeat any tests that are at or outside (and relatively near the tolerance limit) to verify that the test results are valid and not affected by a lack of temperature stability. Tests should also be repeated when action is considered based on the predominance of errors. The consequences of rejecting meters are much greater than the consequences of passing meters. The inspector should always make the extra effort to ensure that

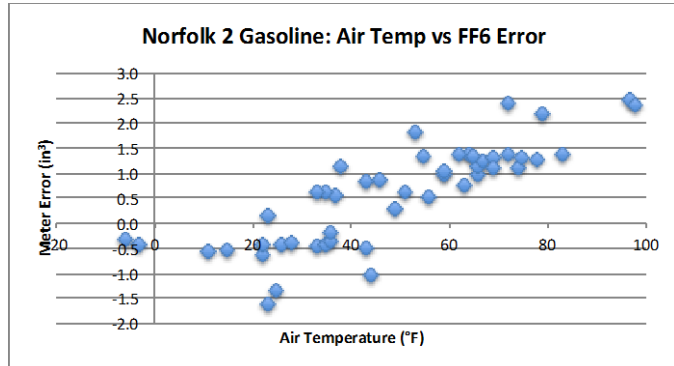


the results of enforcement tests are valid so that meters are not rejected due to the effects of variables that may have influences the test results.

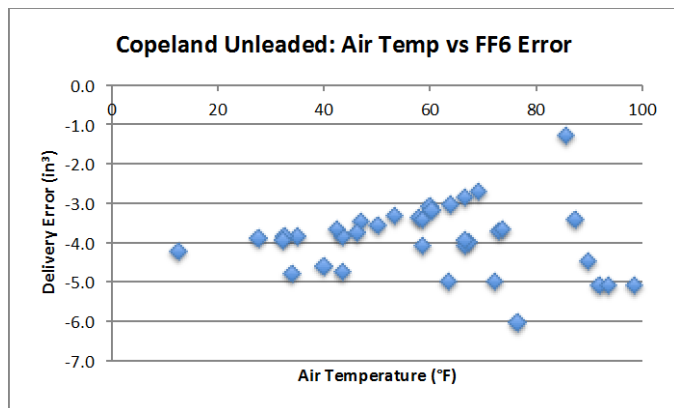
### Seasonal Temperature Effects

Stabilizing the temperature of the fuel throughout the dispenser and the standard still does not eliminate all of the temperature effects. Differences in test results from summer to winter or, more specifically warmer and colder air temperatures, are still evident. The temperature effect causes the apparent accuracy of the meter to change from summer to winter, even though the meter has not been adjusted.

The chart at the right shows the meter delivery error for the sixth fast-flow test plotted against the air temperature throughout the survey. Although the product temperature was stabilized with five consecutive fast-flow tests before the sixth test, the effect of temperature is still present. The correlation coefficient for the data is 0.82. The difference in delivery errors over the course of the survey has a range of about 4 in<sup>3</sup>. This apparent change in accuracy is probably due (1) in part to the temperature effect on the meter itself and (2) the remainder is due to the temperature effect on the volume of the fuel. **However, not all makes of meters responded the same way as the meter above. (See the chart to the right.) Some meters showed smaller temperature effects, while others showed virtually no temperature effects. There were some meters that actually appeared to deliver less fuel in hot weather than in cold weather.**



It is important to understand how this remaining temperature effect will affect the test results. If the meter shown in the Norfolk 2 chart above was adjusted to zero error in hot weather, then in cold weather the meter would appear to deliver 3 to 4 in<sup>3</sup> less fuel than in hot weather. Assuming that all of the meters in a single station are of the same model as this one and all of the meters

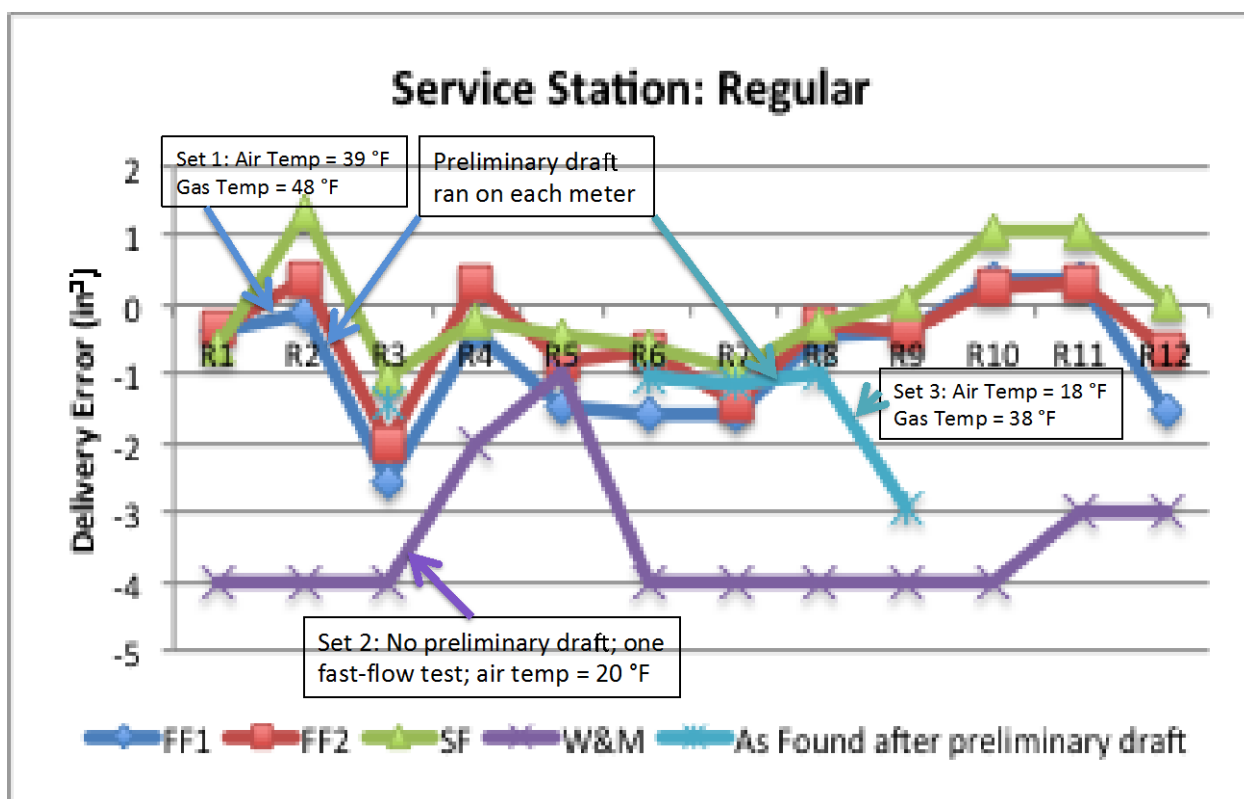


were adjusted to zero error in hot weather, then when tested in cold weather, the test results for all of the meters in the station would appear to under deliver and give the appearance of a predominance of errors in favor of the station. The results of slow-flow tests will be affected to a greater extent than the results of fast-flow tests, because more time is needed to deliver the desired test quantity, so there is more time for the differences in temperature to affect the test results. In this example, these under-delivery errors are not due to a fraudulent action of the part of the service representative during the adjustment of the meter, but a consequence of the temperature effect on the test results.

If all of the meters were adjusted to zero error in cold weather, then all of the meters would appear to deliver more fuel in warm weather. Weights and measures officials must consider the effects of temperature, especially when considering action for a predominance of errors, since the appearance of the predominance of errors may be due to temperature effects and may not be due to fraudulent adjustment on the part of service representative or the station owner.

### Effect of Temperature on Predominance of Errors

The lack of temperature stability and different temperature conditions can bias the test results for one set of tests versus another. The chart below shows the test results (Set 1) for a service company representative who tested 12 regular gasoline meters in a service station (noted as FF1, FF2 and SF). A couple of months later, a weights and measures inspector conducted one fast-flow test on the meters (Set 2). A few days later, the service company representative retested four of the meters to determine the “as found” condition (Set 3).



The first set of tests run by a service company consisted of a preliminary test draft on each meter, followed by two fast-flow tests and one slow-flow test. The air temperature was 39 °F and the temperature of the gasoline was 48 °F.

Approximately two months later, the local weights and measures inspector conducted one fast-flow test on each meter and concluded that the meters were delivering predominately short measure. The test results for the weights and measures inspector are shown in the chart above and noted as W&M. No preliminary test drafts were run on the meters. The air temperature was 20 °F. The temperature of the gasoline is not known, but it was probably around 38 °F.

The service company returned a few days after the weights and measures inspector tested the meters and retested four meters to establish the “as found” condition. The air temperature was 18 °F and the temperature of the gasoline was 38 °F. A preliminary draft was run on each meter before a fast-flow test was conducted. The results for three of the four meters were essentially the same as when the service representative tested the meters about two months earlier. One meter delivered about 2.5 in<sup>3</sup> less than two months earlier.

The key aspect of the test results is that the test results for the weights and measures inspector were biased toward under delivery and gave the impression that the meters were delivering short measure gasoline. However, the test results by the weights and measures inspector were affected by temperature and the lack of temperature stability. In fact, the results obtained by the weights and measures inspector were not valid indications of the accuracy of the meters.

These test results are another example that show that the results of the first test of a meter may be invalid when the temperatures of the gasoline, the meter piping inside the dispenser, the dispenser hose and the standard are not stabilized before the meter is tested for accuracy. The results for the service company showed that when a preliminary draft was run on each meter, then the results of the third set of tests were generally consistent with the first set of test results conducted under a different set of test conditions. Since the weights and measures inspector did not stabilize the temperatures of the gasoline, the meter and the standard before running the accuracy tests, the inspector’s test results were biased and gave a false impression that the meters were set predominantly in favor of the seller. This situation illustrates the importance of repeating tests to stabilize temperature and verify test results before rejecting meters for an apparent predominance of errors.

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## Appendix B

### Items 320-1, 324-1, 330-1, and 360-1:

#### 320-1: Scales; 324-1: Belt-Conveyor Scale Systems; 330-1: Liquid Measuring Devices; and 360-1: Appendix D. Definitions

Comments by Henry Oppermann  
Weights and Measures Consulting

#### Topics

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SELLING TREATED GRAIN BY THE “SEED UNIT”: ITEM 360-1.....	3
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#### Position Statement

This document addresses the four items that are related: 320-1, 324-1, 330-1, and 360-1. The proposals are ill conceived, poorly developed and without merit. The proposed definition in item 360-1 is incorrect, because it does not properly define a batching scale. I encourage the S&T Committee to withdraw these items.

The objective of the proposals is to create a category of scales in the Scales Code for the KSi automatic bulk weighing systems used in the KSi seed treatment process, so that the scales are not classified as automatic bulk weighing systems. Apparently, they want to call the weighing systems “batching scales” so they can circumvent the requirements of the Automatic Bulk Weighing Systems Code, which are needed to ensure accurate weighments.

Furthermore, KSi wants to issue “weigh tickets” in seed units and base the sale of treated seeds in seed units. “Seed units” are not legal units of measurement and should not be used as the basis for commercial transactions.

Even if the NCWM would adopt the proposed definition in 360-1, this will not help KSi, because simply changing what they call their weighing systems does not change how their systems operate. Their scale systems are automatic bulk weighing systems; they are not batching scales.

#### Definition of Batching Scale: Item 360-1

A batching scale weighs two or more materials into a weigh hopper as part of a single weighment, that is, one weighing cycle that starts at zero, goes to a loaded condition by addition two or more materials, and then returns to zero. The proposed definition of a batching scale in item 360-1 has several key points that create problems.

1. The raw material could be a single material. Batching scales weigh two or more materials as part of a batching process.

2. The reference to “predetermined quantities by weight and/or liquid measure” is unclear. What is the purpose of this terminology? Does this mean that every transaction must be by the same predetermined quantity? Can the predetermined quantity vary for each transaction? Are the predetermined quantities based upon specified weights and volumes or may they be set percentages of the weighed product? If this definition is to apply to the KSi systems that automatically weigh multiple drafts of a single commodity in a weigh hopper as part of an automatic bulk weighing system, then how does this definition apply to the last draft of the multiple drafts, which may be a different amount from the previous drafts?
3. The proposed definition addresses a scale that weighs in predetermined quantities, but leaves out the word “automatically.” The KSi scales can weigh some small orders (less than the scale capacity) as single draft and automatically weigh larger orders as multiple drafts. As currently designed, the KSi scales are not required to return to zero before initiating the next weighing cycle. The load and no-load weight values should be recorded, but they are not.
4. The unit of measure for the final product may be different from any of the units of measure for the raw materials. These units are not defined, but they must be legal units of measurement. KSi wants to use “seed units.”

If the S&T Committee believes that a definition of a batching scale is needed, then the definition should be correct and clearly distinguish between batching scales, hopper scales and automatic bulk weighing systems. The following alternate definition of a batching scale is provided for consideration. Clarifying language is included to remove ambiguity regarding different applications for scales and weighing systems.

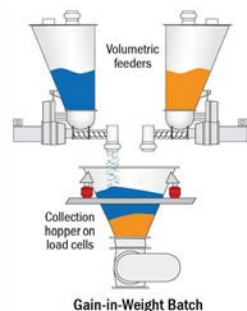
**Batching scale.** – A batching scale is a scale that weighs two or more commodities or materials into a weigh hopper as part of a single weighment. To clarify, a hopper scale or weighing system that weighs a single commodity or material as a single weighment is not a batching scale. Also, a hopper scale or weighing system that automatically weighs a single commodity or material in multiple drafts (either fixed or variable-sized drafts) for a single transaction is not a batching scale, since these scales or systems are automatic bulk weighing systems and must meet the requirements of the Automatic Bulk Weighing Systems Code.

### Batching Scales and Automatic Bulk Weighing Systems: Items 360-1 and 320-1

A scale has to weigh two or more materials together or added to the weigh hopper in sequence as part of a weighing process to be a batching scale. Examples are shown below.

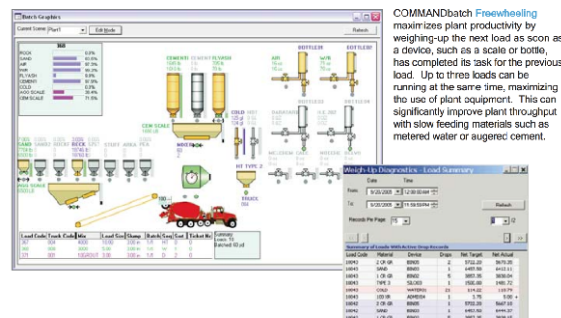
#### This is a Batching Scale

<http://www.ktron.com/process-equipment/feeders/technology/gain-in-weight-batching.cfm>



#### Command Alkon Batching System

[http://www.commandalkon.com/wp-content/uploads/2014/06/booklet\\_plantautomation.pdf](http://www.commandalkon.com/wp-content/uploads/2014/06/booklet_plantautomation.pdf)



The categorization of scales under Handbook 44 are based upon the weighing application, the manner of operation of the scale and, sometimes, upon the commodity that is weighed. Whatever happens to the commodity after it is weighed is immaterial to the categorization of a scale. For example, if an automatic bulk weighing system is used to weigh grain, the application and the categorization of the scale do not depend on if, after weighing, (1) the grain is then transferred into the hold of a ship for export, (2) the grain is ground for use in a food product, or (3) the grain is treated as seed for planting.

Based on the proposed definition in item 360-1, would the automatic bulk weighing systems (scales) used to weigh grains for export and into the hold in a ship now be called batching scales? Do these scales have to meet the requirements of the Automatic Bulk Weighing Systems Code or do they fall under the Scales Code?

There is a difference between batching systems that utilize batching scales and batching systems that utilize hopper scales dedicated to weighing a single material for an individual transaction. A batching scale weighs multiple materials that are delivered into the weigh hopper as part of a single weighment (i.e., before emptying) based upon a prescribed recipe.

The application section of the Automatic Bulk Weighing Systems Code states the following:

**A.1. General.** – This code applies to automatic bulk weighing systems, that is, **weighing systems adapted to the automatic weighing of a commodity in successive drafts of predetermined amounts automatically recording the no-load and loaded weight values** and accumulating the net weight of each draft. (Emphasis added)

The KSi systems automatically weigh seed grains in successive drafts of predetermined amounts, but they do not record the load and no-load weight values of each draft. For a given customer order, the scales weigh only one seed grain for treatment. They print the accumulated weight of all drafts with the assumption that the scale returned to zero for each draft. Actually, they allow the scale to operate automatically for multiple drafts if the scale returns within the “scale empty tolerance” that can be programmed into the controller. Already, based on the described operation, the scales have several violations of the Automatic Bulk Weighing Systems Code. The “scale empty tolerance” feature also violates a requirement in the Scales Code.

KS*i* claims that 30 state weights and measures programs classify their system as a hopper scale and one state program calls it an automatic bulk weighing system. The state that classified it as an automatic bulk weighing system has classified the system correctly. The other states should reexamine the operation of these scales in their jurisdictions and, if those scales automatically weigh multiple drafts of grain for some or all of the transactions, then the states should require these systems to meet the requirements of the automatic bulk weighing systems code.

### **Selling Treated Grain by the “Seed Unit”: Item 360-1**

KS*i* wants to be able to sell **bulk** treated grain in seed units. This is not allowed by the Uniform Weights and Measures Law (UWML) or by the Uniform Regulation for the Method of Sale of Commodities in Handbook 130. The second paragraph in Section 2 of the UWML states, “The definitions of basic units of weight and measure, the tables of weight and measure, and weights and measures equivalents as published by NIST are recognized and shall govern weighing and measuring equipment and transactions in the state.” There isn’t a NIST standard number of seeds per “seed unit” for different grains and never will be.

The Uniform Packaging and Labeling Regulation allows the sale by count of packaged, treated seed for packages with net contents of less than 225 g or 8 oz. The sale by count does not apply to the sale of bulk treated seed.

*Programmable Seed Counts:* Some of the companies using the KSi seed treatment systems sell the treated seed on the basis of seed units. The number of seeds per pound and the number of seeds per unit are programmable through the controller. For transactions based on seed units, the number of seeds per pound and the number of seeds per unit are effectively calibration values and must be sealed. However, the NTEP Certificate says that there are no metrological features in the controller, so it doesn’t have to be sealed. This is a conflict. Either the controllers on the KSi scales installed in the field are not consistent with the “type” that was evaluated by NTEP or the features were not evaluated by NTEP.

*Are they counting scales?* If companies sell treated seed by seed units, are these scales actually counting scales? If they are counting scales, then they should be marked according to Scales Code Table S.6.3.(b) point 13 (below) with the statement, “The counting feature is not legal for trade.” Also, if they are counting scales, then they must meet the requirements for counting scales, utilize proper sampling procedures to determine the seed count per unit of weight, and utilize adequate sample sizes (with appropriate scales) to determine the seed count per unit of weight. The Scales Code recognizes only Class I and Class II scales as counting scales.

13. *A scale designed for a special application rather than general use shall be conspicuously marked with suitable words, visible to the operator and to the customer, restricting its use to that application, e.g., postal scale, prepack scale, weight classifier, etc.\** When a scale is installed with an operational counting feature, the scale shall be marked on both the operator and customer sides with the statement “The counting feature is not legal for trade,” except when a Class I or Class II prescription scale complies with all Handbook 44 requirements applicable to counting features.

Even if you call them counting scales, the scales that automatically weigh multiple drafts to obtain the quantity for the transaction are automatic bulk weighing systems and have to meet the requirements of the Automatic Bulk Weighing Systems Code.

### **Definition Allows Different Units of Measure: Item 360-1**

The proposed definition allows the sale of the product in units of measure different from the units of measure used to weigh the raw material. Suppose that I have one of these systems, can I sell the treated seed by the Gasoline Equivalent Gallon? Tomorrow, can I sell it by the Diesel Equivalent Gallon? What prevents me from doing that? If this definition is adopted, then do I have to use legal units of measurement?

California produces huge amounts of grapes that are used to produce wine. The picked grapes are weighed on platform scales or truck scales. If the NCWM adopts the proposed definition for batching scales, does that mean that the scales used to weigh grapes for wine-making can indicate in bottles of wine? What would prohibit it under this definition? Under the proposed definition, can the scales be considered batching scales, since they are used in one step of the overall wine production process?

### **Non-automatic Batching Systems: Item 320-1**

The proposed definition in item 360-1 is for a batching scale. The proposed change in item 320-1 adds the text “including non-automatic batching systems.” What is a non-automatic batching system? What is the difference between a non-automatic and an automatic batching system? What is the difference between a batching scale and a batching system? Why is this proposed additional text needed, when there are no changes proposed for the Scales Code? What is the objective of this proposed change?

### **Return to Zero Tolerance or Scale Empty Tolerance: Item 320-1**

The scales have a programmable zero empty tolerance feature that is larger than the return-to-zero requirement in Handbook 44. NTEP CC 14-009 for the automatic bulk weighing system controller does not list this feature on the Certificate. Additionally, the CC states that “There are no metrological functions that require a seal.” Either this feature was not brought to the attention of NTEP at the time of the type evaluation or the manufacturer has changed the design of the controller and added a metrological characteristic to the controller. Either way, this feature should not be allowed on a commercial measuring device.

### **Addition to the Liquid Measuring Devices Code: Items 330-1 and 360-1**

Based on the proposed definition in 360-1 and the proposed addition to the LMD Code item 330-1, if a RMFD has one meter for regular and one for premium gasoline and the midgrade is a blend of the two, does that make the RMFD a batching meter?

If a loading rack meter blends the additives into the gasoline at the time that the tank truck is loaded, does the loading rack meter become a batching meter? What is the difference between a loading rack meter and a loading rack batching meter?

Are there different requirements that must be added to the code to apply to batching meters? If not, then why add a statement in the application section of the code for a batching meter when there aren't any special requirements for batching meters?

### **Addition to the Automatic Weighing Systems Code: Items 224-1 and 360-1**

As for Item 324-1, which is the addition to the Automatic Weighing Systems Code, the Code applies to completely different types of scales than the KSi automatic bulk weighing systems. If this change is made and an automatic checkweigher is used in a packaging line for packaging macaroni-and-cheese packages, does the checkweigher



become a macaroni-and-cheese batching scale? If an automatic checkweigher is used in a cheese packaging line, does it become a cheese-batching scale? What is the basis for proposing the addition to the A.1. paragraph? To which types of scales is this proposed addition intended to apply?

## Conclusions

In summary:

- A gain-in-weight batching scale weighs multiple raw materials in the hopper.
- A scale used in a production process is not a batching scale, unless it weighs two or more different materials as a batch.
- Seed treatment is a production process; not a batching process.
- Weighing a single grain for a transaction does not make the scale a batching scale.
- The KSi systems weigh a single grain (seed) for each order, which the industry appears to call a “batch.” Calling the product of the seed treatment process a “batch,” for the purposes of a transaction, does not make the scale a batching scale.
- A scale that automatically weighs multiple drafts of a single grain is an automatic bulk weighing system.

The four items, 320-1, 324-1, 330-1, and 360-1, are ill conceived, poorly developed and without merit. These items should be withdrawn from the S&T Committee Agenda.

If a definition of batching scale is needed, then the following definition is offered for consideration.

**Batching scale.** – A batching scale is a scale that weighs two or more commodities or materials into a weigh hopper as part of a single weighment. To clarify, a hopper scale or weighing system that weighs a single commodity or material as a single weighment is not a batching scale. Also, a hopper scale or weighing system that automatically weighs a single commodity or material in multiple drafts (either fixed or variable-sized drafts) for a single transaction is not a batching scale, since these scales or systems are automatic bulk weighing systems and must meet the requirements of the Automatic Bulk Weighing Systems Code.

## Appendix: Examples of Batching Systems

Web Site References:

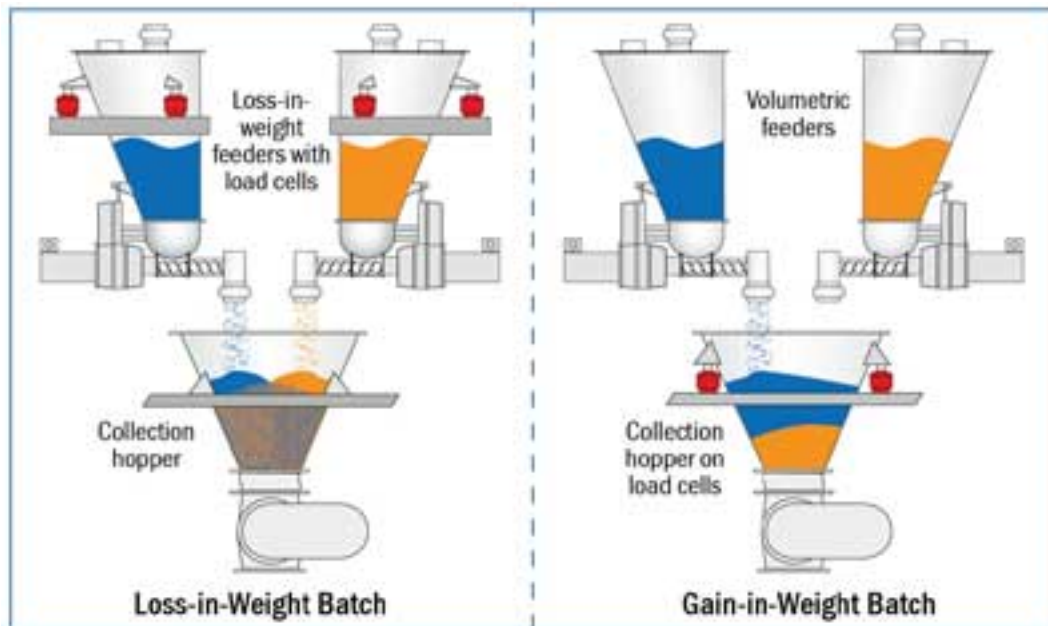
<http://www.ktron.com/process-equipment/feeders/technology/batch-feeding.cfm>

<http://www.ktron.com/process-equipment/feeders/technology/gain-in-weight-batching.cfm>

<http://www.ktron.com/process-equipment/feeders/technology/loss-in-weight-batching.cfm>

### Batch Feeding and Weighing Systems

There are two principle batching methods for weighing and feeding bulk materials



The manufacture of any blended product typically involves the intermediate process steps of transfer and weighing or batching of individual ingredients based upon their weight percentage in a blend. Depending on this percentage, materials are categorized as majors, minors and micros.

A **Gain-in-Weight (GIW) batching station** includes volumetric metering devices, such as screw feeders or valves, that deliver the product to a hopper on load cells. The **Loss-in-Weight (LIW) batching system** employs gravimetric feeding devices, such as loss-in-weight screw or vibratory feeders, which are mounted on individual load cells or scales. In cases where small amounts of micro ingredients are required, both methods may be employed: LIW feeders for the micros and minors, and GIW batchers for the major ingredients.

### Gain-in-Weight Batching Principle

Volumetric feeders are often used in Gain-in-Weight (GIW) applications for controlled batch dispensing and weighing of dry bulk materials. Batching may take place directly into IBCs (Intermediate Bulk Containers), hoppers or drums. Batched ingredients may also be dispensed directly into batch blenders. Where hazardous ingredients are among the batched ingredients, processors need a batching device where ingredients can be easily contained to eliminate any exposure of the product to the operator or to the environment.

In GIW batching the volumetric metering devices sequentially feed multiple ingredients into a collection hopper mounted on load cells. Each feeder delivers approximately 90% of the ingredient weight at high speed, slowing down towards the end of the cycle to deliver the last 10% at a reduced rate (often called “dribble mode”) to ensure higher accuracy.

The GIW controller monitors the weight of each ingredient and signals each volumetric feeder to start, increase or reduce speed, or stop accordingly. Once all the ingredients have been delivered, the batch is complete and the mixture is discharged into the process below.

**Loss-In-Weight Batching Principle**

LIW batching is used when individual ingredients must be weighed more accurately or when the batch cycle times need to be very short. Gravimetric feeders operating in batch mode simultaneously feed multiple ingredients into a collection hopper. Adjustment of the delivery speed (on/off, fast/slow) lies with the LIW feeder controls. Since each feeder has its own dedicated weighing system, the LIW batching system, delivers highly accurate batches for each ingredient.

Once all the ingredients have been delivered, the batch is complete and the mixture is delivered to the process below. Since all ingredients are being metered at the same time, there is no layering of ingredients, and the overall batch time as well as further processing times downstream are greatly reduced.

This method of batching is preferred where micro ingredients are involved, since highly accurate weighing is often required by the recipe and by the desire to control the cost of expensive ingredients.

**Gain-in-Weight (GIW) versus Loss-in-Weight (LIW)**

Batch size, number of materials, material characteristics and accuracy requirements will all influence which type of batching — via loss-in-weight or gain-in-weight feeding — is best. Typical accuracies that can be expected with the GIW method of batch weighing are +/- 0.5% of the full scale capacity. LIW batching delivers +/- 0.1 - 0.5% of batch weight setpoint (see table).

**Comparison Chart: Loss-in-Weight vs. Gain-in-Weight Batching**

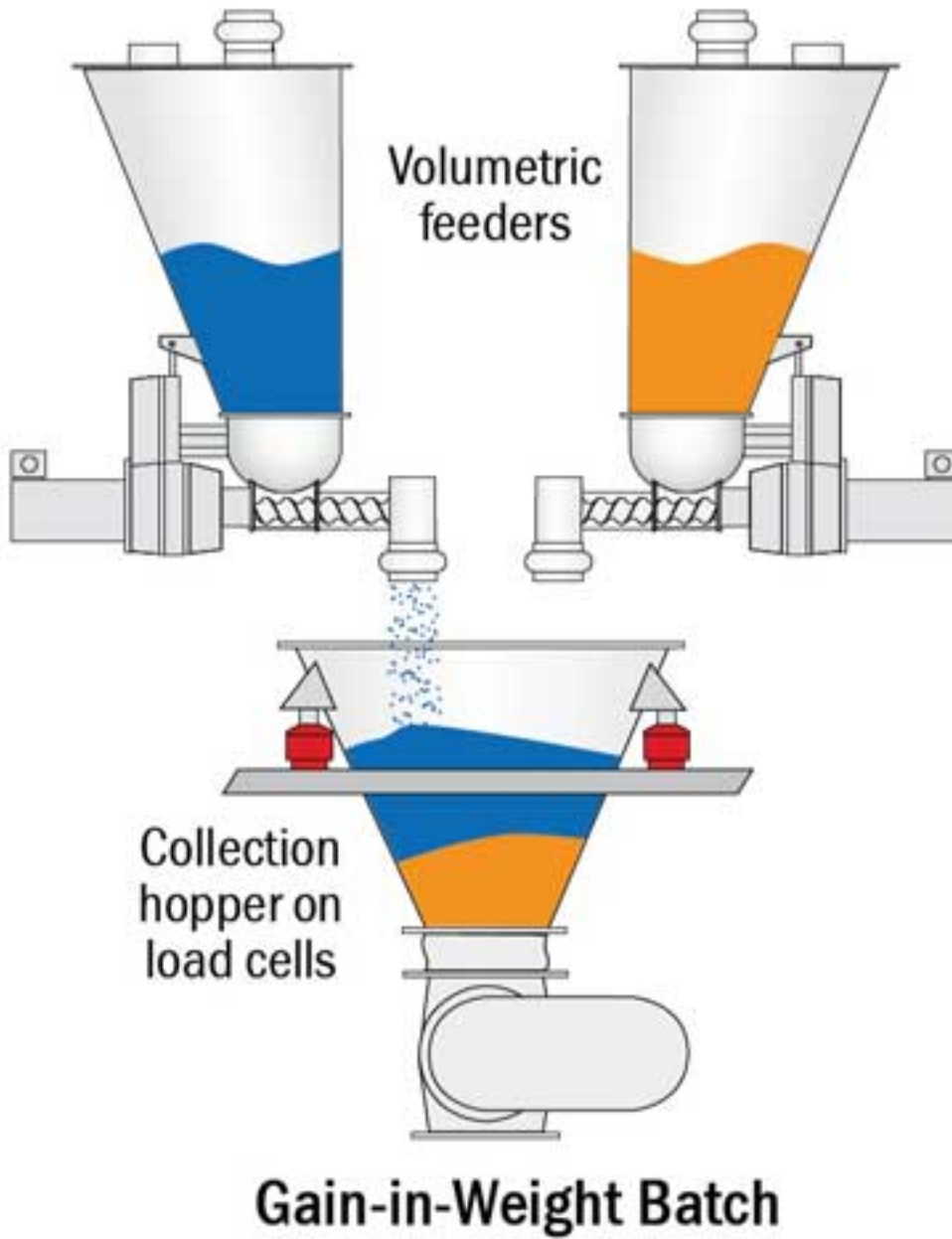
Requirements	Loss-in-Weight Batching	Gain-in-Weight Batching
Accuracy	0.1 - 0.5 % of batch weight setpoint	0.5 % or greater of the overall capacity of the scale or load cells
Single ingredient batching	Best	Good - Depending on the size of the batch versus the overall scale capacity; highly dependent on container size versus ingredient weight %
Multi ingredient batching	Best - Quickest way to batch out multi ingredients simultaneously	Good - Only one component at a time
Cost	Moderate - Each feeder on load cells/scale	Lower - Volumetric feeders with one set of load cells/scale for receiving vessel
Containment designs for hazardous materials	Available	Available

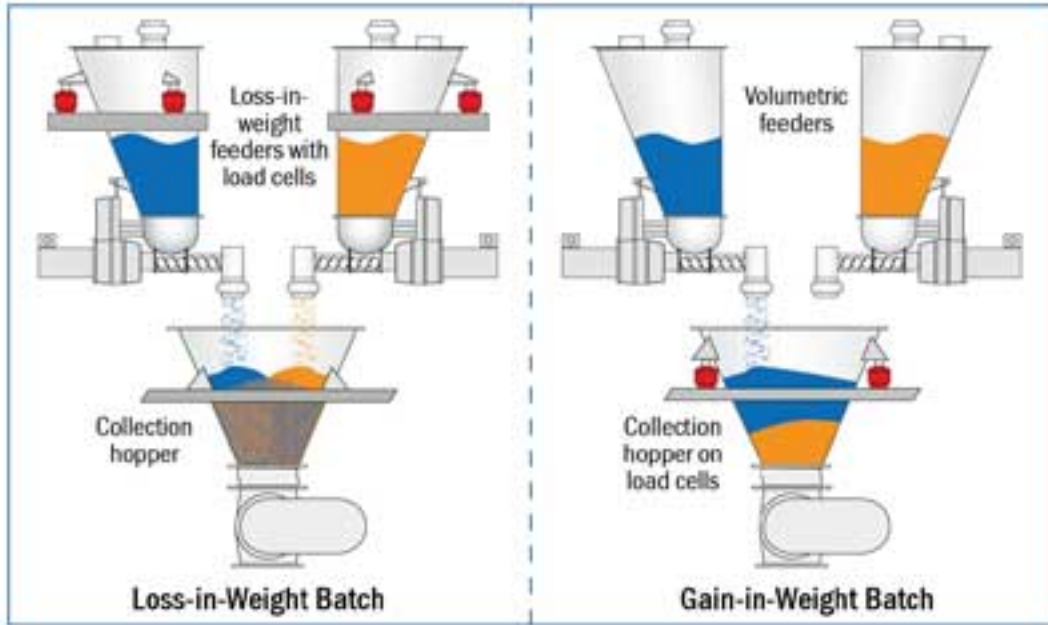
The Gain-in-Weight batching method is necessarily sequential for each ingredient, and therefore requires a longer overall batching time than with LIW batching. This sequential feeding also results in a layering of ingredients, so that mixing may be required before dispensing the batch into the process.

In cases where multiple products (major, minor and/or micro ingredients) are batched into larger IBC containers, a combination of volumetric and loss-in-weight (LIW) feeders may be used. The volumetric feeders are used to batch out the major ingredients first, directly into the IBC on a platform scale. The LIW feeders are each mounted on individual weighing systems (load cells or scales), and are then used to simultaneously batch out the smaller percentage minor/micro ingredients.

The scale on which the vessel is located is then used to verify the overall total batch weight of all the components. This combination of LIW and GIW technologies eliminates the requirement to batch each ingredient separately, thus decreasing the overall process batch times.

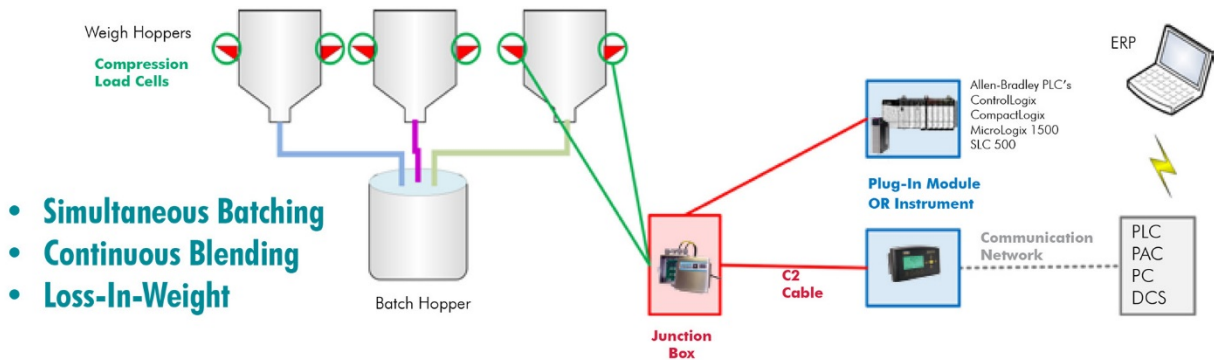
Most floor scales do not have sufficient speed and resolution to detect small amounts of batched products relative to the larger overall weights of the IBC or process vessel. If accuracy requirements on minors are in the range of 0.1 to 0.5 %, LIW feeders are typically used with the feeders mounted on high speed digital load cells with 1 part in 4 million resolution. A LIW batch controller monitors material weight loss from the feeder hopper and controls the start/stop function of the feeder to control the achievement of batch weight setpoint.





**Web Site Reference:**

<http://www.hardysolutions.com/solutions/solutions-by-application/batching-and-blending-make/batching-by-weight>



**Web Site Reference:**

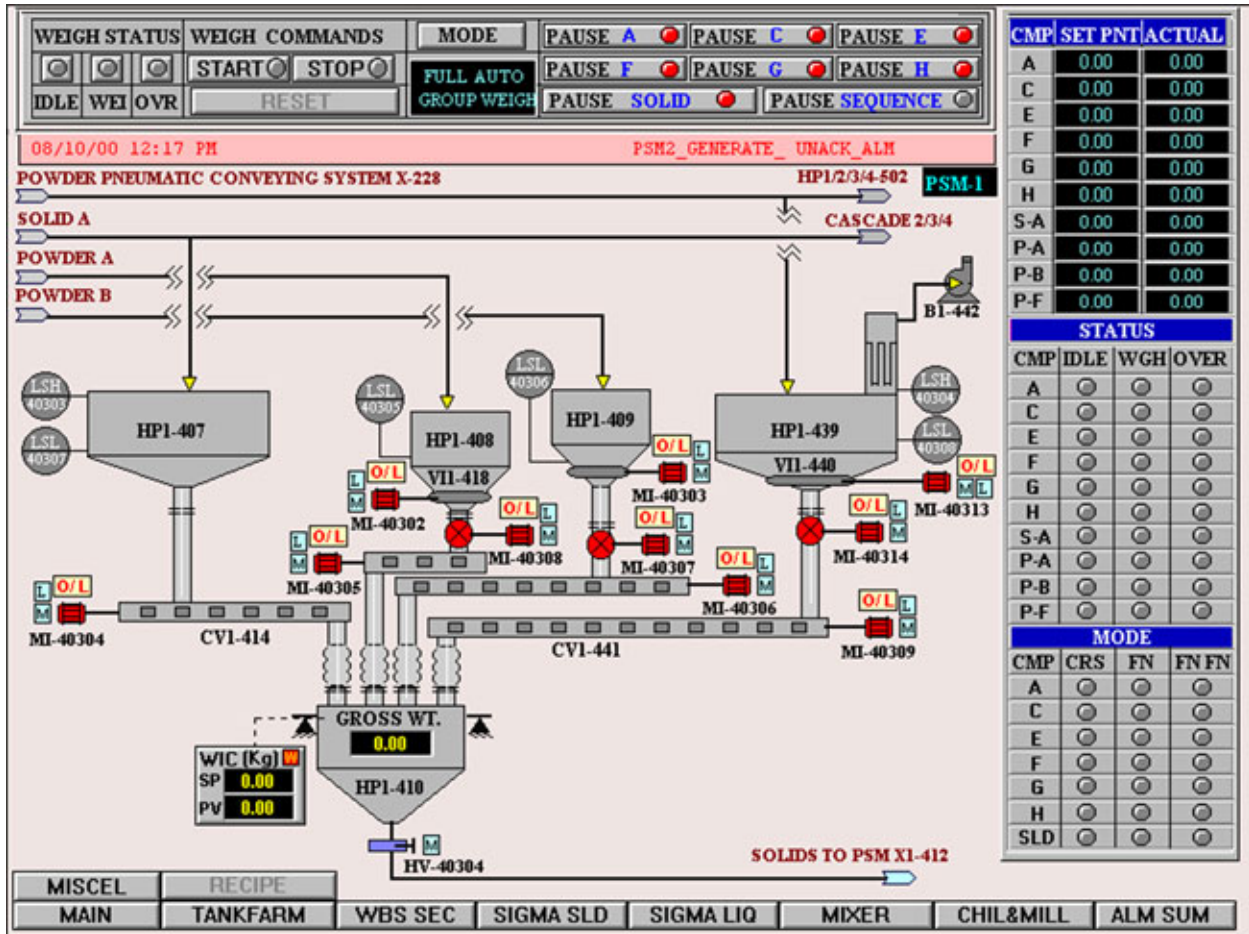
[http://www.prochem.co.in/batching\\_systems.html](http://www.prochem.co.in/batching_systems.html)

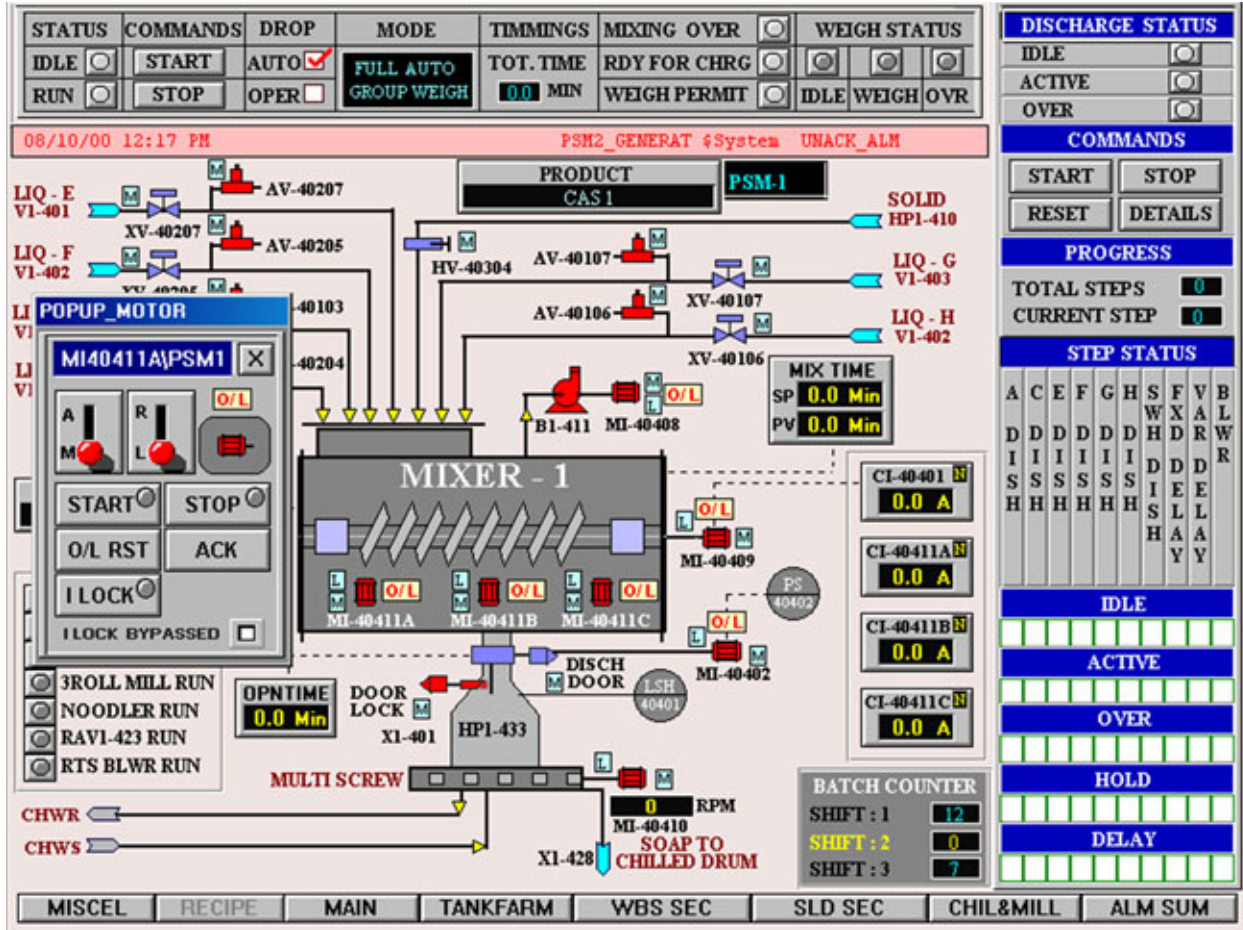
Many powder handling systems require bulk weighing of large amounts of materials and the preparation of product batches for ingredient formulations. Typical applications are for food mixes, soups and flavourings, pre-mixed baking recipes, infant formulas, drinks, sauces, health and nutritional supplements, breakfast cereals, confectionery, pharmaceuticals and many others.

**Typical Features:**

- High accuracy load-cells and weight control electronics
- Gain-in-weight, loss-in-weight and continuous weighing systems
- Fast/bulk fill and slow/trickle filling with self-tuning pre-act systems

- Major, minor and micro ingredient dosing systems
- Maximized flexibility for variable recipes
- Automatic top-up systems
- Safe, sanitary and dust free systems
- Multiple ingredient systems
- State of the art control systems and recipe management using SCADA/HMI software for process visualization, inventory control, and reporting functions for management information systems.







## Appendix C

### Item 320-4:

#### Draft Tentative Code Applicable to Weigh-In-Motion Systems Used for Vehicle Enforcement Screening

### Section 2.25. Weigh-In-Motion Systems used for Vehicle Enforcement Screening – Draft Code

#### A. Application

- A.1. General.** – This code applies to systems used to weigh vehicles, while in motion, for the purpose of screening and sorting the vehicles based on the vehicle weight to determine if a static weighment is necessary.
- A.2. Exception:** – The code does not apply to weighing systems intended for the collection of statistical traffic data.
- A.3. Additional Code Requirements.** – In addition to the requirements of this code, Weigh-In-Motion Screening Systems shall meet the requirements of Section 1.10. General Code.

#### S. Specifications

##### S.1. Design of Indicating and Recording Elements and of Recorded Representations.

**S.1.1. Ready Indication.** – The system shall provide a means of verifying that the system is operational and ready for use.

**S.1.2. Value of System Division Units.** – The value of a system division “d” expressed in a unit of weight shall be equal to:

- (a) 1, 2, or 5; or
- (b) a decimal multiple or submultiple of 1, 2, or 5.

**Examples:** divisions may be 10, 20, 50, 100; or 0.01, 0.02, 0.05; or 0.1, 0.2, 0.5, etc.

**S.1.2.1. Units of Measure.** – The system shall indicate weight values using only a single unit of measure.

**S.1.3. Maximum Value of Division Size.** – The value of the system division “d” for a Class A, Weight-In-Motion System shall not be greater than 50 kg (100 lb).

**S.1.4. Value of Other Units of Measure.**

**S.1.4.1. Speed.** – Vehicle speeds shall be measured in miles per hour or kilometers per hour.

**S.1.4.2. Axle-Spacing (Length).** – The center-to-center distance between any two successive axles shall be measured in:

- (a) feet and inches;

(b) feet and decimal submultiples of a foot; or

(c) meters and decimal submultiples of a meter.

**S.1.4.3. Vehicle Length.** – If the system is capable of measuring the overall length of the vehicle, the length of the vehicle shall be measured in feet and/or inches, or meters.

**S.1.5. Capacity Indication.** –An indicating or recording element shall not display nor record any values greater than 105 % of the specified capacity of the load receiving element.

**S.1.6. Identification of a Fault.** – Fault conditions shall be presented to the operator in a clear and unambiguous means. The following fault conditions shall be identified:

(a) Vehicle speed is below the minimum or above the maximum speed as specified.

(b) The maximum number of vehicle axles as specified has been exceeded.

(c) A change in vehicle speed greater than that specified has been detected.

**S.1.7. Recorded Representations.**

**S.1.7.1. Values to be Recorded.** – At a minimum, the following values shall be printed and/or stored electronically for each vehicle weighment:

(a) transaction identification number;

(b) lane identification (required if more than one lane at the site has the ability to weigh a vehicle in motion);

(c) vehicle speed;

(d) number of axles;

(e) weight of each axle;

(f) identification and weight of axles groups;

(g) axle spacing;

(h) total vehicle weight;

(i) all fault conditions that occurred during the weighing of the vehicle;

(j) violations, as identified in paragraph S.2.1., that occurred during the weighing of the vehicle; and

(k) time and date.

**S.1.8. Value of the Indicated and Recorded System Division.** – The value of the system’s division “(d),” as recorded, shall be the same as the division value indicated.

**S.2. System Design Requirements.**

**S.2.1. Violation Parameters.** – The instrument shall be capable of accepting user entered violation parameters for the following items:

- (a) single axle weight limit;
- (b) axle group weight limit;
- (c) gross vehicle weight limit; and
- (d) bridge formula maximum.

The instrument shall display and or record violation conditions when these parameters have been exceeded.

### **S.3. Design of Weighing Elements.**

**S.3.1. Multiple Load-Receiving Elements.** –An instrument with a single indicating or recording element, or a combination indicating-recording element, that is coupled to two or more load-receiving elements with independent weighing systems, shall be provided with means to prohibit the activation of any load-receiving element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which load receiving element (or elements) is in use.

### **S.4. Design of Weighing Devices, Accuracy Class.**

**S.4.1. Designation of Accuracy.** – WIM Systems meeting the requirements of this code shall be designated as accuracy Class A.

**Note:** This does not preclude higher accuracy classes from being proposed and added to this Code in the future when it can be demonstrated that WIM systems grouped within those accuracy classes can achieve the higher level of accuracy specified for those devices.

**S.5. Marking Requirements.** – In addition to the marking requirements in G-S.1. Identification (except G.S.1.(e)), the system shall be marked with the following information:

- (a) accuracy class;
- (b) value of the system division “d”;
- (c) operational temperature limits;
- (d) number of instrumented lanes (not required if only one lane is instrumented);
- (e) minimum and maximum vehicle speed;
- (f) maximum number of axles per vehicle;
- (g) maximum change in vehicle speed during weighment; and
- (h) minimum and maximum load.

**S.5.1. Location of Marking Information.** – The marking information required in G-S.1. of the General Code and S.5. shall be visible after installation. The information shall be marked on the system or recalled from an information screen.

## N. Notes

### N.1. Test Procedures.

**N.1.1. Selection of Test Vehicles.** – All dynamic testing associated with the procedures described in each of the Subparagraphs of N.1.5 shall be performed with a minimum of two test vehicles.

- (a) The first test vehicle may be a two axle, six tire, single unit truck; that is, a vehicle with two axles with the rear axle having dual wheels. The vehicle shall have a maximum Gross Vehicle Weight of 10 000 lb.
- (b) The second test vehicle shall be a five axle, single trailer truck with a maximum Gross Vehicle Weight of 80 000 lb.

**Note:** Consideration should be made for testing the systems using vehicles which are typical to the systems daily operation.

**N.1.1.1. Weighing of Test Vehicles.** – All test vehicles shall be weighed on a reference scale before being used to conduct the dynamic tests.

**N.1.1.2. Determining Reference Weights for Axle, Axle Groups and Gross Vehicle Weight.** – The reference weights shall be the average weight value of a minimum of three static weighments of all single axle, axle groups and gross vehicle weight.

**Note:** The axles within an axle group are not considered single axles.

### N.1.2. Test Loads.

**N.1.2.1. Static Test Loads.** – All static test loads shall use certified test weights.

**N.1.2.2. Dynamic Test Loads.** – Test vehicles used for dynamic testing shall be loaded to 85 % to 95 % of their legal maximum Gross Vehicle Weight. The “load” shall be non-shifting and shall be positioned to present as close as possible, an equal side-to-side load.

**N.1.3. Reference Scale.** – Each reference vehicle shall be weighed statically on a multiple platform vehicle scale comprised of three individual weighing/load-receiving elements, each an independent scale. The three individual weighing/load receiving elements shall be of such dimension and spacing to facilitate 1) the single-draft weighing of all reference test vehicles, and 2) the simultaneous weighing of each single axle and axle group of the reference test vehicles on different individual elements of the scale; gross vehicle weight determined by summing the values of the different reference axle and reference axle groups of a test vehicle. The scale shall be tested immediately prior to using it to establish reference test loads and in no case more than 24 hours prior. To qualify for use as a suitable reference scale, it must meet NIST Handbook 44, Class III L maintenance tolerances.

**N.1.3.1. Location of a Reference Scale.** – The location of the reference scale must be considered as vehicle weights will change due to fuel consumption.

**N.1.4. Test Speeds.** – All dynamic tests shall be conducted within 20 % below or at the posted speed limit.

### N.1.5. Test Procedures.

**N.1.5.1. Dynamic Load Test.** – The dynamic test shall be conducted using the test vehicles defined in N.1.1. The test shall consist of a minimum of 20 runs for each test vehicle at the speed as stated in N.1.4.

At the conclusion of the dynamic test there will be a minimum of 20 weight readings for each single axle, axle group and gross vehicle weight of the test vehicle. The tolerance for each weight reading shall be based on the percentage values specified in Table T.2.2.

**N.1.5.2. Vehicle Position Test.** – During the conduct of the dynamic testing ensure that the vehicle stays within the defined roadway along the width of the sensor. The test shall be conducted with 10 runs with the vehicle centered along the width of the sensor, five runs with the vehicle on the right side along the width of the sensor, and five runs with the vehicle on the left side along the width of the sensor. Only gross vehicle weight is used for this test and the tolerance for each weight shall be based on the tolerance value specified in T.2.3.

**N.1.5.3. Axle Spacing Test.** – The axle spacing test is a review of the displayed and/or recorded axle spacing distance of the test vehicles. The tolerance value for each distance shall be based on the tolerance value specified in T.2.4.

## T. Tolerances

### T.1. Principles.

**T.1.1. Design.** – The tolerance for a weigh-in-motion system is a performance requirement independent of the design principle used.

### T.2. Tolerance Values for Accuracy Class A.

**T.2.1. To Tests Involving Digital Indications or Representations** – To the tolerances that would otherwise be applied in Paragraphs T.2.2. and T.2.3., there shall be added an amount equal to one-half the value of the scale division to account for the uncertainty of digital rounding.

**T.2.2. Tolerance Values for Dynamic Load Test.** – The tolerance values applicable during dynamic load testing are as specified in Table T.2.2.

<b>Table T.2.2.</b>	
<b>Tolerances for Accuracy Class A</b>	
<b><u>Load Description*</u></b>	<b><u>Tolerance as a Percentage of Applied Test Load</u></b>
Axle Load	± 20 %
Axle Group Load	± 15 %
Gross Vehicle Weight	± 10 %
* No more than 5 % of the weighments in each of the load description subgroups shown in this table shall exceed the applicable tolerance.	

**T.2.3. Tolerance Value for Vehicle Position Test.** – The tolerance value applied to each gross vehicle weight is ± 10 % of the applied test load.

**T.2.4. Tolerance Value for Axle Spacing.** – The tolerance value applied to each axle spacing measurement shall be ± 0.15 meter (0.5 ft).

### T.3. Influence Factors.

– The following factor is applicable to tests conducted under controlled conditions only.

**T.3.1. Temperature.** – Systems shall satisfy the tolerance requirements under all operating temperature **Error! Bookmark not defined.** unless a limited operating temperature range is specified by the manufacturer.

**T.4. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility.** – The difference between the weight indication due to the disturbance and the weight indication without the disturbance shall not exceed the tolerance value as stated in Table T.2.2.

## UR. USER REQUIREMENTS

**UR.1. Selection Requirements.** – Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its capacity, number of scale divisions, value of the scale division or verification scale division and minimum capacity.

**UR.1.1. General.** – The typical class or type of device for particular weighing applications is shown in Table 1. Typical Class or Type of Device for Weighing Applications.

<b>Table 1.</b>	
<b>Typical Class or Type of Device for Weighing Applications</b>	
<b>Class</b>	<b>Weighing Application</b>
A	Screening and sorting of vehicles based on axle, axle group and gross vehicle weight.
<b>Note:</b> A WIM system with a higher accuracy class than that specified as “typical” may be used.	

**UR.2. User Location Conditions and Maintenance.** – The system shall be installed and maintained as defined in the manufacturer’s recommendation.

**UR.2.1. System Modification.** – The dimensions (e.g., length, width, thickness, etc.) of the load receiving element of a system shall not be changed beyond the manufacturer’s specifications, nor shall the capacity of a scale be increased beyond its design capacity by replacing or modifying the original primary indicating or recording element with one of a higher capacity, except when the modification has been approved by a competent engineering authority, preferably that of the engineering department of the manufacturer of the system, and by the weights and measures authority having jurisdiction over the system.

**UR.2.2. Foundation, Supports, and Clearance.** – The foundation and supports shall be such as to provide strength, rigidity, and permanence of all components.

On load-receiving elements which use moving parts for determining the load value, clearance shall be provided around all live parts to the extent that no contacts may result when the load-receiving element is empty, nor throughout the weighing range of the system.

**UR.2.3. Access to Weighing Elements.** – If necessary, adequate provision shall be made for inspection and maintenance of the weighing elements.

**UR.3. Maximum Load.** – A system shall not be used to weigh a load of more than the marked maximum load of the system.

**The following are proposed definitions to be added to NIST Handbook 44, Appendix D to support the Weigh-In-Motion Systems used for Vehicle Enforcement Screening – Draft Code.**

**axle.** – The axis oriented transversely to the nominal direction of vehicle motion, and extending the full width of the vehicle, about which the wheel(s) at both ends rotate.

**axle-group load.** – The sum of all tire loads of the wheels on a group of adjacent axles; a portion of the gross-vehicle weight.

**axle load.** – The sum of all tire loads of the wheels on an axle; a portion of the gross-vehicle weight.

**axle spacing.** – The distance between the centers of any two axles. When specifying axle spacing, you also need to identify the axles used.

**single-axle load.** – The load transmitted to the road surface by the tires lying on the same longitudinal axis (that axis transverse to the movement of the vehicle and about which the wheels rotate).

**tandem-axle load.** – The load transmitted to the road surface by the tires of two single-axles lying on the same longitudinal axis (that axis transverse to the movement of the vehicle and about which the wheels rotate).

**triple-axle load.** – The load transmitted to the road surface by the tires of three single-axles lying on the same longitudinal axis (that axis transverse to the movement of the vehicle and about which the wheels rotate).

**weigh-in-motion (WIM).** – A process of estimating a moving vehicle's gross weight and the portion of that weight that is carried by each wheel, axle, or axle group, or combination thereof, by measurement and analysis of dynamic vehicle tire forces.

**weigh-in-motion screening scale.** – A WIM system used to identify potentially overweight vehicles.

**wheel weight.** – The weight value of any single or set of wheels on one side of a vehicle on a single axle.

**WIM System** – A set of sensors and supporting instruments that measure the presence of a moving vehicle and the related dynamic tire forces at specified locations with respect to time; estimate tire loads; calculate speed, axle spacing, vehicle class according to axle arrangement, and other parameters concerning the vehicle; and process, display, store, and transmit this information. This standard applies only to highway vehicles.

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## Appendix D

### Item 330-4:

#### N.4.2.5. Determination of Error on Wholesale Devices with Multiple Flow Rates and Calibration Factors

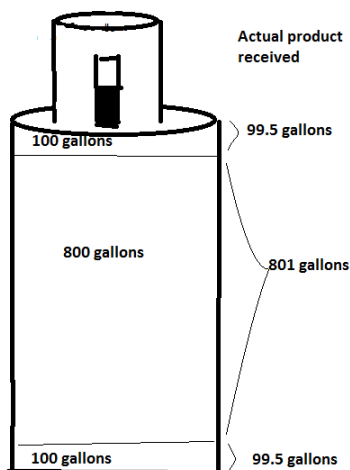
## How Slow Flow Accuracy Affects LMD's

Because the legal tolerance on slow flow tests is so great (+/-0.5%) compared to industry standards (typically +/- 0.05%), and because slow flow tests themselves are so time consuming, registered service agents may be tempted to skip slow flow tests entirely during seasonal re-calibrations. Even if one ignores the fact that the Liquid Measuring Device Code in NIST Handbook 44 requires that a special test be done at the slow flow rate, there remains a very good reason that slow flow rates should always be tested. If the error at the slow flow rate is unknown, then it is impossible to calibrate the high flow rates to deliver with the extreme accuracy sought by industry on quantities which are greater or less than the test prover used at the time of calibration.

Imagine a typical whole sale meter which is calibrated using a 1,000 gallon prover at a terminal where the customers' trucks have pocket sizes between 1,000 and 4,000 gallons. The meter has an electronic register programmed with a slow flow rate for start-up and shut-down, a high-flow rate for typical deliveries, and a mid-speed fallback rate for when the pumps can't keep up with demand. Startup and shutdown deliveries are 100 gallons each regardless of total quantity delivered.

Now imagine that the service agent calibrating the meter didn't check the slow flow rate and didn't know that the meter was short five gallons on a one thousand gallon test. Instead, he calibrated the fallback and normal flow rates without testing the slow flow and introduced a linear error which increases the farther the transaction quantity deviates from the prover size. On a 1,000 gallon delivery the meter would appear to be accurate, but on a 3,400 gallon delivery a three gallon error has been introduced. That is a 0.09% error which is almost twice the typical industry goal.

**Calibrating high flow means compensating for slow flow error.**



When calibrating at the normal and fallback speeds, the meter registers 200 gallons of product for the startup and shutdown, but actually delivers only 199 gallons. (99.5 gallons delivered for every 100 gallons registered at slow speed.) If the service technician calibrates the meter to zero at normal and fallback rates, the meter will actually deliver 801 gallons for every 800 gallons it registers at those rates.

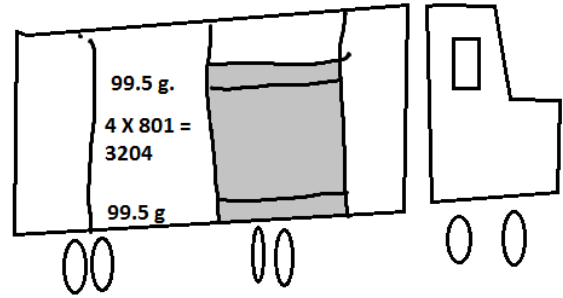
Every subsequent delivery of 1000 gallons should receive exactly the right amount. Every delivery exceeding 1000 gallons will be 'long' and every delivery less than 1000 gallons will be short.

To determine the error on a typical delivery, the service agent needs to calculate the error introduced by the startup and shutdown gallons, and then the error introduced at the higher flow rates.

For a 3,400 gallon delivery in this example, the meter would register 100 gallons on startup but only deliver 99.5 gallons. It would then jump to normal rate and deliver 801 gallons for every 800 gallons it registers until it goes into shutdown mode when it slows down and again delivers only 99.5 gallons of the 100 gallons it registers. Delivery error is +3 gallons (0.09%).

**EXAMPLE SLOW FLOW IS 5G/1000G SHORT AND HIGH FLOW WAS ADJUSTED AS A RESULT.**

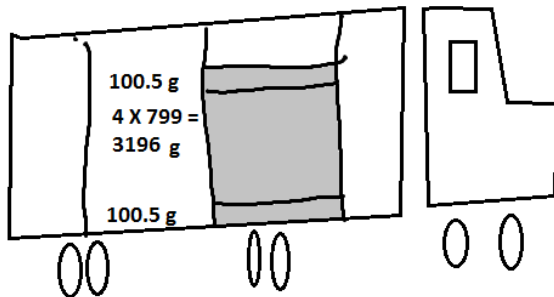
Driver ordered 3400 gallons for pocket 2.



$$3204 + 99.5 + 99.5 = 3403$$

**EXAMPLE WHEN SLOW FLOW RATE IS 5G/1000G LONG AND HIGH FLOW WAS ADJUSTED AS A RESULT.**

Driver ordered 3400 gallons for pocket 2.



$$3196 + 100.5 + 100.5 = 3397$$

The math would be reversed if the meter had been five gallons long on a 1,000 gallon slow flow test at the startup and shutdown speed. The meter would deliver 100.5 gallons for every 100 gallons it registered at startup and shutdown, but only 799 gallons for every 800 gallons registered at the normal delivery rate. The total delivery is 3 gallons (0.09%) short. Under-registration, which is favorable to consumers in most situations, can be detrimental to them when it occurs at the slow flow speed.

Does it matter considering that the error introduced is so much smaller than the tolerance allowed in the liquid measuring code? It does to industry, or they wouldn't set such tight accuracy standards for themselves. And it does to Weights & Measures officials who must consider the predominant direction of error in addition to tolerance. Everyone's time is wasted chasing extreme accuracy at the normal delivery rate if the accuracy of the startup and shutdown rate has been ignored.

## Appendix E

### Item 331-2:

#### N.4.2.1. Determination of Error on Vehicle-Tank Meters with Multiple Flow Rates and Calibration Factors

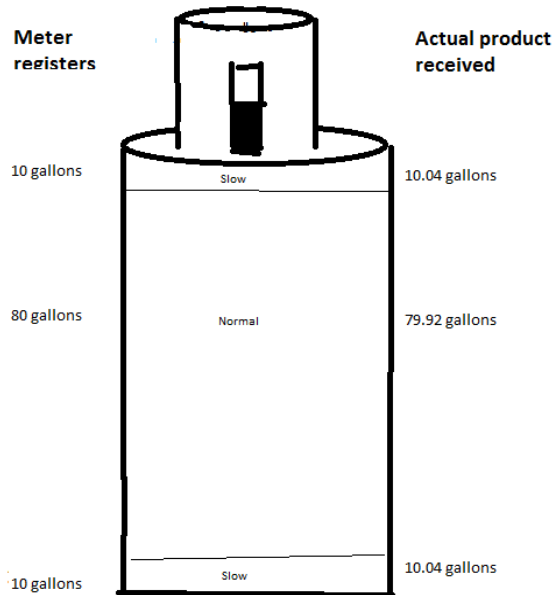
## How Slow Flow Errors Affect VTM's

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Imagine a typical VTM which is calibrated using a 100 gallon prover for a bulk delivery company whose customers' tanks are typically between 100 and 1,000 gallons. The meter has an electronic register programmed with a slow flow rate for start-up and shut-down, and a high-flow rate for typical deliveries. Startup and shutdown deliveries are 10 gallons each regardless of total quantity delivered.

Now imagine that the service agent calibrating the meter didn't check the slow flow rate and didn't know that the meter was long 0.4 gallons on a 100 gallon test. Instead, he calibrated the normal flow rate without testing the slow flow and introduced a linear error which increases the farther the transaction quantity deviates from the prover size. On a 100 gallon delivery the meter would appear to be accurate, but on a 500 gallon delivery a -0.4 gallon error has been introduced. That is within tolerance, but if all of his meters have similar errors in the same direction, typical deliveries will be in the operator's favor at the expense of his customers.

### Calibrating high flow means compensating for slow flow error.



When calibrating at the normal speed, the meter registers 20 gallons of product for the startup and shutdown, but actually delivers 20.08 gallons. (10.04 gallons delivered for every 10.00 gallons registered at slow speed.) If the service technician calibrates the meter to zero at normal speed, the meter will actually deliver 79.92 gallons for every 80.00 gallons it registers at that flow rate.

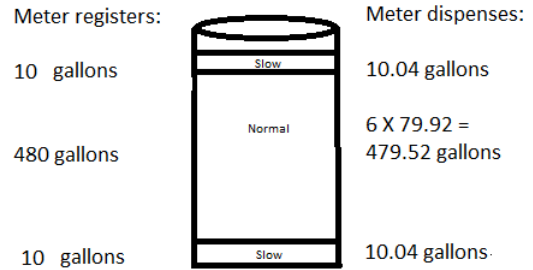
Every subsequent delivery of 100 gallons should receive exactly the right amount. Every delivery exceeding 100 gallons will be 'short' and every delivery less than 100 gallons will be 'long.'

To determine the error on a typical delivery, the service agent needs to calculate the error introduced by the startup and shutdown gallons, and then the error introduced at the higher flow rates.

For a 500 gallon delivery in this example, the meter would register 10 gallons on startup but actually deliver 10.04 gallons. It would then jump to normal rate and deliver 79.92 gallons for every 80 gallons it registers until it goes into shutdown mode when it slows down and again delivers 10.04 gallons as it registers only an additional 10 gallons.

**SLOW FLOW RATE IS +0.4 g/100 G, AND CALIBRATION OF NORMAL RATE WAS ADJUSTED TO COMPENSATE**

Customer ordered 500 gallons of product.



Meter registers 500 gallons but only delivers 499.6 gallons.

The error would be well within maintenance tolerance so the Weights and Measures official need only be concerned if the slow flow errors on all the meters for a particular product are in the same direction. At that point, the official should determine the direction of the error on a typical delivery to determine if the equipment is being properly maintained. Device users can ensure they have no problems with this requirement by making sure that slow flow errors are not predominantly in one direction.

## Appendix F

### Item 337-1:

#### **Submitters Background and Justification for Handbook 44 Definition of “Diesel Gallon Equivalent (DGE)” of Compressed Natural Gas (CNG) and “Liquefied Natural Gas (LNG)” as a Vehicular Fuel**

##### **Clean Vehicle Education Foundation**

##### *Development of the “Gasoline Gallon Equivalent” by NCWM\**

In 1993, under the auspices of the National Conference on Weights and Measures (NCWM), a Compressed Natural Gas (CNG) Working Group came together to determine the way in which CNG would be sold to the public at retail as a motor fuel.

The working group focused on three issues:

1. How to provide the Natural Gas Vehicle (NGV) industry a method of sale that would be familiar and acceptable to consumers
2. How to provide weights and measures officials a verifiable and quantifiable means to determine the accuracy of natural gas dispensers; and
3. How to meet these requirements with a uniform, national standard.

NCWM considered three proposals for the method of sale of CNG:

1. Joules, the unit of energy measurement in SI units
2. Mass
3. The Gasoline Gallon Equivalent (GGE)

The Natural Gas Vehicle Coalition (now NGV America) recommended that the Gasoline Gallon Equivalent be adopted as the method of sale for CNG, and that it be based on the energy equivalent of a gallon of gasoline. The use of the GGE was recommended primarily for the convenience of the retail customer comparing the cost and fuel economy of a natural gas vehicle to a comparable gasoline vehicle. During the discussion, a proposal was made to eliminate the reference to energy content of CNG and replace it with a fixed conversion factor based on mass, with the fixed mass of CNG being equal to a gallon of gasoline. Measurement of mass in the retail dispenser and verification by W&M officials is easier and less costly than measurement of energy content.

Since the energy content of a unit measure of CNG (standard cubic foot - scf) and gasoline (gallon) vary widely depending on the sample of fuel measured, the reference gallon of gasoline was determined to be Indolene, the gasoline used by EPA to certify emissions and fuel economy, with an energy content (lower heating value) of 114,118 BTU/gal. Work conducted by the Institute of Gas Technology and the Gas Research Institute (now combined into the Gas Technology Institute) surveyed 6811 samples of natural gas nationwide and concluded that the “average” natural gas in the U.S. had an

\* *Report of the 78<sup>th</sup> National Conference on Weights and Measures, 1993*, NIST Special Publication 854, pp 322-326.

*Report of the 79<sup>th</sup> National Conference on Weights and Measures, 1994*, NIST Special Publication 870, pp 213-217.

*Program and Committee Reports for the National Conference on Weights and Measures, 79<sup>th</sup> Annual Meeting, July 17-21, 1994*, NCWM Publication 16, pp 89-92.

energy content (lower heating value) of 923.7 BTU/scf, and a density of 0.0458172 lbs/cubic foot. This translates 20,160.551 BTU/lb. Dividing gasoline's 114.118 BTU/gal by natural gas's 20,160.551 BTU/lb gives 5.660 lbs of natural gas = 1 GGE. Similar calculations determined that a gasoline liter equivalent of natural gas equals 0.678 kg of natural gas.

At its 79<sup>th</sup> Annual Meeting in July of 1994, NCWM adopted resolutions that: “All natural gas kept, offered or exposed for sale or sold at retail as a vehicle fuel shall be in terms of the gasoline liter equivalent (GLE) or gasoline gallon equivalent (GGE), and

All retail natural gas dispensers shall be labeled with the conversion factor in terms of kilograms or pounds. The label shall be permanently and conspicuously displayed on the face of the dispenser and shall have either the statement “1 Gasoline Liter Equivalent (GLE) is equal to 0.678 kg of Natural Gas” or “1 Gasoline Gallon Equivalent (GGE) is equal to 5.660 lbs of Natural Gas” according to the method of sale used.”

These statements can be found in NIST Handbook 130<sup>\*</sup>, along with the definition of “natural gas” which seems to apply only to Compressed Natural Gas, not to Liquefied Natural Gas. Handbook 130, §§3.11 and 3.12 (Engine Fuels, Petroleum Products, and Automotive Lubricants Regulations) confirm that these requirements are for CNG, rather than LNG. Similar requirements and definitions are found in Handbook 44.

During the discussions it was recognized that, although diesel and gasoline are both sold in gallon units, a gallon of diesel fuel has substantially more energy content than a gallon of gasoline. While it is convenient to use the Gasoline Gallon Equivalent unit when comparing the cost and fuel economy of gasoline-powered light-duty vehicles to equivalent natural gas vehicles, a Diesel Gallon Equivalent unit would be more useful for operators of medium and heavy-duty (usually diesel powered) vehicles. However, in 1994, the NCWM working group “agreed to defer development of a “Diesel Gallon Equivalent” until the issues related to the ‘Gasoline Gallon Equivalent’ were decided by the NCWM and agreed to meet again if additional work is necessary.”\*\* The issue of the formal definition a Diesel Gallon Equivalent (DGE) unit has not come before NCWM from that time until today, although the DGE is often used in the industry, defined as 6.31 lbs of compressed natural gas.

*Need for a Definition of a “Diesel Gallon Equivalent” Unit*

Today there are an increasing number of commercial vehicles using natural gas as a fuel, to lower emissions and Greenhouse Gases, decrease America's use of petroleum, and lower fuel costs (U.S. DOE Clean Cities Alternative Fuel Price Report for April 2012

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\* “Method of Sale Regulation,” §2.27

\*\* *Report of the 79<sup>th</sup> National Conference on Weights and Measures, 1994*, NIST Special Publication 870, p 214

shows in Table 2 ‘Overall Average Fuel Price on Energy-Equivalent Basis’ that diesel is priced at \$4.12/gal and CNG at \$2.32/gal [http://www.afdc.energy.gov/afdc/pdfs/afpr\\_apr\\_12.pdf](http://www.afdc.energy.gov/afdc/pdfs/afpr_apr_12.pdf)).

Since the NCWM’s working group deferred development of a DGE unit in 1994, there has been little call by the natural gas vehicle industry for the formalization of that unit in the sale of Compressed Natural Gas. However, the use of **Liquefied** Natural Gas (LNG) as a motor fuel has been growing (more than 350 LNG stations are being built on the nations interstate Highways) and there is significant interest in using the DGE as a unit for the sale of that fuel.

LNG as a motor fuel is used almost exclusively by commercial vehicles, most of which view diesel as the conventional alternative. Using the same logic as was used for the development of the GGE unit, the convenience of the retail customer comparing the cost and fuel economy of a natural gas vehicle to a comparable conventional vehicle, it makes sense for NCWM to now “officially” define the DGE.

Other than §3.12. Liquefied Natural Gas, in the Engine Fuels and Automotive Lubricants

Regulation section of Handbook 130, we find no specific provisions in either Handbook 44

or Handbook 130 for the retail sale of LNG as a motor fuel. However LNG is sold in

California and other states on a mass basis (by the pound), which allows for easy confirmation by weights and measures authorities. An “official” definition of the DGE as a specific mass of LNG and CNG would allow states to easily move from retail sale by pound to retail sale by DGE, simplifying the sale process for the retail customer used to dealing with “gallons of diesel” as a fuel measure.

Therefore, at this time we are asking for a definition of the Diesel Gallon Equivalent (and Diesel Liter Equivalent) units by NCWM.

*Justification of the Definition of a DGE as 6.38 Pounds of Compressed Natural Gas* Handbook 130

contains the following definitions of natural Gas as a vehicle fuel<sup>\*</sup> : **Gasoline liter equivalent (GLE).** –

Gasoline liter equivalent (GLE) means  
0.678 kg of natural gas.

**Gasoline gallon equivalent (GGE).** – Gasoline gallon equivalent (GGE) means  
2.567 kg (5.660 lb) of natural gas.

As the NCWM working group recognized during its deliberations in 1993 on the Gasoline Gallon Equivalent unit, both gasoline and natural gas can vary in their BTU content from sample to sample. The working group determined the gasoline gallon (energy) equivalent based on a gallon of Indolene (114,118 BTU/gal – lower heating value) and a survey of 6811 natural gas samples nationwide with an average of 923.7 BTU/scf (lower heating value) and a density of 0.0458172 lbs/cubic foot. This equates

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\* NIST handbook 130, 2006, Method of State Regulation, §§2.27.1.2 and 2.227.1.3; also Engine Fuels, Petroleum Products, and Automotive Lubricants Regulation, §§1.25 and 1.26.

to 20,160.551 BTU/lb. Dividing gasoline's 114.118 BTU/gal by natural gas's 20,160.551 BTU/lb gives 5.660 lbs of natural gas = 1 GGE. Similar calculations determined that a gasoline liter equivalent of natural gas equals 0.678 kg of natural gas.

Starting with 5.660 lbs of natural gas = 1 GGE and 0.678 kg of natural gas = 1 GLE, we can calculate the mass of natural gas necessary to make a DGE and a DLE by comparing the amount of energy in a gallon of diesel fuel to the amount of energy in a gallon of gasoline fuel and apply that ratio to scale up the masses of natural gas calculated for the GGE and GLE units.

Unfortunately, it is no easier today than it was in 1993 to set one energy value as representative of a unit for all gasoline, (or diesel) fuel. EPA's certification fuel has likely changed in energy content since 1993, as both gasoline and diesel fuels have been modified for improved emissions.

We recommend using the most recent Department of Energy *Transportation Energy Data Book*<sup>\*</sup>, as an authoritative reference for both gasoline and diesel fuel energy values. Taking further surveys or basing our calculations on today's EPA certification fuel only delays our action, substantially increases costs, and, in the end, provides a limited potential increase in accuracy based on one point in time. Table B.4 of the *Transportation Energy Data Book*, on the heat content of fuels lists the net energy of diesel as 128,700 BTU/Gal. The 31<sup>st</sup> Edition may be downloaded at the following site.

<http://cta.ornl.gov/data/download31.shtml>

Therefore a Diesel Gallon Equivalent of compressed natural gas is:  $(128,700 \text{ BTU/Gal} / 20,160.551$

$\text{BTU/lb}) = 6.38 \text{ lb/DGE} (2.894 \text{ kg/DGE})$  and a Diesel Liter Equivalent of compressed natural gas is:

$2.894 \text{ kg/DGE} \times 0.2642 \text{ Gal/Liter} = 0.765 \text{ kg/DLE}$

*Justification of the Definition of a DGE as 6.06 Pounds of Liquefied Natural Gas*

Cooling pipeline natural gas to  $-259^{\circ}\text{F}$  makes liquefied Natural Gas (LNG). The pipeline natural gas has the same national average composition as was determined for CNG

with a LHV of 20,160.551 BTU/lb. In order to reduce the natural gas temperature for liquefaction carbon dioxide must be removed since it would solidify in the system and

nitrogen, which remains a gas at LNG temperatures, is reduced to less than 0.5% by volume in the final product. These changes to the composition of the pipeline gas increase the LHV of LNG to 21,240 BTU/lb.

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\* Stacy C. Davis and Susan W. Diegel, Oak Ridge National Laboratory, *Transportation Energy Data Book*, Edition 31, 2012, ORNL-6987, or <http://cta.ornl.gov/data/index.shtml>



National Average Natural Gas Composition Used for GGE Standard - Applied to LNG DGE - GGE Calculation								
CNG				LNG				
Components	LHV - BTU/LB	LBS/CF	%V <sup>1</sup>	%V <sup>2</sup>	LBS/CF	%MASS	LHV	
C1	21537	0.0425	92.87	95.12	0.040425567	90.29305699	19446.41568	
C2	20394	0.0803	3.34	3.42	0.002746969	6.13552872	1251.279727	
C3	19807	0.1196	0.63	0.65	0.000771727	1.723700114	341.4132816	
i-C4	19529	0.1582	0.07	0.07	0.000113422	0.253334595	49.47371306	
n-C4	19815	0.1582	0.12	0.12	0.000194437	0.434287877	86.05414286	
i-C5	19478	0.1907	0.04	0.04	7.81272E-05	0.174502103	33.98951966	
n-C5	20485	0.1907	0.03	0.03	5.85954E-05	0.130876577	26.81006688	
C6	19403	0.0228	0.05	0.05	1.16761E-05	0.026079234	5.06015379	
N2	0	0.0744	2.07	0.50	0.000370992	0.828633789	0	
CO2	0	0.117	0.78	0.00	0	0	0	
			100.00	100.00	0.044771512	100	21240	
							Diesel <sup>3</sup> LHV=	128,700
							LNG - DGE=	6.06

<sup>1</sup> CNG national average composition of natural gas from the NCWM Laws and Regulations - CNG Working Group letter 10/18/1993 Appendix A. Conversion Factor Background

<sup>2</sup> LNG composition based on CNG composition with CO2 removed and nitrogen reduced to 0.5%

<sup>3</sup> DOE Transportation Energy Data Book Table B.4

Note: each 0.1% reduction/addition of nitrogen in LNG lowers/raises DGE by 0.01 lb

Therefore a Diesel Gallon Equivalent of LNG is:

$$128,700 \text{ BTU/lb} / 21,240 \text{ BTU/lb} = 6.06 \text{ lb/DGE} (2.749 \text{ kg/DGE})$$

and a Diesel Liter Equivalent of LNG is:

$$2.749 \text{ kg/DGE} \times 0.2642 \text{ Gal/Liter} = 0.7263 \text{ kg/DLE}$$

The attached presentation file provides an overview of the CNG and LNG processes from pipeline to dispensing along with the calculation of the LNG LHV based on the change in LNG chemical composition through the liquefaction process.

Prepared by:

Clean Vehicle Education Foundation

<http://www.cleanvehicle.org>

# Clean Vehicle Education Foundation



Proposal for CNG & LNG – DGE  
NCWM  
March 20, 2013

Douglas Horne – President

12/10/13

[www.cleanvehicle.org](http://www.cleanvehicle.org)

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## Why DGE is Now Needed by the NGV Market

- In the 1994 NCWM set GGE at 5.66 lbs but deferred the development of DGE because:

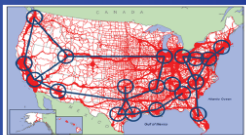
The consumer market was LD gasoline conversions



and diesel class NGVs were fleets such as transit that use private stations.



CNG Class 8



In the last twenty years the market growth has been in HD vehicles and now a national network of of public CNG and LNG - LCNG fueling is emerging

LNG Class 8



CNG HD



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## CNG and LNG Delivery Systems



## CNG DGE

### Based on 1994 NCWM GGE Standard

- The 1994 acceptance NCWM of Gasoline Gallon Equivalent (GGE) for natural gas to be equal to 5.660 lbs was based on a national weighted average composition of natural gas
  - density of 0.0458172 lbs/scf
  - LHV = 20,160.551 BTU/lb
- Using the the same natural gas composition and the LHV of diesel noted in Table B.4 of the DOE Transportation Energy Data Book
  - 128,700/20,160.551 gives the Diesel Gallon Equivalent (DGE) of 6.38 lbs
- For those NGVs that use CNG as a replacement for diesel, a DGE of CNG would be 6.38 lbs

## DGE for Vehicle Using LNG and

- As shown in the LNG delivery system slide the national average pipeline gas has a LHV of 20,160 BTU/lb and during liquefaction the inert gas constituents are reduced thus increasing the LHV to 21,240 BTU/lb
  - For those NGVs that use LNG as a replacement for diesel, a DGE of LNG would be 128,700 LHV diesel divided by 21,240 LHV of LNG equaling 6.06 lbs

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## DGE & GGE Based on LNG Composition

National Average Natural Gas Composition Used for GGE Standard - Applied to LNG DGE - GGE Calculation								
Components	CNG			LNG				
	LHV - BTU/LB	LBS/CF	%V <sup>1</sup>	%V <sup>2</sup>	LBS/CF	%MASS	LHV	
C1	21537	0.0425	92.87	95.12	0.040425567	90.29305699	19446.41568	
C2	20394	0.0803	3.34	3.42	0.002746969	6.13552872	1251.279727	
C3	19807	0.1196	0.63	0.65	0.000771727	1.723700114	341.4132816	
i-C4	19529	0.1582	0.07	0.07	0.000113422	0.253334595	49.47371306	
n-C4	19815	0.1582	0.12	0.12	0.000194437	0.434287877	86.05414286	
i-C5	19478	0.1907	0.04	0.04	7.81272E-05	0.174502103	33.98951966	
n-C5	20485	0.1907	0.03	0.03	5.85954E-05	0.130876577	26.81006688	
C6	19403	0.0228	0.05	0.05	1.16761E-05	0.026079234	5.06015379	
N2	0	0.0744	2.07	0.50	0.000370992	0.828633789	0	
CO2	0	0.117	0.78	0.00	0	0	0	
			100.00	100.00	0.044771512	100	21240	
							Diesel <sup>3</sup> LHV=	128,700
							LNG - DGE=	6.06

<sup>1</sup>CNG national average composition of natural gas from the NCWM Laws and Regulations - CNG Working Group letter 10/18/1993 Appendix A. Conversion Factor Background

<sup>2</sup>LNG composition based on CNG composition with CO2 removed and nitrogen reduced to 0.5%

<sup>3</sup>DOE Transportation Energy Data Book Table B.4

Note: each 0.1% reduction/addition of nitrogen in LNG lowers/raises DGE by 0.01 lb

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## Proposal

- CNG dispensers may dispense natural gas in two units:
  - GGE = 5.66 lbs
  - DGE = 6.38 lbs
- LNG dispensers will dispense LNG in one unit:
  - DGE = 6.06 lbs

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## Appendix G

### Agenda Item 337-1:

#### **OWM’s Technical Analysis of Agenda Item 337-1. The Following OWM Technical Comments and Recommendations Were Provided in Written Form to Members of the S&T Committee on July 15, 2015**

OWM believes it is essential to establish and follow a method of sale (MOS) for natural gas that provides uniformity, transparency, and accuracy, as has historically been the case with all other commodities offered for sale in the U.S. The community is preparing for increased sales in a fueling application (CNG) first recognized by weights and measures in the mid-1990s and a new alternative fuel application (LNG). Since the 1990s, CNG sales have been largely made in the arena of fleet operations that have invested in CNG-fueled vehicles. In these applications the very livelihood of the fleet customers rests on their being informed consumers who are intimately familiar with budgeting; making value comparisons based on mileage per unit of fuel cost; and bargaining on the price of fuel. New fueling operations opening to the general public will be represented by existing and new stations and offer service to general consumers and distance haulers. Regardless of the MOS, this new customer base will face learning curves as the drivers, the stations, and the officials become familiar with these fuels and their characteristics.

There has been much in-depth thought, consideration, and discussion of what is the most appropriate method of sale for compressed natural gas (CNG) and liquefied natural gas (LNG) vehicle fuel. Various proposals have been put forth before the NCWM for consideration of adoption into NIST Handbook 44 and NIST Handbook 130 to establish the MOS of these products. Whatever proposal is chosen, it must fully satisfy the basic principles of measurement and philosophies of weights and measures that include promoting and ensuring equity in the marketplace; traceable standards; uniformity; a basis for value comparison; transparency of the transaction; consumer protection; and fair business practices and competition.

OWM offers the following brief list of considerations based on its technical analysis of the issues surrounding this item. This brief list is followed by a more in-depth discussion of each point.

- ***Weights and Measures Principles.***  
A fundamental legal metrology principle is to ensure that equity prevails in any commercial weighing or measuring transaction. This includes ensuring that not only is a measurement based on a traceable unit of measure, but the practices surrounding the measurement and its application provide for clear and understandable transactions that facilitate value comparisons and promote fair competition. Equivalent “units” are not traceable units and their use and implementation may frustrate value comparison and affect the ability of businesses, including other types of fueling applications, to fairly compete.
- ***Sale by Mass with Supplemental Information.***  
OWM believes that the best option is to require the sale of all natural gas in mass units (kg or lb) as measured by the metering technology and as outlined in the “Mass Compromise Proposal.” This option ensures a technically correct solution, yet still provides the flexibility to provide consumers with comparison information on multiple other fuels and potentially create less confusion than permitting sales in multiple different “equivalent” values as “units” of measure. The inclusion of supplemental information is a longstanding, valid practice and can provide valuable information to assist consumers in making purchase decisions, but that information should not be used as the basis of measurement and sale.
- ***Limited Data to Support Equivalent “Units.”***  
There is limited current data to support the proposed equivalent “units” for the various fuels. Industry acknowledges that the reports/studies referenced as basis for the energy content used to arrive at the diesel equivalent values are not supported by scientific data gathered in the same manner as the natural gas data that was the basis for the GGE. In the 1990s, the weights and measures community acknowledged that fuel energy analysis was not practical and that is still the case today. However, metering technology currently

exists and has been type approved for commercial use that is capable of making traceable natural gas fuel measurements based on mass that provides an alternative to the proposed, inexact methodology. Note also that there are errors (as previously noted by OWM) in the report that should be corrected in the final report.

- ***Fixed Conversion Values Not Representative of Fuel.***  
Establishing fixed “equivalent values” does not reflect the variation in natural gas or the energy content of the fuels the “equivalents” are based upon. Fixing these values for use as a measurement unit would limit information about natural gas supplies in a consumer’s area. Some states have reported companies using different conversion factors for existing CNG applications (i.e., factors other than the 5.660 lb value established in 1994 for 1 GGE), and struggling to get uniformity in the values programmed into dispensers. Over the last two decades, a large number of CNG applications have provided services to (relatively-informed) fleet operations rather than the general public.
- ***Frustrating Value Comparisons.***  
Devices that dispense natural gas as an engine fuel will serve a broad base of customers who may need to compare natural gas multiple different fuel types, including diesel, biodiesel, gasoline, fuel ethanol, electric, hydrogen, LNG, and others not yet considered. If used as the basis of measurement, the use of different equivalent “units” (e.g., GGE, DGE, and others) at competing stations could frustrate value comparison and limit the ability to make value comparisons with multiple different fuel types.
- ***Proliferation in “Equivalent Units “and Lack of Uniformity.***  
Permitting use of an approximate value as the legal unit of measurement for trade encourages the creation of additional equivalent units for fuels and other products. This will lead to a lack of uniformity; affect the ability of businesses to compete; and lead to consumer confusion and frustrate value comparison, potentially discouraging the use of alternative fuels. Unlike most of the world, the U.S. is creating a new industry practice through the usage of new terms based on marketing practices rather than using a formal, technically sound approach, potentially putting U.S. industry at a disadvantage internationally.
- ***Impact on Existing Equipment.***  
Existing NTEP Certificates of Conformance issued for metering systems dispensing LNG only address dispensers displaying in mass. The impact on the continued acceptance of this equipment including costs and the need for re-evaluation should be considered in discussing any proposed changes.
- ***Conflict with L&R Proposals.***  
The S&T proposals in this item were modified during the January 2015 Interim Meeting. However, corresponding modifications were not made in all of the L&R proposals on natural gas. Consequently, there are conflicts between the S&T and L&R proposals that could lead to confusion in the marketplace if both sets of proposals are adopted as currently presented.
- ***LNG Code Development – Additional Work.***  
Additional work is needed to modify NIST Handbook 44 to fully recognize LNG applications so that there is a uniform basis for inspection/test and type approval procedures. NIST is developing a plan to present to the community for the development of proposed requirements to address LNG measuring devices.
- ***Additional Action Needed if the Current Proposal is Adopted.***  
Some states were encouraged to enact legislation that included specific DGE values for both CNG (6.380 lb) and LNG (6.06 lb) in their laws and regulations and may already have installations in use where fuel deliveries are in equivalent “units.” These jurisdictions should revisit their policies and field sites to determine if the fuel equivalent values conflict with those included in the current proposals.

Additional details and information on these issues are included below.

#### ***Weights and Measures Principles.***

A fundamental legal metrology principle is to ensure that equity prevails in any commercial weighing or measuring transaction. The delivery of full weight or measure and the elimination of fraud and misrepresentation (intentional



and unintentional) have been issues in commercial transactions throughout history. The weights and measures official stands between the buyer and the seller to help ensure fair, accurate, and transparent transactions and must represent the best interests of both parties. Not only does the official verify the accuracy of a commercial measurement, but the official must consider the business practices surrounding the transaction to ensure that consumers fully understand their basis and that competing businesses have a level playing field. Businesses offering competing fuel types may be put at a disadvantage and have difficulty competing with sales based on a non-traceable measurement “unit.”

To ensure the accuracy of commercial measurement transactions, those transactions must be based on units of measurement traceable to the SI. CNG and LNG measurement and sales in known and traceable units of mass (e.g., kilogram or pound) is not only verifiable, but also provides for clear and transparent transactions for consumers and businesses; can be supported and provide for traceable measurements from a metrological standpoint; and provides a fair basis for businesses to compete.

The proposed equivalent “units” are not traceable units. Equivalent units should only be presented as supplemental information; their purpose, to provide consumers with additional information to help facilitate an informed purchasing decision. They must not be used as the basis for the measurement transaction. While not intended to mislead consumers, these equivalents may give the false impression that they accurately represent the energy content of the specific product being dispensed relative to another fuel, which is not the case. Consumers and businesses alike rely on the use of traceable units as the basis for transactions to ensure that value comparisons can be made (in this case among different fuel types as well as different businesses) and that businesses are competing based on the same standards. Marketing practices, such as the creation of equivalent units, should be used to only promote and inform consumers about features of a potential purchase.

***Sale by Mass with Supplemental Information.***

The use of *supplemental* information to assist consumers in making value comparisons in the process of making a purchase decision is a widely accepted practice within the weights and measures community. For example, laundry detergent is often advertised with information about the approximate number of loads that might be obtained from the product. The actual number of loads may vary based on factors such as the characteristics of the water used; how dirty the clothes are that are being washed; how fully the washing machine is loaded; the efficiency of the machine; and even the quality of the detergent. What does not vary is the *quantity* of the product that is received; the quantity is required to be provided in traceable units of measure such as kilograms or pounds (for dry detergent) and liters or gallons (for liquid detergent) and that can be verified by officials and service providers during routine testing. And it is this verifiable quantity information that consumers can depend on as being accurate representations of the amount of product received in a purchase and can, thus, be used to make an informed value comparison among competing products. This quantity information is also what helps to ensure manufacturers and businesses are provided with a level playing field and the ability to fairly compete since marketing, advertising, and the sales transaction itself must be based on the same standard, verifiable, measured quantities for all businesses.

There are many other examples of products where supplemental information is provided such as paint that is accompanied by information about the approximate number of square feet that might be covered; fertilizer with the approximate area of lawn; and even some food products with the approximate number of servings that a consumer might expect for use in a recipe. There are also examples in the transportation arena where supplemental information is provided outside of the measurement/sales transaction. For example, mileage estimates are provided to consumers making new vehicle purchases and this information can also be found on transportation websites to assist consumers in making not only vehicle purchase decisions, but ongoing comparisons of fuel types. As with the laundry detergent example and other examples, actual results may vary. A specific vehicle may actually travel less or more than the estimated miles per gallon based on the speed of the vehicle, the number of stops, the use of air conditioning, whether the windows are up or down, the pressure in the tires, and the driving habits of the operator.

The proposed equivalent “units” for natural gas provide supplemental information that can be useful to consumers, but like other supplemental information, they provide only an approximation and, if used as the basis for measurement, would limit information provided to consumers about comparison with other fuel types. Under the “Mass Compromise Proposal,” customers could still be provided with supplemental information through mechanisms such as pump toppers that provide information about approximate energy values that correspond to deliveries indicated in mass. As an alternative to pump toppers, this information could be included on labels or on websites such as those that already provide information about fuel economy. This also opens the opportunity for the development of “apps” that might

enable a consumer to use a smart phone to quickly calculate and compare a purchase (or potential purchase) with *multiple* fuel types. And, as with mileage estimates, this information could be posted on transportation websites and possibly even updated more easily as supplies change. Using mass as the basis for measurement and sale might also help reduce complaints from suppliers concerning the accuracy of equivalent values used to represent deliveries of their product rather than the metered mass value. It has been acknowledged that “The Mass Compromise Proposal” might be more comprehensive and palatable if it also included corresponding street price signage requirements in NIST HB 130.

***Limited Current Data to Support Proposed Equivalency Values.***

In the 1990s, the weights and measures community acknowledged that fuel energy analysis was not practical at the retail level. The scientific community at NIST has indicated that sales of fossil and alternative fuels by energy content is appropriate when the constituent values of a fuel offered for sale can actually be determined at the time of sale. The energy a buyer can glean from fuel right now must factor in the variables in fuel supplies (well location, seasonal blends, etc.), engine efficiency, and vehicle and road conditions. Industry acknowledges that the reports/studies referenced as basis for the energy content used to arrive at the diesel equivalent values are not supported by scientific data gathered in the same manner as the natural gas data that was the basis for the GGE. The proposal currently presented in the “Item Under Consideration” sets a new precedent for a MOS using an inexact method for making fuel comparisons by averaging a fuel’s energy content and then further averaging that information to arrive at numerical values used in the determination of a fuel’s final cost. However, metering technology currently exists and has been type approved for commercial use that is capable of making traceable natural gas fuel measurements based on mass that provides an alternative to this inexact methodology.

The fuel property data in the current proposals is drawn from a transportation study rather than the agreed-upon process used in 1994. Additionally, the write up on the process in the current and previous S&T and L&R Interim Report Appendices includes mistakes such as the statement “Dividing gasoline’s 114.118 BTU/gal by natural gas’s 20,160.551 BTU/lb gives 5.660 lb of natural gas = 1 GGE,” which, when calculated actually equals 0.005660 lb. This information becomes the historical record of the process followed by the NCWM and should be corrected regardless of the overall decisions made by the NCWM on this issue.

The validity of the data supporting the process by which the conversion factors were derived should be vetted; undergo peer review; and be widely distributed. OWM suggested that FALS, with its standards network and history of expertise in fuel quality issues and field and laboratory standards as well as methods of fuel analysis, might be the best candidate to take on the necessary tasks of validating the values and the process used to arrive at the conversion factors. In January 2015, FALS tasked a small group of NCWM members to review the fuel data to determine if the data supports the conversion values in the proposals or some other numerical values and to report the group’s findings. Since January 2015, that sub group has met multiple times and recently (within the last two weeks) provided recommendations and information to be considered. OWM is currently reviewing this information and expects to provide its observations to the Committee prior to the 2015 NCWM Annual Meeting.

***Fixed Conversion Factors Not Representative of Fuel.***

Those in support of the proposed DGE/DLE have stated that gas supplies have remained relatively unchanged since the establishment of the GGE. However, others in industry, such as one measuring device manufacturer, have referenced the high degree of variability of the product. OWM notes there are opposing industry claims from the Clean Vehicle Education Foundation (CVEF) indicating that the heating value of natural gas is basically unchanged in 21 years, whereas Emerson Process Management stated in the NCWM 2014 Online Position Forum on Item 337-6 that “the specific gravity of LNG can vary as much as 12%, and that the constituents in natural gas (LNG) vary significantly and can be manipulated, thus impacting the measurement of the product. Although those comments were submitted under a separate item, the product being discussed, i.e., natural gas, is the same. The variability in gasoline was acknowledged in the 1992-1994 study and was so much so that “indolene” a standardized test gasoline that is free of additives, was used to establish the average energy content values for a gallon of gasoline. Even the previously agreed upon data may need revisiting given today’s gasoline can contain as much as 10 % ethanol. This point also needs to be considered in examining the data used to develop the proposed equivalent “units.”

Just like gasoline and diesel (the fuels on which the “equivalent values” are based), the energy content of natural gas varies. CNG and LNG are very different products than gasoline and diesel. CNG and LNG do not have the same physical characteristics as gasoline or diesel and they are measured using a different metering technology. Although

vehicle fuel dispensers may look similar externally, a CNG or LNG dispenser has the capability to indicate the fuel delivery in mass units; in fact, this is a requirement for testing purposes.

Some have claimed that use of the GGE conversion factor value established in the 1990s is accepted without complaint. OWM has received periodic complaints and concerns over the years from fuel suppliers having no knowledge of the decisions made in the 1990s to adopt a conversion factor (5.660 lb CNG/gallon of gasoline) based on the fuel supply having a lower energy content. Some states have reported companies using different conversion factors for existing CNG applications (i.e., factors other than the 5.660 lb value established in 1994 for 1 GGE), and weights and measures officials struggle to get uniformity in the values programmed into dispensers in the field. Over the last two decades, a large number of CNG applications have not provided services to the general public (many provided service to fleet operations instead) and, therefore, may not have been routinely regulated by weights and measures. It should also be noted that the 1994 entry of what was then a fledgling industry into legal metrology applications was somewhat contentious because of the use of an approximate conversion factor used to calculate fuel delivery and sales in equivalent volume units. Furthermore, the factor was and remains based on comparison with the averaged energy content of a conventional fuel resulting in a method of sale other than the originally debated sale of fuel by mass units.

***Frustrating Value Comparisons.***

Devices that dispense natural gas as an engine fuel will serve a broad base of customers who may need to compare natural gas multiple different fuel types, including diesel, biodiesel, gasoline, fuel ethanol, electric, hydrogen, LNG, and others not yet considered. If used as the basis of measurement, the use of different equivalent “units” (e.g., GGE, DGE, and others) on different dispensers at competing stations could frustrate value comparison and limit the ability for consumers to make value comparisons with multiple different fuel types. The weights and measures community must carefully consider the most appropriate means to provide sufficient information to customers attempting to make a value comparison of natural gas with these different fuel types, whether at the same station or stations on adjacent street corners.

Since there are multiple different fuel types, it may be difficult to pick a single equivalent “units” that would provide adequate information to the majority of consumers and avoid confusing others. For example, a dispenser might serve vehicles that are conventionally powered by diesel or gasoline fuel. The consumer who switches from a diesel- fueled vehicle may need to make comparisons with diesel fuel. The consumer who switches from a gasoline- powered vehicle may need to make comparisons with gasoline. Those who run flex-fueled vehicles may want to make ongoing comparisons depending on the most current fuel formulation. A natural gas dispenser may also serve consumers who run a flex fueled vehicle that utilizes multiple fuel types. If an equivalent “unit” for one fuel type is used as the basis for the transaction, this may lead to confusion for consumers who have the need to compare with other fuel types. Likewise, a proliferation of equivalent units at the dispenser may not only lead to consumer confusion and frustrate value comparison, but may also have the unintended effect of discouraging the use of natural gas as an alternative fuel.

Consumers may have a variety of reasons for making a decision to purchase a vehicle(s) that runs on natural gas rather than conventional petroleum product or vice versa, but one common denominator is the cost of vehicle fuel as part of the operational expense of a vehicle or fleet. This figure can also be used to determine short- and long-term fuel costs and, at some point, be used to calculate fuel cost per mile (or kilometer). The ability to look at fuel costs in this manner is more accurately represented by what the meter measured. Consumers evaluating the driving distance or mileage consider the size of the fuel tank (which can be listed in any unit of measurement), the vehicle engine efficiency for a particular fuel type, highway driving conditions, vehicle load and a number of other factors to truly determine their individual driving range. The fuel efficiency is one determining factor under consideration prior to a purchase and when purchasing their next vehicle. For the first purchase of a vehicle type the buyer will already have done this “homework” before making such a large investment, even researching the convenience of fueling a vehicle. Once a consumer has purchased a dedicated fueled vehicle, the need to make value comparisons are expected to diminish sharply.

A point that has been raised by some in the community is whether or not “equivalent values” are as necessary as they might have been at one time to encourage consumer acceptance of natural gas as an alternative fuel. For example, the SWMA questioned whether, once a consumer has purchased a vehicle he or she has the need to make ongoing value comparisons or whether this information is more useful prior to purchasing a vehicle. Given the concerns about

consumer confusion with a potential proliferation of “equivalent” values at the dispenser, perhaps requiring mass units on the dispenser (with supplemental information about equivalents) is a more appropriate approach.

***Proliferation in “Equivalent Units “and Lack of Uniformity.***

OWM and others in the community are concerned that permitting use of an approximate value as the legal unit of measurement for trade encourages the creation of additional equivalent units for fuels and other products and will lead to a lack of uniformity and affect the ability of businesses to compete. For example, OWM has already received an inquiry about the possibility of an equivalent “unit” for LPG. A proliferation of different equivalent “units” in the marketplace may not only lead to consumer confusion and frustrate value comparison, but may also have the unintended effect of discouraging the use alternative fuels.

When the measurement transaction departs from traceable, verifiable units of measure, businesses will ultimately have difficulty fairly competing and consumers will become frustrated. For natural gas retail motor-fuel applications, the United States, unlike most of the world, is also creating a new industry practice through the usage of new terms based on *marketing* practices rather than using a formal, technically sound approach. The U.S. system continues to move away from standards applied to similar commercial applications in the international community, which could, in the long term be detrimental to U.S. industry.

***Impact on Existing Equipment.***

Currently, there are six LNG dispensers with NCWM NTEP Certificates of Conformance (CC). These CCs are issued to Bennett Pump Co., Cryostar, Chart Industries, and NorthStar, Inc., to dispensers that display in mass, were tested based on flowrates in pounds per minute, and in several cases depicted on the CC with indications in the pound unit of measurement. It isn’t clear whether or not any testing was conducted in conjunction with these CCs on the use of equivalent “units” and the impact on these CCs should be considered, including the need to retest and reissue these CCs.

***Conflict with the L&R Proposal***

The joint efforts of the S&T and L&R Committees and the subsequent work of the Natural Gas Steering Committee and Natural Gas Fuels Equivalent Values Work Group are to be commended. Having reviewed so many iterations of handbook language, the collaborative work of the two committees may have taken an unintended direction since the wording in each committee’s proposal differs and may not be aligned as originally intended.

The most current versions of the S&T and L&R proposals conflict with one another. The S&T proposal references permissible indications of CNG dispensed as an engine fuel in terms of the gasoline gallon equivalent (GGE) or diesel gallon equivalent (DGE) or in mass units. It does not include references to a diesel liter equivalent (DLE) or gasoline liter equivalent (GLE). The L&R proposal, in addition to GGE, DGE, or mass units, also recognizes indications in GLE and DLE. If the two proposals were to be adopted as written, this could create confusion regarding the appropriate action to take if a retail motor-fuel dispenser (RMFD) is set up to dispense CNG in gasoline liter or diesel liter equivalents.

While OWM recognizes that industry requested references to DLE and GLE be removed from the S&T proposal based on current trade practices, it is not clear if the S&T proposal as written was intended to restrict the sale of CNG in mass units to the pound, or, if kilogram units would still be permitted given that the changes proposed to paragraph S.5.2. require the gallon volume equivalent (for diesel or gasoline, whichever the case) to be marked on the dispenser. OWM notes that metric units are still legally permissible in the U.S. However, recognizes, as specified in the “Foreword” to NIST Handbook 44, that in some cases, where trade practice is restricted to the use of U.S. customary units, some requirements in Handbook 44 may only specify U.S. Customary units until the NCWM achieves a broad consensus on the permitted SI units. In this case, since these equivalent “units” are not actual recognized, traceable units of measure, this may not create a conflict, but OWM wants to be sure that the legality of metric units is understood. Additionally, caution should be taken to avoid a situation where the dispenser is set to measure in kilograms, but the dispenser is marked with an equivalent unit based on gallons rather than on liters since this would lead to consumer confusion.

With respect to the differences between the S&T and L&R proposals, OWM has developed a table titled “Discrepancies in the 2015 CNG and LNG S&T and L&R Proposals to Change HB 44 and HB130” and included it at the end of its analysis of this agenda item. The table provides recommendations based on the assumption that the

S&T proposals reflect the preferences of both Committees -- which may or may not be the case -- based on input received at the NCWM Interim Meeting and discussions among the two Committees. That is, to remedy any conflicts in the two proposals, it is suggested that the L&R HB 130 proposals be further modified to align that language with the corresponding S&T proposals for changes to language in HB 44.

With respect to the proposal’s current provision of allowing states the option of choosing between mass units and volume equivalent units, OWM is concerned that if adopted, this might have the effect of dividing the country into a patchwork of different areas where natural gas dispensed as an engine fuel is offered for sale and sold in one of two acceptable methods, depending on each state’s preference for one of those methods. If a state chooses to allow both units, such confusion could also arise among competing businesses in the same state. If this were to occur, consumers in need of purchasing the product, especially those who regularly travel over state lines, such as interstate truckers, could find it very difficult to make value comparisons of the product when having to refuel in different parts of the country that offer the product for sale in different, yet, legally-acceptable units.

OWM notes, too, that whereas the current proposal addresses the marking of supplemental fuel comparison information on the dispenser, neither the S&T or L&R proposals address the posting of advertised prices on street signs visible from the road, which are most often used by consumers in deciding where to refuel. Thus, the refueling stations in one particular state could advertise prices by the pound on the street sign, whereas, the refueling stations in one or more of the states adjoining it could advertise prices by volume equivalent units on the street sign. These two differing, yet, seemingly acceptable means of advertising might favor the refueling stations in some states over others just by virtue of the units in which the prices are advertised. Believing that the current proposal might pose a conflict with a key NIST OWM responsibility (i.e., to promote uniform standards of weights and measures to facilitate commerce), OWM continues to support the sale of natural gas by mass; permitting information on equivalent energy “units” to be displayed as “supplemental fuel comparison information.”

***LNG Code Development – Additional Work.***

Additional work is needed to modify NIST Handbook 44 to fully recognize LNG applications so that there is a uniform basis for inspection/test and type approval procedures. Currently, the only mention of LNG is in NIST HB 44 Section 3.34 Cryogenic Liquid-Measuring Devices Code in paragraph A.2.(c) which specifies that the code does not apply to devices used solely for dispensing LNG. Given an LNG RMFD may be equipped with either mass flow metering or possibly other measurement technology, the application of multiple codes might occur in the test and inspection of these devices. NIST is developing a plan to present to the community for the development of proposed requirements to address LNG measuring devices.

***Additional Action Needed if the Current Proposal is Adopted.***

Some States were encouraged to enact legislation that included specific DGE values for both CNG (6.380 lb) and LNG (6.06 lb) in their laws and regulations and may already have installations in use where fuel deliveries are in equivalent units. These jurisdictions should revisit their policies and field sites to determine if the fuel equivalent values conflict with those included (CNG 6.384 lb and LNG 6.059 lb) in the proposals before the July 2015 NCWM. The system allows for differences so that a jurisdiction can meet its special local needs, so we expect there will be exceptions and slight variations, but not to the designated value of a measurement unit. This work should be done in conjunction with other state and local regulators that overlap in regulating a commodity and represent different facets of the industry (suppliers, equipment OEMs, fuel tax bureau, etc.) to provide due process and disseminate information about tentative and approved code requirements.

<b>Discrepancies in the 2015 CNG and LNG S&amp;T and L&amp;R Proposals to Change HB 44 and HB 130</b>	
The recommendations listed below identify changes needed to the L&R proposals to align them with those in the S&T proposals. This makes the assumption that the S&T proposals reflect the preferences of both Committees -- which may or may not be the case. The following changes would remedy any conflicts between the S&T and L&R proposals and align the proposed changes to HB 44 with proposed changes to HB 130.	
232-4 V Section 2.27 Retail Sales of Natural Gas Sold as a Vehicle Fuel	
2.27.1.2 Gasoline...(GLE)	S&T is deleting all references to the term “gasoline liter equivalent (GLE)” and any corresponding definition for GLE in HB 44. This was done to avoid perpetuating or creating new non-traceable SI equivalent units.
2.27.1.4. Diesel ...(DLE)	S&T does not propose to include a definition for the term “diesel liter equivalent (DLE)” in its corresponding Agenda Item 337-1. This was done to avoid perpetuating or creating new non-traceable SI equivalent units. Remove the term “diesel liter equivalent (DLE)” from the HB 130 paragraph.
2.27.2.1. Method of ....Sale	S&T proposes to delete all references to the term GLE and any corresponding definition for GLE in HB 44. S&T does not include a new definition for the term “diesel liter equivalent” in its corresponding Agenda Item 337-1. Remove both terms from the HB 130 paragraph.
2.27.2.2. Dispenser Labeling....Gas	S&T does not propose to include a new definition for the term “diesel liter equivalent (DLE)” in its corresponding Agenda Item 337-1. This was to avoid perpetuating or creating new non-traceable SI equivalent units. Remove the term diesel liter equivalent (DLE) from the HB 130 paragraph.
2.27.2.3 Method....Sale	S&T does not propose to include a new definition for the term “diesel liter equivalent” in its corresponding Agenda Item 337-1. This was to avoid perpetuating or creating new non-traceable SI equivalent units. Remove the term “diesel liter equivalent (DLE)” from the HB 130 paragraph.
2.27.2.4. Dispenser Labeling...Gas	S&T will not include a new definition for the term diesel liter equivalent in its corresponding Agenda Item 337-1. This was done to avoid perpetuating or creating new non-traceable SI equivalent units. Remove the term diesel liter equivalent (DLE) from the HB 130 paragraph.
237-1 V .... Section 3.11 ....Compressed Natural Gas (CNG)	
3.11.2.2.2. Conversion Factor	Keep most of the current HB 130 text, but delete the text “either,” and “1 Gasoline Liter Equivalent (GLE) is equal to 0.678 kg of Natural Gas,” and amend the word “statements” to singular form. S&T is deleting all references to the term GLE and any corresponding definition for GLE in HB 44. This was done to avoid perpetuating or creating new non-traceable SI equivalent.
337-1 V Appendix D.... Natural Gas	
Item Title	Delete “DLE” from the title; it is no longer being addressed even though prior to January 2015 the term was being proposed as a new unit.
gasoline gallon equivalent (GGE)	The proposed HB 44 definition for “GGE” does not recognize SI mass units; whereas the definition for “GGE” in HB 130 specifies in 2.27.1.3. that the term “means 2.567 kg (5.660 lb).” As written, the HB 44 proposal does not meet the HB mandate to promote the SI system.

## Appendix H

### Item 360-5:

#### Electric Vehicle Fueling and Submetering Draft Code

This draft code replaces the version of the code included in the Committee’s 2014 Final Report. This version was developed by the USNWG and has been reviewed and forwarded to NCWM by each of the regional associations for national consideration. The submitter, the USNWG, and all four regionals propose that this version be considered for voting in July 2015.

### Draft NIST Handbook 44 Device Code Requirements for Electric Vehicle Fueling Systems

#### SECTION 3.40. ELECTRICITY-MEASURING DEVICES – TENTATIVE CODE

This tentative code has only a trial or experimental status and is not intended to be enforced. The requirements are designed for study prior to the development and adoption of a final code. Officials wanting to conduct an official examination of an Electric Vehicle Supply Equipment (EVSE) or system are advised to see paragraph G-A.3. Special and Unclassified Equipment.

(Tentative Code Added 20XX)

#### A. APPLICATION

**A.1. General.** – This code applies to devices, accessories, and systems used for the measurement of electricity dispensed in vehicle fuel applications wherein a quantity determination or statement of measure is used wholly or partially as a basis for sale or upon which a charge for service is based.

**A.2. Exceptions.** – This code does not apply to:

- (a) The use of any measure or measuring device owned, maintained, and used by a public utility or municipality only in connection with measuring electricity subject to the authority having jurisdiction such as the Public Utilities Commission.
- (b) Electric Vehicle Supply Equipment (EVSEs) used solely for dispensing electrical energy in connection with operations in which the amount dispensed does not affect customer charges or compensation.
- (c) The wholesale delivery of electricity.

**A.3. Additional Code Requirements.** – In addition to the requirements of this code, Electricity-Measuring Devices shall meet the requirements of Section 1.10. General Code.

**A.3.1. Electric Vehicle Supply Equipment (EVSE) with Integral Time-Measuring Devices.** – An EVSE that is used for both the sale of electricity as vehicle fuel and used to measure time during which services (e.g., vehicle parking) are received. These devices shall also meet the requirements of Section 5.55. Timing Devices.

**A.4. Type Evaluation.** – The National Type Evaluation Program (NTEP) will accept for type evaluation only those EVSEs that comply with all requirements of this code and have received safety certification by a Nationally Recognized Testing Laboratory (NRTL).

## S. SPECIFICATIONS

### S.1. Primary Indicating and Recording Elements.

**S.1.1. Electric Vehicle Supply Equipment (EVSE).** – An EVSE used to charge electric vehicles shall be of the computing type and shall indicate the electrical energy, the unit price, and the total price of each transaction.

- (a) EVSEs capable of applying multiple unit prices over the course of a single transaction shall also be capable of indicating the start and stop time, the total quantity of energy delivered, the unit price, and the total price for the quantity of energy delivered during each discrete phase corresponding to one of the multiple unit prices.
- (b) EVSEs capable of applying additional fees for time-based and other services shall also be capable of indicating the total time measured; the unit price(s) for the additional time based service(s); the total computed price(s) for the time measured; and the total transaction price, including the total price for the energy and all additional fees.

**S.1.2. EVSE Indicating Elements.** – An EVSE used to charge electric vehicles shall include an indicating element that accumulates continuously and displays, for a minimum of 15 seconds at the activation by the user and at the start and end of the transaction, the correct measurement results relative to quantity and total price. Indications shall be clear, definite, accurate, and easily read under normal conditions of operation of the device. All indications and representations of electricity sold shall be clearly identified and separate from other time-based fees indicated by an EVSE that is used for both the sale of electricity as vehicle fuel and the sale of other separate time-based services (e.g., vehicle parking).

**S.1.2.1. Multiple EVSEs Associated with a Single Indicating Element** - A system with a single indicating element, for two or more EVSEs, shall be provided with means to display information from the individual EVSE(s) selected or displayed, and shall be provided with automatic means to indicate clearly and definitely which EVSE is associated with the displayed information.

### S.1.3. EVSE Units.

**S.1.3.1. EVSE Units of Measurement.** –EVSEs used to charge electric vehicles shall be indicated and recorded in megajoules (MJ) or kilowatt-hours (kWh) and decimal subdivisions thereof.

**S.1.3.2. EVSE Value of Smallest Unit.** – The value of the smallest unit of indicated delivery by an EVSE, and recorded delivery, if the EVSE is equipped to record, shall be 0.005 MJ or 0.001 kWh.

**S.1.3.3. Values Defined.** – Indicated values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof. An indication of “zero” shall be a zero digit for all displayed digits to the right of the decimal mark and at least one to the left.

### S.2. EVSE Operating Requirements.

#### S.2.1. EVSE Return to Zero.

- (a) The primary indicating and the primary recording elements of an EVSE used to charge electric vehicles, if the EVSE is equipped to record, shall be provided with a means for readily returning the indication to zero either automatically or manually.
- (b) It shall not be possible to return primary indicating elements, or primary recording elements, beyond the correct zero position.



**S.2.2. EVSE Indicator Zero Reset Mechanism.** – The reset mechanism for the indicating element of an EVSE used to charge electric vehicles shall not be operable during a transaction. Once the zeroing operation has begun, it shall not be possible to indicate a value other than the latest measurement, or “all zeros,” blank the indication, or provide other indications that cannot be interpreted as a measurement during the zeroing operation.

**S.2.3. EVSE Provision for Power Loss.**

**S.2.3.1. Transaction Information.** – In the event of a power loss, the information needed to complete any transaction (i.e., delivery is complete and payment is settled) in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable through one of the means listed below or the transaction shall be terminated without any charge for the electrical energy transfer to the vehicle:

- at the EVSE;
- at the console, if the console is accessible to the customer;
- via on site internet access; or
- through toll-free phone access.

For EVSEs in parking areas where vehicles are commonly left for extended periods, the information needed to complete any transaction in progress at the time of the power loss shall be determinable through one of the above means for at least eight hours.

**S.2.3.2. Transaction Termination.** – In the event of a power loss, either: (a) the transaction shall terminate at the time of the power loss; or (b) the EVSE may continue charging without additional authorization if the EVSE is able to determine it is connected to the same vehicle before and after the supply power outage. In either case, there must be a clear indication on the receipt provided to the customer of the interruption, including the date and time of the interruption along with other information required under S.2.6. EVSE Recorded Representations.

**S.2.3.3. User Information.** – The EVSE memory, or equipment on the network supporting the EVSE, shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.

**S.2.4. EVSE Indication of Unit Price and Equipment Capacity and Type of Voltage.**

**S.2.4.1. Unit Price.** – An EVSE shall be able to indicate on each face the unit price at which the EVSE is set to compute or to dispense at any point in time during a transaction.

**S.2.4.2. Equipment Capacity and Type of Voltage.** – An EVSE shall be able to conspicuously indicate on each face the maximum rate of energy transfer (i.e., maximum power) and type of current associated with each unit price offered (e.g., 7 kW AC, 25 kW DC, etc.).

**S.2.4.3. Selection of Unit Price.** – When electrical energy is offered for sale at more than one-unit price through an EVSE, the selection of the unit price shall be made prior to delivery through a deliberate action of the purchaser to select the unit price for the fuel delivery. Except when the conditions for variable price structure have been approved by the customer prior to the sale, a system shall not permit a change to the unit price during delivery of electrical energy.

**Note:** When electrical energy is offered at more than one-unit price, selection of the unit price may be through the deliberate action of the purchaser: 1) using controls on the EVSE; 2) through the purchaser’s use of personal or vehicle mounted electronic equipment communicating with the system; or 3) verbal instructions by the customer.

**S.2.4.4. Agreement Between Indications.** – All quantity, unit price, and total price indications within a measuring system shall agree for each transaction.

**S.2.5. EVSE Money-Value Computations.** – An EVSE shall compute the total sales price at any single-purchase unit price for which the electrical energy being measured is offered for sale at any delivery possible within either the measurement range of the EVSE or the range of the computing elements, whichever is less.

**S.2.5.1. Money-Value Divisions Digital.** – An EVSE with digital indications shall comply with the requirements of paragraph G-S.5.5. Money-Values, Mathematical Agreement, and the total price computation shall be based on quantities not exceeding 0.5 MJ or 0.1 kWh.

**S.2.5.2. Auxiliary Elements.** – If a system is equipped with auxiliary indications, all indicated money value and quantity divisions of the auxiliary element shall be identical with those of the primary element.

**S.2.6. EVSE Recorded Representations.** – a receipt providing the following information shall be available through a built-in or separate recording element at the completion of all transactions:

- (a) the total quantity of the energy delivered with unit of measure;
- (b) the total computed price of the energy sale;
- (c) the unit price of the energy; (for systems capable of applying multiple unit prices for energy during a single transaction, the following additional information is required):
  - (1) the start and stop time of each phase during which one of the multiple unit prices was applied;
  - (2) the unit price applied during each phase;
  - (3) the total quantity of energy delivered during each phase;
  - (4) the total purchase price for the quantity of energy delivered during each phase;
- (d) the maximum rate of energy transfer (i.e., maximum power) and type of current (e.g., 7 kW AC, 25 kW DC, etc.);
- (e) any additional separate charges included in the transaction (e.g., charges for parking time) including:
  - (1) the time and date when the service ends and the time and date when the service begins; or the total time interval purchased, and the time and date that the service either begins or ends;
  - (2) the unit price applied for the time-based service;
  - (3) The total purchase price for the quantity of time measured during the complete transaction;
- (f) the final total price of the complete transaction including all items;
- (g) the unique EVSE identification number;
- (h) the business name; and
- (i) the business location.

For systems equipped with the capability to issue an electronic receipt, the customer may be given the option to receive the receipt electronically (e.g., via cell phone, computer, etc.).

**S.2.7. Indication of Delivery.** – The EVSE shall automatically show on its face the initial zero condition and the quantity delivered (up to the capacity of the indicating elements).

**S.3. Design of Measuring Elements and Measuring Systems.**

**S.3.1. Metrological Components.** – An EVSE measuring system shall be designed and constructed so that metrological components are adequately protected from environmental conditions likely to be detrimental to accuracy. The system shall be designed to prevent undetected access to adjustment mechanisms and terminal blocks by providing for application of a physical security seal or an audit trail.

**S.3.2. Terminals.** – The terminals of the EVSE system shall be arranged so that the possibility of short circuits while removing or replacing the cover, making connections, or adjusting the system, is minimized.

**S.3.3. 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) each individual measurement element;
- (b) any adjustable element for controlling voltage or current when such control tends to affect the accuracy of deliveries;
- (c) any adjustment mechanism that corrects or compensates for energy loss between the system and vehicle connection; and
- (d) any metrological parameter that detrimentally affects the metrological integrity of the EVSE or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal. Audit trails shall use the format set forth in Table S.3.4. Categories of Device and Methods of Sealing.

<b>Table S.3.4. Categories of Device and Methods of Sealing</b>	
<b>Categories of Device</b>	<b>Method 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 EVSE or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual EVSEs at a location. If the counters are located in the system controller rather than at the individual EVSE, means must be provided to generate a hard copy of the information through an on-site device.</p>
<p><b>Category 3:</b> Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>	<p>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the EVSE or through another on-site device. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the EVSE, but not more than 1000 records are required. (<b>Note:</b> Does not require 1000 changes to be stored for each parameter.)</p>

**S.3.4. Data Storage and Retrieval.**

- (a) EVSE data accumulated and indicated shall be unalterable and accessible.
- (b) Values indicated or stored in memory shall not be affected by electrical, mechanical or temperature variations, radio-frequency interference, power failure, or any other environmental influences to the extent that accuracy is impaired.
- (c) Memory and/or display shall be recallable for a minimum of three years. A replaceable battery shall not be used for this purpose.

**S.3.5. Temperature Range for System Components.** – EVSEs shall be accurate and correct over the temperature range of – 40 °C to + 85 °C (– 40 °F to 185 °F). If the system or any measuring system components are not capable of meeting these requirements, the temperature range over which the system is capable shall be stated on the NTEP CC, marked on the EVSE, and installations shall be limited to the narrower temperature limits.

**S.4. Connections.**

**S.4.1. Diversion of Measured Electricity.** – No means shall be provided by which any measured electricity can be diverted from the measuring device.

**S.4.1.1. Unauthorized Disconnection.** – Means shall be provided to automatically terminate the transaction in the event that there is an unauthorized break in the connection with the vehicle.

**S.4.2. Directional Control.** – If a reversal of energy flow could result in errors that exceed the tolerance for the minimum measured quantity, effective means, automatic in operation to prevent or account for the reversal of flow shall be properly installed in the system. (See N.3. Minimum Test Draft (Size).)

**S.5. Markings.** – The following identification and marking requirements are in addition to the requirements of Section 1.10 General Code, paragraph G-S.1. Identification.

**S.5.1. Location of Marking Information; EVSE.** – The marking information required in General Code, paragraph G-S.1. Identification shall appear as follows:

- (a) within 60 cm (24 in) to 150 cm (60 in) from ground level;
- (b) on a portion of the EVSE that cannot be readily removed or interchanged (e.g., not on a service access panel).

**S.5.2. EVSE Identification and Marking Requirements.** – In addition to all the marking requirements of Section 1.10 General Code, paragraph G-S.1. Identification, each EVSE shall have the following information conspicuously, legibly, and indelibly marked:

- (a) voltage rating;
- (b) maximum current deliverable;
- (c) type of current (AC or DC or, if capable of both, both shall be listed);
- (d) minimum measured quantity (MMQ); and
- (e) temperature limits, if narrower than and within  $-20\text{ }^{\circ}\text{C}$  to  $+50\text{ }^{\circ}\text{C}$  ( $-4\text{ }^{\circ}\text{F}$  to  $122\text{ }^{\circ}\text{F}$ ).

**S.5.3. Abbreviations and Symbols.** – The following abbreviations or symbols may appear on an EVSE system.

- (a) VAC = Volts Alternating Current;
- (b) VDC = Volts Direct Current;
- (c) MDA = maximum deliverable amperes;
- (d) J = Joule.

**S.6. Printer.** – When assembly system is equipped with means for printing the measured quantity, the printed information must agree with the indications on the EVSE for the transaction and the printed values shall be clearly defined.

**S.6.1. Printed Receipt.** – Any delivered, printed quantity shall include an EVSE identification number that uniquely identifies the EVSE from all other EVSEs within the seller's facility, the time and date, and the name of the seller. This information may be printed by the EVSE system or pre-printed on the ticket.

**S.7. Totalizers for EVSE Systems.** – EVSE systems shall be designed with a nonresettable totalizer for the quantity delivered through each separate measuring device. Totalizer information shall be adequately protected and unalterable. Totalizer information shall be provided by the system and readily available on site or via on site internet access.

**S.8. Minimum Measured Quantity.** – The minimum measured quantity shall satisfy the conditions of use of the measuring system as follows:

- (a) Measuring systems shall have a minimum measured quantity not exceeding 2.5 MJ or 0.5 kWh.

## **N. NOTES**

**N.1. No Load Test.** – A no load test may be conducted on an EVSE measuring system by applying rated voltage to the system under test and no load applied.

**N.2. Starting Load Test.** – A system starting load test maybe conducted by applying rated voltage and 0.5 ampere (A) load.

**N.3. Minimum Test Draft (Size).** – Full and light load tests shall require test of the EVSE System for a delivery of the minimum measured quantity as declared by the manufacturer.

**N.4. EVSE System Test Loads.** – EVSE measuring system testing shall be accomplished by connecting the test load and test standard at the point where the fixed cord is connected to the vehicle. Losses in the cord between the meter under test and the test standard should be automatically corrected for in the EVSE quantity indication for direct comparison to the test standard and also while the EVSE is in normal operation. For EVSEs that require a customer supplied cord, system testing shall be accomplished by connecting the test load and test standard at the point where the customer’s cord is connected to the EVSE.

### **N.5. Test of an EVSE System.**

**N.5.1. Performance Verification in the Field** – Testing in the field is intended to validate the transactional accuracy of the EVSE system. The following testing is deemed sufficient for field a validation.

**N.5.2. Accuracy Testing** – The testing methodology compares the total energy delivered in a transaction and the total cost charged as displayed/reported by the EVSE with that measured by the measurement standard.

(a) For AC systems:

- (1) Accuracy test of the EVSE system at a load of not less than 85 percent of the maximum deliverable current (MDA) as determined from the pilot signal for a total energy delivered of at least twice the minimum measured quantity (MMQ). If the MDA would result in maximum deliverable power of greater than 7.2 kW, then the test may be performed at 7.2 kW.
- (2) Accuracy test of the EVSE system at a load of not greater than 10 percent of the maximum deliverable current (MDA) as determined from the pilot signal for a total energy delivered of at least the minimum measured quantity (MMQ).

(b) For DC systems (see note):

- (1) Accuracy test of the EVSE system at a load of not less than 85 percent of the maximum deliverable current (MDA) as determined from the pilot signal for a total energy delivered of at least twice the minimum measured quantity (MMQ).
- (2) Accuracy test of the EVSE system at a load of not more than 10 % of the maximum deliverable current (MDA) as determined from the pilot signal for a total energy delivered of at least the minimum measured quantity (MMQ).

**Note:** For DC systems it is anticipated that an electric vehicle may be used as the test load. Under that circumstance testing at the load presented by the vehicle shall be sufficient.

**N.6. Repeatability Tests.** – Tests for repeatability should include a minimum of three consecutive tests at the same load, similar time period, etc. and be conducted under conditions where variations in factors are reduced to minimize the effect on the results obtained.

## **T. TOLERANCES**

### **T.1. Tolerances, General.**

- (a) The tolerances apply equally to errors of underregistration and errors of overregistration.
- (b) The tolerances apply to all deliveries measured at any load within the rated measuring range of the EVSE.
- (c) Where instrument transformers or other components are used, the provisions of this section shall apply to all system components.

### **T.2. Load Test Tolerances.**

**T.2.1. EVSE Load Test Tolerances.** – The tolerances for EVSE load tests are Acceptance Tolerance: 1.0 % and Maintenance Tolerance: 2.0 %.

**T.3. Repeatability.** – When multiple load tests are conducted at the same load condition, the range of the load test results shall not exceed 25 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance.

**T.4. Tolerance Application in Type Evaluation Examinations for EVSEs.** – For type evaluation examinations, the acceptance tolerance values shall apply under the following conditions:

- (a) at any temperature, voltage, load, and power factor within the operating range of the EVSE, and
- (b) regardless of the influence factors in effect at the time of the conduct of the examination, and
- (c) for all quantities greater than the minimum measured quantity.

**T.5. No Load Test.** – An EVSE measuring system shall not register when no load is applied.

**T.6. Starting Load.** – An EVSE measuring system shall register starting load test at a 0.5 ampere (A) load.

## **UR. USER REQUIREMENTS**

### **UR.1. Selection Requirements.**

**UR.1.1. Computing-Type Device; Retail EVSE.** – An EVSE used to charge electric vehicles shall be of the computing type and shall indicate the electrical energy, the unit price, and the total price of each delivery.

**UR.1.2. Connection Cord-Length.** – An adequate means for cord management shall be in use when the cord exceeds 25 ft in length.

### **UR.2. Installation Requirements.**

**UR.2.1. Maximum Deliverable Current.** – The marked maximum deliverable current shall not exceed the total capacity in amperes of the EVSE or the thermal overload protectors of the installation site.

**UR.2.2. Manufacturer’s Instructions.** – An EVSE shall be installed in accordance with the manufacturer’s instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.

**UR.2.3. Load Range.** – An EVSE shall be installed so that the current and voltage will not exceed the rated maximum values over which the EVSE is designed to operate continuously within the specified accuracy. Means to limit current and/or voltage shall be incorporated in the installation if necessary.

**UR.2.4. Regulation Conflicts and Permit Compliance.** – If any provision of Section UR.2. Installation Requirements is less stringent than that required of a similar installation by the serving utility, the installation shall be in accordance with those requirements of the serving utility.

The installer of any EVSE shall obtain all necessary permits.

**UR.2.5. Responsibility, Unattended EVSE.** – An unattended EVSE shall have clearly and conspicuously displayed thereon, or immediately adjacent thereto, adequate information detailing the name, address, and phone number of the local responsible party for the device.

### **UR.3. Use of EVSE.**

**UR.3.1. Unit Price for Retail EVSE Devices.** – The unit price at which the EVSE is set to compute shall be conspicuously displayed or posted on the face of a retail EVSE used in direct sale.

**UR.3.2. Return of Indicating and Recording Elements to Zero.** – The primary indicating elements (visual) and the primary recording elements shall be returned to zero immediately before each transaction.

**UR.3.3. Printed Ticket.** –A receipt providing the following information shall be available through a built-in or separate recording element at the completion of all transactions:

- (a) the total quantity of the energy delivered with unit of measure;
- (b) the total computed price of the energy sale;
- (c) the unit price of the energy; (for systems capable of applying multiple unit prices for energy during a single transaction, the following additional information is required):
  - (1) the start and stop time of each phase during which one of the multiple unit prices was applied;
  - (2) the unit price applied during each phase;
  - (3) the total quantity of energy delivered during each phase;
  - (4) the total purchase price for the quantity of energy delivered during each phase;
- (d) the maximum rate of energy transfer (i.e., maximum power) and type of current (e.g., 7 kW AC, 25 kW DC, etc.);
- (e) any additional separate charges included in the transaction (e.g., charges for parking time) including:
  - (1) the time and date when the service ends and the time and date when the service begins; or the total time interval purchased, and the time and date that the service either begins or ends;
  - (2) the unit price applied for the time-based service;
  - (3) The total purchase price for the quantity of time measured during the complete transaction;



- (f) the final total price of the complete transaction including all items;
- (g) the unique EVSE identification number;
- (h) the business name; and
- (i) the business location.

For systems equipped with the capability to issue an electronic receipt, the customer may be given the option to receive the receipt electronically (e.g., via cell phone, computer, etc.).

**UR.3.4. EVSE in Operation.** – The EVSE shall be permanently, plainly, and visibly identified so that it is clear which EVSE and connector is in operation.

**UR.3.5. Steps After Charging.** – After delivery to a customer from a retail EVSE:

- (a) the EVSE shall be shut-off at the end of a charge, through an automatic interlock that prevents subsequent charging until the indicating elements and recording elements, if the EVSE is equipped and activated to record, have been returned to their zero positions; and
- (b) the vehicle connector shall not be returned to its starting position unless the zero set-back interlock is engaged or becomes engaged by the act of disconnecting from the vehicle or the act of returning the connector to the starting position.

## HANDBOOK 44, APPENDIX D – DEFINITIONS

The specific code to which the definition applies is shown in [brackets] at the end of the definition. Definitions for the General Code [1.10.] apply to all codes in Handbook 44.

### A

**active (real) power.** – The component of electric power that performs work, typically measured in kilowatts (kW) or megawatts (MW). Also known as “real power.” The terms “active” or “real” power are used to modify the base term “power” to differentiate it from reactive and apparent power. The active power ( $P_{ac}$ ) or real power measured by a system, is the product of voltage (E) times current (I) times the cosine of the angle by which the current lags the voltage ( $\cos \phi$ ) or power factor (pf).  $P_{ac} = (E) (I) (\cos \phi)$  where  $\phi$  is the phase angle of the lag. [3.XX]

**alternating current (AC).** – An electric current that reverses direction in a circuit at regular intervals. [3.XX]

**ampere.** – The practical unit of electric current. It is the quantity of current caused to flow by a potential difference of one volt through a resistance of one ohm. One ampere is equal to the flow of one coulomb of charge per second. One coulomb is the unit of electric charge equal in magnitude to the charge of  $6.24 \times 10^{18}$  electrons. [3.XX]

**apparent power.** – The product of the RMS current (I) and the RMS voltage (E) in a circuit. [3.XX]

**audit trail.** – An electronic count and/or information record of the changes to the values of the calibration or configuration parameters of a device. [1.10, 2.20, 2.21, 2.24, 3.30, 3.37, 3.39, 3.XX, 5.56(a)]

(Added 1993)

### B

**balanced load.** – Balanced load is used to indicate equal currents in all phases and relatively equal voltages between phases and between each phase and neutral (if one exists); with approximately equal watts in each phase of the load. [3.XX]

**basic lightning impulse insulation level (BIL).** – A specific insulation level expressed in kilovolts of the crest value of a standard lightning impulse. (Example: BIL = 10 Kv). [3.XX]

**burden (B).** – The impedance of the circuit connected to the instrument transformer's secondary winding. (Example: B = 21 Ohms Max). [3.XX]

## C

**calibration parameter.** – Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy (e.g., span adjustments, linearization factors, and coarse zero adjustments). [2.20, 2.21, 2.24, 3.30, 3.37, 3.39, 3.XX, 5.56(a)]

(Added 1993)

**central location.** – A laboratory or shop used for the testing of systems to measure in-service accuracy. [3.XX]

**configuration parameter.** – Any adjustable or selectable parameter for a device feature that can affect the accuracy of a transaction or can significantly increase the potential for fraudulent use of the device and, due to its nature, needs to be updated only during device installation or upon replacement of a component (e.g., division value[increment], sensor range, and units of measurement). [2.20, 2.21, 2.24, 3.30, 3.37, 3.XX, 5.56(a)]

(Added 1993)

**connection line impedance.** – The impedance of the circuit used to convey energy sold from a fueling device to the storage of an electric vehicle. [3.XX]

**creep.** – A continuous apparent measurement of energy indicated by a system with operating voltage applied and no power consumed (load terminals open circuited). [3.XX]

**current.** – The rate of the flow of electrical charge past any one point in a circuit. The unit of measurement is amperes or coulombs per second. [3.XX]

## D

**direct current (DC).** – an electric current that flows in one direction.

## E

**electric vehicle, plug-in.** – A vehicle that employs electrical energy as a primary or secondary mode of propulsion. Plug-in electric vehicles may be all-electric vehicles (EV's) or plug-in hybrid electric vehicles (PHEV's). All-electric vehicles are powered by an electric motor and battery at all times. All-electric vehicles may also be called battery-electric vehicles (BEV's). Plug-in hybrid electric vehicles employ both an electric motor and an internal combustion engine that consumes either conventional or alternative fuel or a fuel cell. In a parallel type hybrid-electric vehicle, either the electric motor or the engine may propel the vehicle. In a series type hybrid-electric vehicle, the engine or fuel cell generates electricity that is then used by the electric motor to propel the vehicle. EV's, BEV's, and PHEV's are capable of receiving and storing electricity via connection to an external electrical supply. Not all hybrid-electric vehicles are of the plug-in type. Hybrid-electric vehicles that do not have the capability to receive electrical energy from an external supply (HEV's) generate electrical energy onboard with the internal combustion engine, regenerative braking, or both. [3.XX]

**electric vehicle supply equipment (EVSE).** – A device or system designed and used specifically to transfer electrical energy to an electric vehicle, either as charge transferred via physical or wireless connection, by loading a fully charged battery, or by other means. [3.XX]

**electricity as vehicle fuel.** – Electrical energy transferred to and/or stored onboard an electric vehicle primarily for the purpose of propulsion. [3.XX]

**electricity meter.** – A device that measures and registers the integral of an electrical quantity with respect to time.[3.XX]

**element (stator).** – A combination of a voltage-sensing unit and a current-sensing unit, which provides an output proportional to the quantities measured. [3.XX]

**energy.** – The integral of active power with respect to time. [3.XX]

**energy flow.** – The flow of energy between line and load terminals (conductors) of an electricity system. Flow from the line to the load terminals is considered energy delivered. Energy flowing in the opposite direction (i.e., from the load to line terminals) is considered as energy received. [3.XX]

**equipment, commercial.** – Weights, measures, and weighing and measuring devices, instruments, elements, and systems or portion thereof, used or employed in establishing the measurement or in computing any basic charge or payment for services rendered on the basis of weight or measure. As used in this definition, measurement includes the determination of size, quantity, value, extent, area, composition (limited to meat and poultry), constituent value (for grain), or measurement of quantities, things, produce, or articles for distribution or consumption, purchased, offered, or submitted for sale, hire, or award. [1.10, 2.20, 2.21, 2.22, 2.24, 3.30, 3.31, 3.32, 3.33, 3.34, 3.35, 3.38, 3.XX, 4.40, 5.51, 5.56.(a), 5.56.(b), 5.57, 5.58, 5.59]

(Added 2008)

**event counter.** – A nonresettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable calibration or configuration parameters of a device. [2.20, 2.21, 3.30, 3.37, 3.39, 3.XX, 5.54, 5.56(a), 5.56(b), 5.57]

(Added 1993)

**event logger.** – A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter. [2.20, 2.21, 3.30, 3.37, 3.39, 3.XX, 5.54, 5.56(a), 5.56(b), 5.57]

(Added 1993)

**EVSE field reference standard.** – A portable apparatus that is traceable to NIST and is used as a standard to test EVSEs in commercial applications. This instrument is also known as a portable standard or working standard. [3.XX]

## F

**face.** – That portion of a computing-type pump or dispenser which displays the actual computation of price per unit, delivered quantity, and total sale price. In the case of some electronic displays, this may not be an integral part of the pump or dispenser. [3.30, 3.XX]

(Added 1987)

**form designation (FM).** – An alphanumeric designation denoting the circuit arrangement for which the meter is applicable and its specific terminal arrangement. The same designation is applicable to equivalent meters for all manufacturers. (Example: FM 2S) [3.XX]

## H

**hertz (Hz).** – Frequency or cycles per second. One cycle of an alternating current or voltage is one complete set of positive and negative values of the current or voltage. [3.XX]

## I

**instrument transformer ratio.** – The stated ratio of the primary circuit current or voltage compared to the secondary circuit current or voltage. (Example: CTR = 200 : 0.1) [3.XX]

## J

**megajoule (MJ).** – An SI unit of energy equal to 1,000,000 joules. [3.XX]

## K

**kilowatt (kW).** – A unit of power equal to 1,000 watts. [3.XX]

**kilowatt-hour (kWh).** – A unit of energy equal to 1,000 watthours. [3.XX]

## L

**line service.** – The service terminals or conductors connecting the EVSE to the power source. [3.XX]

**load service.** – The service terminals or conductors connecting the EVSE to the electrical load (e.g., vehicle, tenant, etc.). [3.XX]

**load, full.** – A test condition with rated voltage, current at 100 % of test amps level, and power factor of 1.0. [3.XX]

**load, light.** – A test condition with rated voltage, current at 10 % of test amps level, and power factor of 1.0. [3.XX]

## M

**master meter, electric.** – An electric watthour meter owned, maintained, and used for commercial billing purposes by the serving utility. All the electric energy served to a submetered service system is recorded by the master meter. [3.XX]

**meter, electricity.** – An electric watthour meter. [3.XX]

**metrological components.** – Elements or features of a measurement device or system that perform the measurement process or that may affect the final quantity determination or resulting price determinations. This includes accessories that can affect the validity of transactions based upon the measurement process. The measurement process includes determination of quantities; the transmission, processing, storage, or other corrections or adjustments of measurement data or values; and the indication or recording of measurement values or other derived values such as price or worth or charges. [3.XX]

## N

**nationally recognized testing laboratory (NRTL).** – A laboratory that conducts testing and certification that is recognized by OSHA. [3.XX]

**nonresettable totalizer.** – An element interfaced with the measuring or weighing element that indicates the cumulative registration of the measured quantity with no means to return to zero. [3.30, 3.37, 3.39, 3.XX]

## O

**ohm.** – The practical unit of electric resistance that allows one ampere of current to flow when the impressed potential is one volt. [3.XX]

## P

**percent registration.** – Percent registration is calculated as follows:

$$\text{Percent Registration} = \frac{\text{Wh measured by EVSE}}{\text{Wh measured by STANDARD}} \times 100$$

[3.XX]

**percent error.** – Percent Error = Percent Registration – 100. A system is said to be “slow” that has percent registration below 100 % and negative percent error. [3.XX].

**point-of-sale system.** – 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. [2.20, 3.30, 3.32, 3.37, 3.39, 3.XX]

(Added 1986) (Amended 1997)

**power factor.** – The ratio of the active power to the apparent power in an AC circuit. The power factor is a number between 0 and 1 that is equal to 1 when the voltage and current are in phase (load is entirely resistive). [3.XX]

**primary indicating or recording elements.** – The term “primary” is applied to those principal indicating (visual) elements and recording elements that are designed to, or may, be used by the operator in the normal commercial use of a device. The term “primary” is applied to any element or elements that may be the determining factor in arriving at the sale representation when the device is used commercially. (Examples of primary elements are the visual indicators for meters or scales not equipped with ticket printers or other recording elements and both the visual indicators and the ticket printers or other recording elements for meters or scales so equipped.) The term “primary” is not applied to such auxiliary elements as, for example, the totalizing register or predetermined-stop mechanism on a meter or the means for producing a running record of successive weighing operations, these elements being supplementary to those that are the determining factors in sales representations of individual deliveries or weights. (See “indicating element” and “recording element.”) [1.10, 3.XX]

(Amended 20XX)

**primary watthour constant (PK<sub>h</sub>).** – The meter watthour constant per revolution or pulse (K<sub>h</sub>) multiplied by the product of the current and/or voltage transformer ratio(s):

$$PK_h = K_h (\text{Current Transformer Ratio} \times \text{Voltage Transformer Ratio})$$

[3.XX]

## R

**reactive power.** – For sinusoidal quantities in a two-wire circuit, reactive power is the product of the voltage, the current, and the sine of the phase angle between them, using the current as the reference. [3.XX]

**recorded representation.** – The printed, electronically recorded, or other representation that retains a copy of the quantity and any other required information generated by a weighing or measuring device. [1.10, 3.XX]

**recording element.** – An element incorporated, connected to, or associated with ~~in~~ a weighing or measuring device by means of which its performance relative to quantity or money value is permanently recorded in a printed or electronic form. [1.10, 3.XX]

**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 itself necessary to the operation of the weighing or measuring device or is not a permanent part of that device. [2.20, 2.21, 2.24, 3.30, 3.37, 3.39, 3.XX, 5.56(a)]

(Added 1993)

**retail device.** – A measuring device primarily used to measure electrical energy for the purpose of sale to the end user. [3.30, 3.32, 3.37, 3.39, 3.XX]

(Amended 1987, ~~and~~ 2004, and 20XX)

**revolution equivalent.** – The number of watthours represented by one increment (pulse period) of serial data. [3.XX]

**root mean square (RMS).** – The mathematical convention used to describe the average quantity of a property (such as current) that is varying as a sine wave. [3.XX]

## S

**serving utility.** – The utility distribution company that owns the master meter and sells electric energy to the owner of a submeter system. [3.XX]

**starting load.** – The minimum load above which the device will indicate energy flow continuously. [3.XX]

**submeter.** – A system furnished, owned, installed, and maintained by the customer who is served through a utility owned master meter. [3.XX]

## T

**tenant.** – The person or persons served electric energy from a submetered service system. [3.XX]

**test accuracy – in-service.** – The device accuracy determined by a test made during the period that the system is in service. It may be made on the customer's premises without removing the system from its mounting, or by removing the EVSE for testing either on the premises or in a laboratory or shop. [3.XX]

**test amperes (TA).** – The full load current (amperage) specified by the EVSE manufacturer for testing and calibration adjustment. (Example: TA 30) [3.XX]

**test block.** – Device that facilitates safe meter testing by disconnecting the meter from the circuit without interrupting the service to the tenant. [3.XX]

**thermal overload protector.** – A circuit breaker or fuse that automatically limits the maximum current in a circuit. [3.XX]

## U

**unit price.** – The price at which the electrical energy is being sold and expressed in whole units of measurement. [1.10, 3.30, 3.XX]

(Added 1992)

## V

**vehicle connector.** – A device that by insertion into a vehicle inlet, establishes an electrical connection to the electric vehicle for the purpose of providing power and information exchange, with means for attachment of electric vehicle cable. This device is a part of the vehicle coupler.

**vehicle coupler.** – A means enabling the connection, at will, of an electric vehicle cable to the equipment. It consists of a vehicle connector and a vehicle inlet.

**vehicle inlet.** – The part incorporated in, or fixed to the vehicle, which receives power from a vehicle connector.

**volt.** – The practical unit of electromotive force. One volt will cause one ampere to flow when impressed across a resistance of one ohm. [3.XX]

**voltage transformer.** – A device that provides a secondary voltage that is a precise fraction of the primary voltage. [3.XX]

## W

**watt.** – The practical unit of electric power. In an alternating-current circuit (AC), the power in watts is volts times amperes multiplied by the circuit power factor. [3.XX]

**watthour (Wh).** – The practical unit of electric energy, which is expended in one hour when the average power consumed during the hour is one watt. [3.XX]

**watthour – test constant (K<sub>t</sub>).** – The expression of the relationship between the energy applied to the meter system and corresponding occurrence of one test output indication expressed as watthours per test output indication. [3.XX]

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## Appendix I

### Item 360-5:

#### Electric Vehicle Fueling and Submetering

These proposed changes to Handbook 44, Section 5.55. Timing Devices Code are from the USNWM on EVFS and have been reviewed and forwarded to NCWM by each of the regional associations for national consideration. The submitter, the USNWG, and all four regionals propose that these changes be considered for Voting in July 2015.

### SECTION 5.55. TIMING DEVICES

#### A. APPLICATION

**A.1. General.** – This code applies to devices used to measure time during which services are being dispensed (such as vehicle parking, laundry drying, and car washing). **This code also applies to Electric Vehicle Supply Equipment (EVSE) when used to assess charges for time-based services in addition to those charged for electrical energy.**

**A.2. Additional Code Requirements.** – In addition to the requirements of this code, Timing Devices shall meet the requirements of Section 1.10. General Code.

#### S. SPECIFICATIONS

##### S.1. Design of Indicating and Recording Elements and of Recorded Representations.

###### S.1.1. Primary Elements.

**S.1.1.1. General.** – A timing device shall be equipped with a primary indicating element, and may also be equipped with a primary recording element. **A timing device incorporated into an Electric Vehicle Supply Equipment system for use in assessing charges for timing separate from charges for electrical energy shall be equipped with the capability to provide a recorded representation of the transaction through a built-in or separate recording element.** A readily observable in-service light or other equally effective means that automatically indicates when laundry driers, vacuum cleaners, and car washes are in operation shall be deemed an appropriate primary indicating element.

(Amended 1979)

**S.1.1.2. Units.** – A timing device shall indicate and record, if the device is equipped to record, the time in terms of minutes for time intervals of 60 minutes or less and in hours and minutes for time intervals greater than 60 minutes.

**S.1.1.3. Value of Smallest Unit.** – The value of the smallest unit of indicated time and recorded time, if the device is equipped to record, shall not exceed the equivalent of:

- (a) one-half hour on parking meters indicating time in excess of two hours;
- (b) six minutes on parking meters indicating time in excess of one but not greater than two hours; or
- (c) five minutes on all other devices, except those equipped with an in-service light.

(Amended 1975)

**S.1.1.4. Advancement of Indicating and Recording Elements.** – Primary indicating and recording elements shall be susceptible to advancement only during the mechanical operation of the device, except that clocks may be equipped to manually reset the time.

**S.1.1.5. Operation of In-Service Indicator Light.** – For devices equipped with an in-service light indicator, the in-service light indicator shall be operative only during the time the device is in operation.

**S.1.1.6. Discontinuous Indicating Parking Meters.** – An indication of the time purchased shall be provided at the time the meter is activated in units of no more than one minute for times less than one hour and not more than two minutes for times of one hour or more. Convenient means shall be provided to indicate to the purchaser the unexpired time.

(Added 1975) (Amended 1976)

## **S.1.2. Graduations.**

**S.1.2.1. Length.** – Graduations shall be so varied in length that they may be conveniently read.

**S.1.2.2. Width.** – In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations and the width of main graduations shall be not more than 50 % greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

**S.1.2.3. Clear Interval Between Graduations.** – The clear interval shall be not less than 0.75 mm (0.03 in). If the graduations are not parallel, the measurement shall be made:

- (a) along the line of relative movement between the graduations at the end of the indicator; or
- (b) if the indicator is continuous, at the point of widest separation of the graduations.

## **S.1.3. Indicators.**

**S.1.3.1. Symmetry.** – The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

**S.1.3.2. Length.** – The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

**S.1.3.3. Width.** – The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

- (a) the width of the widest graduation; and
- (b) the width of the minimum clear interval between the graduations.

**S.1.3.4. Parallax.** – Parallax effect shall be reduced to a practicable minimum.

## **S.1.4. ~~Printed Tickets~~ Recorded Representations.**

**S.1.4.1. Timing Devices, Electric Vehicle Supply Equipment.** – A timing device incorporated into an EVSE for use in assessing charges for timing separate from charges for electrical energy shall issue a recorded representation itemizing the charges for these services as defined in Section 3.XX. Electricity-Measuring Devices.

**S.1.4.1.1. Duplicate Receipts. – Duplicate receipts are permissible, provided the word “duplicate” or “copy” is included on the receipt.**

**S.1.4.2. All other Timing Devices.** – A printed ticket issued or stamped by a timing device shall have printed clearly thereon:

- (a) the time and day when the service ends and the time and day when the service begins, except that a self-service money-operated device that clearly displays the time of day need not record the time and day when the service begins; or
- (b) the time interval purchased, and the time and day that the service either begins or ends.

(Amended 1983)

**S.2. Marking Requirements, Operating Instructions.** – Operating instructions shall be clearly stated on the device.

**S.3. Interference.** – **The design of the EVSE shall be such that there will be no interference between the time and electrical energy measurement elements of the system.**

**S.4. Provisions for Sealing.** – **Adequate provisions shall be made to provide security for the timing element.**

**S.5. Power Interruption.** – **In the event of a power loss, the information needed to complete any transaction (i.e., delivery is complete and payment is settled) in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable through one of the means listed below or the transaction shall be terminated without any charge for the electrical energy transfer to the vehicle. :**

- **at the EVSE;**
- **at the console, if the console is accessible to the customer;**
- **via on site internet access; or**
- **through toll-free phone access.**

**For EVSEs in parking areas where vehicles are commonly left for extended periods, the information needed to complete any transaction in progress at the time of the power loss shall be determinable through one of the above means for at least 8 hours.**

**S.5.1. Transaction Termination.** – **In the event of a power loss, either: (a) the transaction shall terminate at the time of the power loss; or (b) the EVSE may continue charging without additional authorization if the EVSE is able to determine it is connected to the same vehicle before and after the supply power outage . In either case, there must be a clear indication on the receipt provided to the customer of the interruption, including the date and time of the interruption along with other information required under S.1.4.2. Recorded Representation; All Other Timing Devices.**

**S.5.2. User Information.** – **The EVSE memory, or equipment on the network supporting the EVSE, shall retain information on the quantity of time and the sales price totals during power loss.**

## N. NOTES

**N.1. Test Method.** – A timing device shall be tested with a timepiece with an error of not greater than plus or minus 15 seconds per 24-hour period. In the test of timing devices with a nominal capacity of 1 hour or less, stopwatches with a minimum division of not greater than one-fifth second shall be used. In the test of timing devices with a nominal capacity of more than one hour, the value of the minimum division on the timepiece shall be not greater than

one second. Time pieces and stopwatches shall be calibrated with standard time signals as described in National Institute of Standards and Technology Special Publication 432, NIST Time and Frequency Dissemination Services, or any superseding publication.

(Amended 1978)

**N.2. Broadcast Times and Frequencies.** – Time and frequency standards are broadcast by the stations listed in Table N.2. Broadcast Times and Frequencies.

<b>Table N.2.* Broadcast Times and Frequencies</b>			
<b>Station</b>	<b>Location, Latitude, Longitude</b>	<b>Frequency (MHz)</b>	<b>Times of Transmission (UTC)</b>
WWV	Fort Collins, Colorado 40E41' N 105E02' W	2.5 5.0 10.0	Continuous
WWVH	Kauai, Hawaii 21E59' N 159E46' W	2.5 5.0 10.0 15.0	Continuous
CHU	Ottawa, Canada 45E18' N 75E45' W	3.330 7.335 14.670 14.670	Continuous

\*From NIST Special Publication 559, "Time and Frequency Users' Manual," 1990.

(Added 1988)

**N.3. Interference Tests, EVSE – On an EVSE equipped with a timing device used to calculate time-based charges in addition to any charges assessed for electrical energy, a test shall be conducted to ensure that there is no interference between time and electrical energy measuring elements.**

## T. TOLERANCES

**T.1. Tolerance Values.** – Maintenance and acceptance tolerances for timing devices shall be as follows:

**T.1.1. For Timing Devices Other Than Those Specified in T.1.2. For Time Clocks and Time Recorders and T.1.3. On Parking Meters.** – The maintenance and acceptance tolerances shall be:

(a) On Overregistration: 5 seconds for any time interval of 1 minute or more; and  
 (Amended 1986)

(b) On Underregistration: 6 seconds per indicated minute.  
 (Amended 1975)

**T.1.2. For Time Clocks and Time Recorders.** – The maintenance and acceptance tolerances on over-registration and underregistration shall be three seconds per hour, but not to exceed one minute per day.  
 (Amended 1975)

**T.1.3. On Parking Meters and Other Timing Devices Used to Assess Charges for Parking.** – The maintenance and acceptance tolerances are shown in Table T.1.3. Maintenance and Acceptance Tolerances for Parking Meters and Other Timing Devices Used to Assess Charges for Parking.

<b>Table T.1.3. Maintenance and Acceptance Tolerances for Parking Meters and Other Timing Devices Used to Assess Charges for Parking</b>		
<b>Maintenance and Acceptance Tolerances</b>		
<b>Nominal Time Capacity</b>	<b>On Overregistration</b>	<b>On Underregistration</b>
30 minutes or less	No tolerance	10 seconds per minute, but not less than 2 minutes
Over 30 minutes to and including 1 hour	No tolerance	5 minutes plus 4 seconds per minute over 30 minutes
Over 1 hour	No tolerance	7 minutes plus 2 minutes per hour over 1 hour

**T.2. Tests Involving Digital Indications or Representations.** – To the tolerances that would otherwise be applied, there shall be added an amount equal to one-half the minimum value that can be indicated or recorded.

### UR. USER REQUIREMENTS

**UR.1. Statement of Rates.** – The following information shall be clearly, prominently, and conspicuously displayed:

- (a) ~~€~~The price in terms of money per unit or units of time for the service dispensed; and
- (b) for a timing device other than an EVSE, the number of coins the device will accept and be activated by at one time ~~shall be clearly, prominently and conspicuously displayed.~~

(Amended 1976) (Amended 20XX)

**UR.2. Time Representations.** – Any time representation shall be within plus or minus two minutes of the correct time in effect in the area, except on an individual clock used only for “time out”; in addition, the time indication of the “time-out” clock shall be the same as or less than that of the “time-in” clock.

(Amended 1975)

For quick reference in reviewing this document, below is a definition copied from Appendix D for “overregistration and underregistration.” A way to remember this is if a device is “overregistering,” it is showing “over” or more than the amount that is showing on the standard. Note that zero tolerance is allowed on “overregistration” for parking charges because a consequence of showing that more time has elapsed than actually has occurred could be a parking violation for the driver of the vehicle.

**overregistration and underregistration.** – When an instrument or device is of such a character that it indicates or records values as a result of its operation, its error is said to be in the direction of overregistration or underregistration, depending upon whether the indications are, respectively, greater or less than they should be. Examples of devices having errors of “overregistration” are: a fabric-measuring device that indicates more than the true length of material passed through it; and a liquid-measuring device that indicates more than the true amount of the liquid delivered by the device. Examples of devices having errors of “underregistration” are: a meter that indicates less than the true amount of product that it delivers; and a weighing scale that indicates or records less than the true weight of the applied load. [1.10]

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