MFM-4 V S.5.1. Location of Marking Information; Retail Motor-Fuel Dispensers.

Source:
NIST OWM (2019)

Purpose:
Extend the provision allowing the use of a key or tool for accessing internal required markings for *liquid* retail motor-fuel dispensers to include retail motor-fuel dispensers delivering *compressed gases*.

Item Under Consideration:
Amend NIST Handbook 44 Mass Flow Meters Code as follows:

*S.5.1. **Location of Marking Information; Retail Motor-Fuel Dispensers.** – 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 the base of the dispenser;

(b) either internally and/or externally provided the information is permanent and easily read; and

(c) on a portion of the device that cannot be readily removed or interchanged (i.e., not on a service access panel).

Note: *The use of a dispenser key or tool to access internal marking information is permitted for retail liquid* ***and compressed gas****-measuring devices.*
[Nonretroactive as of January 1, 2003]
(Added 2006) **(Amended 2019)**

Background/Discussion: See Appendix A, Page S&T-A175.

Additional letters, presentation and data may have been submitted for consideration with this item. Please refer to https://www.ncwm.net/meetings/annual/publication-16 to review these documents.

MFM-5 A N.3. Test Drafts.

At the 2019 NCWM Interim Meeting the S&T committee decided to combine the items on the agenda dealing with the issue of transfer standard (Including Items in a block) into one block. (New) Block 1 of this Interim Meeting report now includes Gen-3, B1 (original items from the 2019 interim agenda that appeared under block 1), B2, LPG-3 and MFM-5.

HGM – HYDROGEN GAS-MEASURING DEVICES

HGM-6 V Tentative Code Status and Preamble., A.2.(c) Exceptions., N.2 Test Medium., N.3. Test Drafts., N.4.1. Master Meter (Transfer) Standard Test., N.4.2. Gravimetric Tests., N.4.3 PVT Pressure Volume Temperature Test., N.6.1.1. Repeatability Tests., T.3. Repeatability., T.6. Tolerance –Minimum Measured Quantity (MMQ). and Appendix D. Definitions where applicable.

Source:
California (2019)

Purpose:
Remove the tentative status and include amendments to support current dispenser and test equipment capabilities.

Item Under Consideration:
Amend NIST Handbook 44, Hydrogen Gas-Measuring Devices Tentative Code follows:

Section 3.39. Hydrogen Gas-Measuring Devices ~~—Tentative Code~~

~~This tentative code has 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. Requirements that apply to wholesale applications are under study and development by the U.S. National Working Group for the Development of Commercial Hydrogen Measurement Standards. Officials wanting to conduct an official examination of a device or system are advised to see paragraph G-A.3. Special and Unclassified Equipment.0~~
~~(Tentative Code Added 2010)~~
The status of Section 3.39. Hydrogen Gas-Measuring Devices was changed from "tentative" to "permanent" effective January 1, 2020.

(Added 2010) (Amended 2019).

...

A.2. Exceptions. -
(c) Devices used for dispensing a hydrogen gas with a hydrogen fuel index lower than 99.97 % and concentrations of specified impurities that exceed level limits **in the latest version of SAE International J2719.**

...

N.2. Test Medium. – The device shall be tested with the product commercially measured except that, in a type evaluation examination, hydrogen gas as specified in NIST Handbook 130 shall be used.
~~Note: Corresponding requirements are under development and this paragraph will be revisited.~~

N.3. Test Drafts. –The minimum test shall be one test draft at **twice** the declared minimum measured quantity and one test draft at approximately ~~ten~~ **five** times the minimum measured quantity or ~~1~~ **4** kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed. (See T.3. Repeatability)

The test draft shall be made at flows representative of that during normal delivery. The pressure drop between the dispenser and the proving system shall not be greater than that for normal deliveries. The control of the flow (e.g., pipework or valve(s) size, etc.) shall be such that the flow of the measuring system is maintained within the range specified by the manufacturer.

N.4. Tests.

~~N.4.1. Master Meter (Transfer) Standard Test. When comparing a measuring system with a calibrated transfer standard, the minimum test shall be one test draft at the declared minimum measured quantity and one test draft at approximately ten times the minimum measured quantity or 1 kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed.~~

~~N.4.1.1. Verification of Master Metering Systems. A master metering system used to verify a hydrogen gas-measuring device shall be verified before and after the verification process. A~~

~~master metering system used to calibrate a hydrogen gas-measuring device shall be verified before starting the calibration and after the calibration process.~~

N.4.21. Gravimetric Tests. – The weight of the test drafts shall be equal to at least **twice** the amount delivered by the device at the declared minimum measured quantity and one test draft at approximately ~~ten~~ **five** times the minimum measured quantity or ~~1~~ **4** kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed

N.4.32 PVT Pressure Volume Temperature Test. – The minimum test with a calibrated volumetric standard shall be one test draft at **twice** the declared minimum measured quantity and one test draft at approximately ~~ten~~ **five** times the minimum measured quantity or ~~1~~ **4** kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed.

...

N.6.1.1. Repeatability Tests. –Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size **with a minimum of 1000 divisions,** and be conducted under controlled conditions where variations in factors are reduced to minimize the effect on the results obtained.

...

T.3. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size **greater than 1000 divisions**, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. (Also see N.6.1.1. Repeatability Tests.)

...

T.6. Tolerance – on Minimum Measured Quantity (MMQ). - The applicable tolerance to the minimum measured quantity is twice those shown in Table T.2. Accuracy Classes and Tolerances for Hydrogen Gas-Measuring Devices.

And

Appendix D. Definitions

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, **3.39,** 5.56(a)]

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, **3.39,** 4.40, 5.51, 5.56.(a), 5.56.(b), 5.57, 5.58, 5.59]

unit price. – The price at which the product is being sold and expressed in whole units of measurement. [1.10, 3.30, **3.39**] (Note: The Specifications and Tolerances Committee may wish to check other code sections to add for reference to this definition.)

Editor's Instructions:

(A) Take all the definitions from the 3.39. Hydrogen Gas-Measuring Devices – Tentative Code and replace the current definitions in NIST HB 44 Appendix D. Definitions, and

(B) *Add 3.39 to these definitions in NIST HB 44 Appendix D. Definitions.*

Background/Discussion: See Appendix A, Page S&T-A182.

Additional letters, presentations, and data may have been submitted for consideration with this item. Please refer to https://www.ncwm.net/meetings/annual/publication-16 to review these documents.

EVF – ELECTRIC VEHICLE FUELING SYSTEMS

EVF-3 D S.3.5. Temperature Range for System Components. and S.5.2. EVSE Identification and Marking Requirements.

Source:
NIST OWM (2019)

Purpose:
Ensure there are no inconsistencies in the tentative code between the temperature range requirement of – 40 °C to + 85 °C (– 40 °F to 185 °F) specified for the EVSE's operation and the requirement in paragraph S.5.2. EVSE Identification and Marking Requirements that specifies an EVSE must be marked with its temperature limits when they are narrower than and within – 20 °C to + 50 °C (– 4 °F to 122 °F).

Item Under Consideration:
Amend NIST Handbook 44, Electric Vehicle Fueling Systems follows:

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.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 °C to + 50 °C (– 4 °F to 122 °F).

Background/Discussion: See Appendix A, Page S&T-A189.

Additional letters, presentation and data may have been submitted for consideration with this item. Please refer to https://www.ncwm.net/meetings/annual/publication-16 to review these documents.

See 2019 NCWM Interim Meeting comments and 2019 NIST OWM analysis in Agenda Item B1 of this report.

Regional Association Comments:
WWMA 2018 Annual Meeting: The WWMA recommends this item be addressed together with the items in Block 1 and 2; and MFM-2; LPG-3 and designate the status as Developing. For details, see the "Comments and Justification" in Block 1.

NEWMA 2018 Interim Meeting: See the comments above on Block 1. This is recommended as a Developing Item and part of a group (with Block 1, Block 2, LPG-3 and GEN-4) on the NCWM agenda.

SWMA 2018 Annual Meeting: The SWMA heard comment that this should be included in a block with Block 1, Block 2, GEN-4 and LPG-3. NIST also notes that there was concern raised with the appropriateness of the minimum delivery time. The Committee encourages this item be included in the block and consider the minimum delivery time as it is being developed.

CWMA 2018 Interim Meeting: The submitter has agreed to harmonize language previously discussed in this agenda (Block 1 & OTH-2) and the CWMA believes this item is ready to be elevated to a voting status.
Written comments from Seraphin and others are available on the NCWM website as noted below.

Additional letters, presentation and data may have been submitted for consideration with this item. Please refer to https://www.ncwm.net/meetings/annual/publication-16 to review these documents.

HGM – HYDROGEN GAS-MEASURING DEVICES

HGM-6 V Tentative Code Status and Preamble., A.2.(c) Exceptions., N.2 Test Medium., N.3. Test Drafts., N.4.1. Master Meter (Transfer) Standard Test., N.4.2. Gravimetric Tests., N.4.3 PVT Pressure Volume Temperature Test., N.6.1.1. Repeatability Tests., T.3. Repeatability., T.6. Tolerance –Minimum Measured Quantity (MMQ). and Appendix D. Definitions where applicable.

Background/Discussion:
NIST Handbook (HB) 44 Section 3.39 Hydrogen Gas-Measuring Devices – Tentative Code, was adopted by NCWM in 2010 and first published in 2011, with only a trial and experimental status. Since 2012, the California Division of Measurement Standards (CA DMS) has conducted five successful type evaluations of hydrogen dispensers, and California state and county officials have performed initial verifications and/or annual examinations of dispensers at the 36 retail stations throughout the state. In 2016, changes were made to NIST HB 44 Section 3.39 to expand the device tolerances from 1.5 % and 2.0 % to 5.0 % and 7.0 %, based upon CA DMS' test data. Today, CA DMS believes the code with the adoption of the proposed amendments is ready for permanent status. There are other jurisdictions that have hydrogen dispensers with the potential for commercial operation, most notably in the U.S. northeast (CT, MA, NJ, NY, RI) where industry is supporting the development of a "hydrogen highway." Additionally, NIST HB 44 Section 3.39 is generally compatible with the 2018 version of the corresponding international standard, Organization of International Legal Metrology Recommendation 139 (OIML R 139) - *Compressed gaseous fuel measuring systems for vehicles.*

The following are specific justifications for the eleven proposed amendments to Section 3.39. Hydrogen Gas-Measuring Devices - Tentative Code:

(1) Section 3.39. Hydrogen Gas-Measuring Devices - Tentative Code

CA DMS proposes that this title be removed and replaced with Section 3.39. Hydrogen Gas-Measuring Devices without the words "Tentative Code." This change is necessary because a tentative code has only trial or experimental status and is not enforceable. Removal of these words will make clear that NIST HB 44 3.39 is the basis of enforcement for hydrogen gas-measuring devices in the U.S. Additionally, CA DMS proposes to remove the preamble as it would be unnecessary in a code with permanent status.

(2) 3.39. Hydrogen Gas-Measuring Devices. A.2. Exceptions (c)

CA DMS proposes that this requirement be amended. Current language is not specific as to what is meant by the "concentrations of specified impurities that exceed level limits." This is because at the time the tentative code was drafted, limits for certain constituents had not been finalized and there wasn't a recognized national fuel quality standard for hydrogen fuel. Since then, SAE International has approved and published a specification for hydrogen for use in fuel cell vehicles, SAE J2719. (Note: This SAE standard is also codified in NIST HB 130, G. Uniform Fuels and Automotive Lubricants Regulation, paragraph 2.20. Hydrogen Fuel.)

(3) N.2 Test Medium.

CA DMS proposes that the Note be deleted. In NIST HB 130, G. Uniform Fuels and Automotive Lubricants Regulation, SAE International J2719 is referenced in paragraph 2.17. Hydrogen Fuel. This fuel quality specification was first published in 2011, after Section 3.39. Hydrogen Gas-Measuring Devices - Tentative Code was adopted by NCWM.

(4) N.3. Test Drafts.

CA DMS proposes that this be amended to increase the size for the minimum test draft used when verifying that a hydrogen gas-measuring device meets the minimum tolerances and specifications. The test draft size in NIST Handbook 44 is too small and creates increased measurement uncertainty. The proposed minimum test draft size also aligns with OIML R 139 - *Compressed gaseous fuel measuring systems for vehicles*. The second draft test size reduction to five times the minimum measured quantity from ten times accommodates the physical limitations of hydrogen dispenser testing equipment (currently less than 5.0 kg. but greater than 4.0 kg).

(5) N.4.1. Master Meter (Transfer) Standard Test.

CA DMS proposes that this be amended to increase the size for the minimum test draft used when verifying that a hydrogen gas-measuring device meets the minimum tolerances and specifications. The test draft size in NIST Handbook 44 is too small and creates increased measurement uncertainty. The proposed minimum test draft size also aligns with OIML R 139 - *Compressed gaseous fuel measuring systems for vehicles*. The second draft test size reduction to five times the minimum measured quantity from ten times accommodates the physical limitations of hydrogen dispenser testing equipment (currently less than 5.0 kg. but greater than 4.0 kg).

(6) N.4.2. Gravimetric Tests.

CA DMS proposes that this be amended to increase the size for the minimum test draft used when verifying that a hydrogen gas-measuring device meets the minimum tolerances and specifications. The test draft size in NIST Handbook 44 is too small and creates increased measurement uncertainty. The proposed minimum test draft size also aligns with OIML R 139 - *Compressed gaseous fuel measuring systems for vehicles.* The second draft test size reduction to five times the minimum measured quantity from ten times accommodates the physical limitations of hydrogen dispenser testing equipment (currently less than 5.0 kg. but greater than 4.0 kg).

(7) N.4.3. PVT Pressure Volume Temperature Test.

CA DMS proposes that this be amended to increase the size for the minimum test draft used when verifying that a hydrogen gas-measuring device meets the minimum tolerances and specifications. The test draft size in NIST Handbook 44 is too small and creates increased measurement uncertainty. The proposed minimum test draft size also aligns with OIML R 139 - *Compressed gaseous fuel measuring systems for vehicles*. The second draft test size reduction to five times the minimum measured quantity from ten times accommodates the physical limitations of hydrogen dispenser testing equipment (currently less than 5.0 kg. but greater than 4.0 kg).

(8) N.6.1.1. Repeatability Tests.

CA DMS proposes that this paragraph be amended to specify the size of the test draft used when verifying a hydrogen dispenser. If the proposed test draft size is too small, it will not be possible to get a measurement that is both reliable and repeatable. Also, if the test draft size is too small, it is difficult to verify compliance using the equipment presently available to officials and service agencies that inspect and/or repair these devices.

(9) T.3. Repeatability.

CA DMS proposes that this paragraph be amended. This section references N.6.1.1. which specifies that the test drafts be of approximately the same size, but it has no requirement for the minimum weight of the test draft. The test draft size must be sufficiently large to obtain a measurement that is both reliable and repeatable. If the test draft size is too small, it is difficult to verify compliance using the equipment presently available to officials and service agencies that repair hydrogen gas-measuring devices. This proposed tolerance also aligns with the OIML R 139 - *Compressed gaseous fuel measuring systems for vehicles*.

(10) T.6. Tolerance – Minimum Measured Quantity (MMQ).

CA DMS proposes that this paragraph be added. It is necessary to adopt a different tolerance for the minimum measured quantity because the test draft size in NIST HB 44 Section 3.39. is so small that it creates increased measurement uncertainty. Increasing the tolerance also eliminates the need for more precise testing equipment. This proposed tolerance also aligns with OIML R 139 - *Compressed gaseous fuel measuring systems for vehicles*.

(11) Appendix D. Definitions

When the tentative code is upgraded to a permanent status, the definitions listed at the end of the tentative code should be deleted and added to NIST HB 44 Appendix D. Definitions, to reference Section "3.39" where applicable. In addition to the definitions listed in the tentative code, the following terms should also have "3.39" added: configuration parameter, commercial equipment, and unit price.

NIST OWM: OWM comments were provided to the Committee in advance of the 2019 Interim Meeting and subsequently made available on the NCWM website. OWM offers the following points for consideration.

- NIST OWM concurs with a majority of the recommended modifications to the current NIST Handbook 44, Section 3.39 Hydrogen Gas-Measuring Devices-Tentative Code.
- OWM believes the proposal to upgrade the code's status should not be delayed because it is urgently needed to support the growing infrastructure for hydrogen.
- However, prior to voting on the proposed changes to the current HB 44 Hydrogen Code, a consensus needs to be reached on 2 key technical issues:
  - Repeatability
    - N.6.1.1. Repeatability Test
    - T.3. Repeatability
  - Inconsistent application of MMQ tolerances.
    - New T.6 Tolerance – on Minimum Measured Quantity (MMQ)
- The proposed change to these paragraphs would limit repeatability test drafts to not less than 1000 increments of the device under test. This is more than the MMQ for these devices and the MMQ is a point at which these devices would be commonly used.
- The submitter referenced OIML R 139 as the source of this proposed change. NIST OWM is seeking further clarification from the Co-Conveners of OIML R 139 if a repeatability test is permissible at the MMQ.
- OWM plans to continue its collaborations with the submitter with the goal of resolving these points prior to the Spring regional meetings if not before.

Additional background information is included below:
As proposed the test notes might imply repeatability tests by evaluators and officials are to be conducted at quantities in excess of fuel tank top-off amounts and the typical minimum measurement that can be accurately delivered by the dispenser and where that amount is a required marking on the dispenser's identification plate since 2010.

It seems reasonable to not reinvent the standard and frequently the U.S. has drawn on international standards and the states for procedures already developed and supported by test data. In fact, in 2018 the international community updated OIML R 139 to address many compressed gas dispenser features specific to the hydrogen application.

Proper test are made with equipment provided by either the official or in some cases the owner/operator of the device and are of the proper design that meet the NIST Handbook 44 Fundamental Considerations guidelines for a test apparatus. Hydrogen station inspections are carefully orchestrated.

The U.S. did not adopt every aspect of the international term MMQ. Suitable equipment was part of the 1991 S&T Committees discussions. The MMQ is one method for determining if a device is suitable for use in a given application. The device may not be used to measure quantities smaller than the MMQ; this is comparable to the minimum load that may be weighed on a scale. The Committee did consider a proposed set of criteria for use to establish the suitability of liquid measuring devices, where the accuracy test tolerance for deliveries at the MMQ was twice the tolerance applied for a normal delivery. At that point in time tolerances ranged from 0.25 % to 1.0 %. Given the allowable errors proposed in new paragraph T.6. Tolerances MMQ, thus doubling the current acceptance and maintenance tolerances of 5.0 % and 7.0 % would permit significant errors for deliveries of small quantities.

The test notes in the current edition of the hydrogen code specify, at minimum, one accuracy test at the minimum measured quantity (MMQ) and one additional test at whichever is the greater amount either a delivery at ten times the MMQ or 1 kilogram. These test drafts are applicable to all three test methods recognized by the code. The proposed modification would require all repeatability tests regardless of the test method to be conducted at a minimum delivery of 1 kilogram. OWM has observed that hydrogen gas dispensers in operation are rated with a 500 gram MMQ (i.e., 500 scale intervals), a test draft size which would not meet the minimum quantity of 1000 scale intervals being proposed in multiple test notes that apply to the official repeatability tests of the dispenser.

The MMQ is the smallest quantity the device is designed to measure and is established by the manufacturer. The U.S. sources of hydrogen dispenser test data are increasing. The data available appears to confirm hydrogen dispensers meet the tolerance for MMQ deliveries. It appears OIML R 139 also recognizes an accuracy test at the MMQ delivery.

As a result of the NIST OWM analysis of the latest published OIML R 139 -1 paragraph 5.4.1; Repeatability which appears to require that the amount of fuel dispensed for a repeatability test must be equal to or greater than 1000 scale intervals. We have worked two examples provided below for both compressed natural gas (CNG) and hydrogen. Paragraph 5.4.1 works for U.S. CNG dispensers that typically have an MMQ of 2.0 pounds (approximately 0.900 kg), but U.S. hydrogen gas dispensers typically have a 500 gram MMQ that does not meet the repeatability test quantity requirement.

IN THE U.S.
IN THE CASE OF A COMPRESSED NATURAL GAS (CNG) REFUELING DISPENSER:

Compressed natural gas dispensers indicate a delivery for test purposes in a 0.001 pound unit of measure.
Applying OIML R 139-1, 5.4.1 to these CNG dispensers 1 000 x 0.001 pound = 1.0 pound

This means each delivery quantity is never less than 1.0 pound (or 0.4535147 kilogram) when conducting a repeatability test.
Most U.S. CNG dispenser manufacturers declare an MMQ of 2.0 pounds (i.e., 2 000 scale intervals)

A delivery amount at the MMQ of 2.0 pounds satisfies the requirement in 5.4.1 for a delivered quantity of 1.0 pound or greater

IN THE U.S.
IN THE CASE OF A HYDROGEN GAS REFUELING DISPENSER:

Hydrogen gas dispensers indicate a delivery in a 0.001 kilogram unit of measure.

Applying OIML R 139-1, 5.4.1 to these hydrogen gas dispensers 1 000 x 0.001 kilogram = 1.0 kilogram

This means each delivery is never less than 1.0 kilogram when conducting a repeatability test.

Most U.S. hydrogen gas dispenser manufacturers declare an MMQ of 500 grams (or 0.5 kilogram [i.e., 500 scale intervals])

A delivery amount at the MMQ of 0.5 kilogram does not satisfy the requirement in 5.4.1 for a delivered quantity of 1.0 kilogram or greater

During the 2019 NCWM Interim Meeting, the Committee heard from Mr. Kevin Schnepp (California) that California has been using this tentative code and feels it is ready to go forward with some modification as a voting item. Mr. Michael Keilty (Endress + Hauser Flowtec) voiced his support for the item; however, he felt it inappropriate to include information on master meter testing based on ongoing discussions about 2019 S&T agenda Block 1 Items and Block 2 Items. These blocks of items are proposals intended to establish the appropriate nomenclature for use to identify and define test apparatus when this equipment is referenced in the codes.

During the committee's work session, the members of the committee agreed with Mr. Keilty's suggestion to remove paragraphs 4.1 and 4.1.1 and renumber the remaining paragraphs. This action removes the master meter standard test method from the code. For clarity the Committee also removed text with strike through editorial marks that remained in the proposal, since this alternate text only illustrated wording once considered by the WWMA, but never intended for national consideration. With this agreement, the committee agreed to move the item forward as Voting.

Regional Association Comments:

WWMA 2018 Annual Meeting: During the WWMA meeting, NIST OWM and California Dept. of Food and Agriculture - Division of Measurement Standards (CADMS) collaborated on OWM's open hearing comments and brought back a revised recommendation for WWMA to consider. This revision is outlined below. OWM believes the additional modifications are appropriate, though has some remaining questions about the 1000-division draft size for repeatability. OWM is confident that, with additional input and discussion from the community, ***this point can be resolved without delaying action on this proposal.*** Thus, rather than delay progress on upgrading this code, OWM believes it appropriate and expedient to move the item forward for a vote and, should an alternative solution present itself between now and the 2019 Interim Meeting as a result of collaboration between CA and OWM (along with any other input received) that alternative could be presented to the NCWM S&T Committee at that time.

WWMA considered the comments received and acknowledged the points raised by Michael Keilty (Endress + Hauser Flowtec) regarding the references to "transfer standards" in the current code. The WWMA noted these references have been in the code since its inception and are presently in multiple other codes including the Cryogenic LMD Code, Carbon Dioxide LMD Code, EVSE Code, and others. The proposals referenced in Blocks 1 and 2; Gen-4; LPG-3; and MFM-5 (which the WWMA has recommended grouping together) have raised the question of the appropriateness of the terminology of the test equipment used in this item. However, those proposals do not currently recommend removing the paragraphs using that terminology from those codes. Should the work in that grouped item result in recommended changes to those references, the WWMA would expect that such recommendations would apply universally to all those codes, including the Hydrogen Gas-Measuring Devices Code. The WWMA did not feel it would be appropriate to single out this code in advance of such recommendations.

Mr. Keilty also questioned the inclusion of the Pressure-Volume-Temperature method in the testing criteria, noting the USNWG on Hydrogen had specifically opposed this method. Ms. Tina Butcher confirmed the USNWG had raised questions about the PVT method, but the concern was not related to the test method; the concern was regarding the use of this method for the determination of the commercial quantity because of the practicality of validating the volume of the receiving container. The reference to the use of PVT solely as a test method was included in the code based on recommendations of the USNWG.

The WWMA agreed that the code is ready to upgrade to a permanent status with the revisions proposed by CA in the WWMA's Agenda and the additional changes outlined in the attached updated version of its proposal. During the WWMA's work session, the WWMA identified a term that needed clarification in paragraph N.6.1.1. Repeatability

Tests and T.3. Repeatability. A summary of the changes proposed to the code are shown below, including that change made by the WWMA. The WWMA recommends this item be forwarded to the NCWM S&T Committee with these changes and designated as a Voting item on the NCWM S&T Committee Agenda.

Section 3.39. Hydrogen Gas-Measuring Devices ~~—Tentative Code~~

~~This tentative code has 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. Requirements that apply to wholesale applications are under study and development by the U.S. National Working Group for the Development of Commercial Hydrogen Measurement Standards. Officials wanting to conduct an official examination of a device or system are advised to see paragraph G-A.3. Special and Unclassified Equipment. (Tentative Code Added 2010)~~

The status of Section 3.39. Hydrogen Gas-Measuring Devices was changed from "tentative" to "permanent" effective January 1, 2020.

(Code Added 2010 and Upgraded 2019)

A.2. Exceptions. -

(c) Devices used for dispensing a hydrogen gas with a hydrogen fuel index lower than 99.97 % and concentrations of specified impurities that exceed level limits **in the ~~most current~~ latest version of SAE International J2719.**

N.2. Test Medium. – The device shall be tested with the product commercially measured except that, in a type evaluation examination, hydrogen gas as specified in NIST Handbook 130 shall be used.

~~**Note: Corresponding requirements are under development and this paragraph will be revisited.**~~

N.3. Test Drafts. –The minimum test shall be one test draft at **twice** the declared minimum measured quantity and one test draft at approximately **~~ten~~ five** times the minimum measured quantity or ~~1~~ **4** kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed. (See T.3. Repeatability)

The test draft shall be made at flows representative of that during normal delivery. The pressure drop between the dispenser and the proving system shall not be greater than that for normal deliveries. The control of the flow (e.g., pipework or valve(s) size, etc.) shall be such that the flow of the measuring system is maintained within the range specified by the manufacturer.

N.4.1. Master Meter (Transfer) Standard Test. –When comparing a measuring system with a calibrated transfer standard, the minimum test shall be one test draft at **twice** the declared minimum measured quantity and one test draft at approximately **~~ten~~ five** times the minimum measured quantity or ~~1~~ **4** kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed.

N.4.2. Gravimetric Tests. – The weight of the test drafts shall be equal to at least **twice** the amount delivered by the device at the declared minimum measured quantity and one test draft at approximately **~~ten~~ five** times the minimum measured quantity or ~~1~~ **4** kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed

N.4.3 PVT Pressure Volume Temperature Test. – The minimum test with a calibrated volumetric standard shall be one test draft at **twice** the declared minimum measured quantity and one test draft at approximately **~~ten~~ five** times the minimum measured quantity or ~~1~~ **4** kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed.

N.6.1.1. Repeatability Tests. –Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size **with ~~no less than~~ a minimum of 1000 ~~scale intervals (~~increments on the device under test~~),~~** and be conducted under controlled conditions where variations in factors are reduced to minimize the effect on the results obtained.

N.7. Density. - N.7. Density. – Temperature and pressure of hydrogen gas shall be measured during the test for the determination of density or volume correction factors when applicable. For the thermophysical properties of hydrogen the following publications shall apply: for density calculations

at temperatures above 255 K and pressures up to 120 MPa, a simple relationship may be used that is given in the publication of Lemmon et al., J. Res. NIST, 2008. Calculations for a wider range of conditions and additional thermophysical properties of hydrogen are available free of charge online at the "NIST Chemistry WebBook, NIST Standard Reference Database Number 69" https://webbook.nist.gov/chemistry, or available for purchase from NIST as the computer program NIST Standard Reference Database 23 "NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version ~~8~~ **10.0**" https://www.nist.gov/srd/~~nist23.cfm~~**refprop**. These calculations are based on the reference Leachman, J.W., Jacobsen, R.T, Lemmon, E.W., and Penoncello, S.G. "Fundamental Equations of State for Parahydrogen, Normal Hydrogen, and Orthohydrogen" to be published in the Journal of Physical and Chemical Reference Data (~~http://www.nist.gov/manuscript-publication-search.cfm?pub_id=832374~~ (**https://www.nist.gov/publications/fundamental-equations-state-parahydrogen-normal-hydrogen-and-orthohydrogen?pub_id=832374**). More information may be obtained from NIST at ~~http://www.boulder.nist.gov/div838/Hydrogen/Index.htm~~ **https://www.nist.gov/publications/fundamental-equations-state-parahydrogen-normal-hydrogen-and-orthohydrogen.**

T.3. Repeatability. – When multiple tests are conducted at approximately the same flow rate and draft size **greater than 1000** ~~scale intervals (~~**increments on the device under test**~~)~~, the range of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. (Also see N.6.1.1. Repeatability Tests.)

T.6. Tolerance – on Minimum Measured Quantity (MMQ). - The applicable tolerance to the minimum measured quantity is twice those shown in Table T.2. Accuracy Classes and Tolerances for Hydrogen Gas-Measuring Devices.

Appendix D. Definitions

Instructions:

(A) Take all the definitions from the 3.39. Hydrogen Gas-Measuring Devices – Tentative Code and replace the current definitions in NIST HB 44 Appendix D. Definitions, and

(B) Add **3.39** to these definitions in NIST HB 44 Appendix D. Definitions:

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, **3.39,** 5.56(a)]

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, **3.39,** 4.40, 5.51, 5.56.(a), 5.56.(b), 5.57, 5.58, 5.59]

unit price. – The price at which the product is being sold and expressed in whole units of measurement. [1.10, 3.30, **3.39**] (Note: The Specifications and Tolerances Committee may wish to check other code sections to add for reference to this definition.)

NEWMA- 2018 Interim Meeting: During its open hearings, NEWMA received a comment from Mr. Mike Sikula (New York) that a Hydrogen Gas Measuring (HGM) system was tested in NY and appeared to test successfully. The system was tested by a private company and witnessed by NY state weights and measures officials.

Mr. Walt Remmert (Pennsylvania) commented that most states will find the test equipment cost prohibitive and feels that weights and measures will not be testing these systems. Mr. Jim McEnerney (Connecticut) stated that CT has a HGM but is not being used due to it being new to the market.

NEWMA believes this item should be upgraded from tentative code and recommends it be given a Voting status on the NCWM S&T Committee agenda.

SWMA 2018 Annual Meeting: The SWMA heard that an agreement has been reached on the development of this proposal that has been supported by the Western Weights and Measures Association (WWMA) and the revised version of the proposal appears in their report which was provided to SWMA. NIST OWM considers the WWMA revised version of this proposal to be fully developed.

SWMA agrees that the WWMA proposal should be used and recommends that version of the proposal as a voting item.

CWMA 2018 Interim Meeting: No comments were heard. CWMA recommends this as a voting item.

Additional letters, presentations, and data may have been submitted for consideration with this item. Please refer to https://www.ncwm.net/meetings/annual/publication-16 to review these documents.

EVF – ELECTRIC VEHICLE FUELING SYSTEMS

EVF-3 D S.3.5. Temperature Range for System Components. and S.5.2. EVSE Identification and Marking Requirements.

This item has been assigned to the submitter for further development. For more information or to provide comment please contact:

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Background/Discussion:

In 2012 the USNWG began work to develop legal metrology standards for electricity measuring systems used in both electric vehicle fueling and submetering applications under a single code. The USNWG's first draft standard was based on the California Code of Regulation (CCR) Article 2.2 Electric Watthour Meters Section 4027. Initially the temperature range requirements for the operation of metering components and marking the equipment covered the same range and were taken verbatim from CCR Section 4027.2 paragraphs S.4.(o) Meter Identification and Marking Requirements and paragraph S.12. Temperature Range for Metering Components. Both requirements specified a temperature range of – 20 °C to + 50 °C.

The USNWG has also harmonized wherever possible with ANSI C12.1-2014 Electric Meters-Code for Electricity Metering and ANSI C12.20-2015 Electricity Meters 0.1, 0.2 and 0.5 Accuracy Classes. In 2014 the USNWG agreed to widen the temperature range in NIST HB 44, section 3.40, paragraph S.3.5. for systems components to – 40 °C to + 85 °C based on input that the wider range is an ANSI standard commercial temperature range. This range was adopted in 2015 and appears in the current NIST HB 44. However, only in ANSI C12.1 Section 4 in 4.7.3.16 Test Number 30 Effect of Operating Temperature is – 30 °C specified as the lowest minimum temperature limit and in 4.7.3.17 Test Number 31 Effects of Relative Humidity is + 85 °C specified as the maximum temperature limit.

Electric Vehicle Service Equipment (EVSE) must be capable of operating accurately over the temperature range specified in Section 3.40 Electric Vehicle Fueling Systems – Tentative Code or marked accordingly. Paragraph S.3.5. Temperature Range for Systems Components specifies that an EVSE not capable of operating over the specified temperature range of – 40 °C to + 85 °C (– 40 °F to 185 °F) must be marked with its narrower temperature range. The submitter is working to ensure there are no inconsistencies between the temperature range requirements specified for the EVSE's operation and the requirement in paragraph S.5.2. EVSE Identification and Marking Requirements that specify an EVSE must be marked with its temperature limits when they are narrower than and within – 20 °C to + 50 °C (– 4 °F to 122 °F).