

**U.S. National Work Group
for the
Development of Commercial Hydrogen Measurement Standards**

January 30, 2009 1:00 p.m. - 3:00 p.m. EST

Joint Subcommittees Teleconference/Webconference Meeting

Device Standards Subcommittee (DSS)

and

Fuel Specifications Subcommittee (FSS)

MEETING SUMMARY

The joint USNWG Subcommittee meeting was sponsored by the U.S. Department of Energy and U.S. Department of Commerce's National Institute of Standards and Technology.

This meeting was hosted by CSA America, Inc.

Purpose: The U.S. National Work Group (USNWG) met to continue its work to promote the establishment of a comprehensive set of (1) design, accuracy, installation, use, and method of sale requirements, (2) test procedures, and (3) fuel quality standards for equipment used in hydrogen measurements for vehicle and other refueling applications.

AGENDA ITEMS

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NOTE: Appendices A-C of the Meeting Summary are available on request.

Joint Device Standards Subcommittee and Fuel Specifications Subcommittee Meeting Agenda

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Appendix	Related Agenda Items(s)	Title
A	(1), (2), (3), and (4)	Draft 3.3 of NIST Handbook 44 Gas Measuring Devices Code
B	(4)	Draft 2.3 of NIST Handbook 130 Uniform Laws and Regulations, Engine Fuel Quality
C	(6)(c)	Summary of the December 2008 USNWG Meeting
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**Device Standards Subcommittee (DSS)
and
Fuel Specifications Subcommittee (FSS)
January 30, 2009 1:00 p.m. – 3:00 p.m. (EST)
Joint USNWG Subcommittees Teleconference/Webconference Meeting**

1:00 P.M. (EST) Welcome Current/New Members and Roll Call (See Appendix F for a list of meeting participants)

(1) Development of Device Standards and Test Procedures for Commercial Hydrogen Measurement

(a) User Requirements

The USNWG began its January 2009 discussions in the User Requirements and Definitions Sections of Draft 3.3 of the NIST Handbook 44 Hydrogen Gas Measuring Devices Code (See Appendix A). This latest version of the code is the result of work by the DSS at its December 2008 meeting.

The USNWG made several minor editorial changes to paragraphs UR.1.2. Discharge Hose-Length and UR.1.3.(c)(2) Minimum Measured Quantity (MMQ); Conditions of Use, and it also held lengthy discussions on the intent of paragraph UR.1.3.(c). Paragraph U.R.1.3.(c) provides guidance to the operator/installer during installation, modification, and maintenance of equipment so that they do not exceed the limits on the size of the MMQ. Paragraph UR.1.3.(c) was developed as a corresponding user requirement to the design requirements in paragraph S.8. Minimum Measured Quantity; Conditions of Use.

Paragraph UR.1.3.(c) specifies the MMQ value in relationship to the measuring system's flow rate and is worded in a similar format to the language in OIML R 139 "Compressed Gaseous Fuel Measuring Systems for Vehicles paragraph 2.3.2 Field of Operation; MMQ form and Conditions of Use as follows:

UR.1.3. Minimum Measured Quantity.

(c) The minimum measured quantity shall satisfy the conditions of use of the measuring system as follows:

(1) Measuring systems having a maximum flow rate less than or equal to 4 kg/min shall have a minimum measured quantity not exceeding 0.5 kg

(2) Measuring systems having a maximum flow rate greater than 4 kg/min but not greater than 12 kg/min shall have a minimum measured quantity not exceeding 1.0 kg

The international requirement recognizes measuring systems with maximum flow rates greater than 70 kg/min. Consequently, the USNWG questioned whether or not the MMQs for all measuring systems with flow rates greater than 12

kg/min were adequately addressed in paragraph UR.1.3.(c). The USNWG considered real world refueling applications for larger vehicles such as small local buses with a hydrogen fuel storage tank capacity of 30 kg and larger buses with a 60 kg storage tank capacity. An automobile rated for refueling by a measuring system rated at 35 MPa (350 bar) would see a hydrogen delivery at 6 g/sec (0.36 kg/min); whereas a vehicle designed for refueling at 70 MPa (700 bar) would see deliveries at 28 g/sec (1.68 kg/min). A measuring system used to refuel larger vehicles such as a bus would be designed to fill a storage tank in 4 minutes, although the refueling procedure would typically be scheduled every other night. In this case, the maximum flow rate of the refueling system would need to be approximately 15 kg/min.

The USNWG agreed that measuring systems currently in use for vehicle refueling would not require a flow rate much greater than 10 kg/min. However, measuring systems used for automobiles and large passenger vehicles (i.e., buses) must undergo MMQ accuracy tests and meet other related criteria for both applications.

The USNWG also questioned whether or not paragraph UR.1.3.(c) is too prescriptive or is even necessary since the user/operator/installer should be following the conditions of use established by the equipment manufacturer. The conditions of use for a measuring system with regard to the MMQ and the associated flow rate(s) are already addressed in general language in paragraph UR.2.1. Manufacturer's Instructions and specifically in paragraph S.8. as follows:

S.8. Minimum Measured Quantity. – The minimum measured quantity shall satisfy the conditions of use of the measuring system as follows:

(a) Measuring systems having a maximum flow rate less than or equal to 4 kg/min shall have a minimum measured quantity not exceeding 0.5 kg.

(b) Measuring systems having a maximum flow rate not greater than 4 kg/min but not greater than 12 kg/min shall have a minimum measured quantity not exceeding 1.0 kg.

Because of its discussion about the necessity for both user and design requirements in the code the USNWG decided to reevaluate the wording of corresponding design paragraph S.8. The USNWG agreed that specific language for the design of the MMQ should be developed and universally apply to all commercial applications. The USNWG will also reexamine paragraphs such as S.3.1. Maximum and Minimum Flow Rates which reads as follows:

S.3.1. Maximum and Minimum Flow-Rates. - The ratio of the maximum to minimum flow-rates specified by the manufacturer for devices measuring gases shall be 10:1 or greater.

to ensure that there is no conflicting language in these requirements.

During its December 2008 meeting, the USNWG developed the language in paragraph S.8. The limits of a measuring system's MMQ value were based on the (1) language in OIML R 139 paragraph 2.3.2, (2) typical flow rates of systems already in use (0-4 kg/min and 4-12 kg/min), and (3) values that would result in sufficient resolution of the indicated mass to determine the accuracy of a delivery.

The principle for (3) is taken from NIST Handbook 44 Appendix A Fundamental Considerations Section 3. Testing Apparatus paragraph 3.2. Tolerances for Standards which states in part that "when the standard

is used without correction, its combined error and uncertainty must be less than one-third of the applicable device tolerance." For example given an MMQ value of 500 g and the proposed performance tolerance of 1.5 % (See Draft 3.3 Table T.2 Accuracy Classes for Hydrogen Gas Meter Applications) the permissible error for a delivery at the MMQ of 500 g would be calculated 500 g multiplied by 0.015 which equals 7.5 g. Based on the Fundamental Consideration we would not want to attribute more than one-third of the allowable 7.5 g of error to the test standard. In this case the test standard combined error and uncertainty should not be greater than the value of 7.5 g divided by 3, which equals 2.5 g. A typical test standard used for verification of this equipment indicates mass in a quantity division value of 2 g, which satisfies the mathematical relationship between a test standard and accuracy level of the equipment under test that is specified in the Fundamental Considerations.

The USNWG agreed that Marc Buttler (Micro Motion, Inc.) and Juana Williams (NIST WMD) will rework the language in paragraph S.8 and examine related paragraphs in the draft code to eliminate any conflicts between requirements. One option that was recommended is to explore the use of a single formula that could be applied to all applications such as

The MMQ shall comply with the formula:

$$\text{MMQ} = \frac{\text{maximum flow rate of a measuring system for 1 minute}}{10}$$

(b) Revisions to User Requirements in Draft 3.3 of the NIST Handbook 44 Hydrogen Gas Measuring Devices Code

Paragraphs modified by the USNWG during the January 2009 meeting and the rationale for their actions are as follows:

January 2009 USNWG Modifications to User Requirements in Draft 3.3 of the Hydrogen Gas Measuring Devices Code		
Change to Requirements:	Requirement Title:	Reason for Change:
Edit text in paragraph UR.1.2.	Discharge Hose-Length.	Editorial to correct spelling.
<p><u>UR.1.2. Discharge Hose-Length. - The length of the discharge hose on a retail fuel dispenser:</u></p> <p><u>(c) shall be measured with the hose fully extended if it is coiled or otherwise retained or connected inside a housing.</u></p> <p><u>An unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.</u></p>		
Change to Requirements:	Requirement Title:	Reason for Change:
Delete text in paragraph UR.1.3.(2)	Minimum Measured Quantity	Deleted the word "not" to correctly state the mathematical relationship that shall apply for the measuring system's flow rate when applying the conditions in subparagraph UR.1.3 (c)(2)
<u>UR.1.3. Minimum Measured Quantity.</u>		

(c) The minimum measured quantity shall satisfy the conditions of use of the measuring system as follows:

(1) Measuring systems having a maximum flow rate less than or equal to 4 kg/min shall have a minimum measured quantity not exceeding 0.5 kg

(2) Measuring systems having a maximum flow rate ~~not~~ greater than 4 kg/min but not greater than 12 kg/min shall have a minimum measured quantity not exceeding 1.0 kg

(2) Application of Device Standards

(a) Paragraph A.3. Type Evaluation

During its December 2008 meeting, the DSS requested that the Technical Advisor research paragraph A.3. Type Evaluation to determine whether or not this paragraph adequately addresses a device that may be submitted for type evaluation. Historically, new codes adopted by the National Conference on Weights and Measures are given tentative status for a period up to five years. A 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 that has permanent status. This practice allows sufficient time for fully developing an appropriate final code and to receive input from all stakeholders (regulatory officials, manufacturers, laboratories, consumers, etc.) affected by the requirements.

Any regulatory authority wanting to conduct an official examination of a device or system are advised to review Section 1.10 General Code paragraph G-A.3. Special and Unclassified Equipment. The provisions in paragraph G-A.3. allow an official to apply the General and/or specific code requirements for similar applications to commercial equipment, which for one reason or another does not fall under a single permanent device code. In accordance with paragraph G-A.3. an official may proceed with type evaluation and routine inspection and test of commercial equipment on a continuing basis until such time as there is a permanent code.

It should also be noted that this is a brand new code that is intended to apply to all generations of this software driven equipment. Consequently, there is no need to include enforcement dates in the code, where the requirements apply at a different time period to older equipment than they would to newer equipment.

As written in Draft 3.3 the application paragraph intending to address equipment undergoing type evaluation would be part of a tentative code and like all other paragraphs would apply only on a trial or experimental basis. The USNWG acknowledges that multiple jurisdictions already have codes, policies, and procedures in place to address new equipment when there is no corresponding permanent code. However, the USNWG agreed that a new preamble (see table below) should be added to the draft code to clarify how the Hydrogen Gas Measuring Devices Code and other applicable codes apply to hydrogen dispensing equipment. The preamble will also cite paragraph G-A.3. for stakeholders unfamiliar with how to proceed with new equipment in the interim period. The National Type Evaluation Program already applies to new devices not covered by a specific device code even though the program bases its evaluation criteria on NIST Handbook 44 General and device Code sections. Paragraph A.3. will be deleted from the draft code.

(b) Revisions to Application Requirements in Draft 3.3 of the NIST Handbook 44 Hydrogen Gas Measuring Devices Code

Paragraphs modified by the USNWG during the January 2009 meeting and the rationale for their actions are as follows:

January 2009 USNWG Modifications to Application Requirements in Draft 3.3 of the Hydrogen Gas Measuring Devices Code		
Change to Requirements:	Requirement Title:	Reason for Change:
Delete paragraph A.3. and add a new preamble after the section title for the draft code.		Added a new preamble to replace the application paragraph to clarify how this newly recognized code, which will have tentative status rather than permanent status, will apply to devices submitted for type evaluation and used in commercial applications.
<p><u>A.3. Type Evaluation. – The National Type Evaluation Program will accept for type evaluation only those devices that comply with all requirements of this code.</u></p> <p><u>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 a device or system are advised to see paragraph G-A.3. Special and Unclassified Equipment.</u></p>		

(3) Marking Information

During the development of the NIST Handbook 44 Hydrogen Gas Measuring Devices Code a requirement specifying the proper location of marking information required in General Code paragraph G-S.1. Identification and paragraphs S.5. Markings(a) through (j) may have been inadvertently omitted. Similar retail applications in NIST Handbook 44 Sections 3.30 Liquid Measuring Devices and 3.37 Mass Flow Meters Codes include a requirement that specifies the location of marking information.

The Liquid Measuring Devices Code specifies:

S.4.4.2. Location of Marking Information; Retail Motor-Fuel Dispensers. – *The marking information required in the 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-measuring devices.
[Nonretroactive as of January 1, 2003]*

(Added 2002) (Amended 2004)

The Mass Flow Meters Code specifies:

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-measuring devices.*

[Nonretroactive as of January 1, 2003]

(Added 2006)

These design requirements are intended to ensure that required marking information is placed in an easily accessible location. The marking information is necessary to ensure devices conform to type, are suitable and approved for a particular application, and in determining the appropriate test of the equipment. The required marking information should be permanently affixed to the device so that it is not accidentally removed or inadvertently switched to another device during inspection and test or servicing of the equipment. The USNWG was asked to consider whether or not a similar requirement should be included in the Hydrogen Gas Measuring Devices Code. The USNWG agreed to carry this discussion over to the February 24, 2009, meeting to provide ample time for stakeholders to research the proposed requirement.

(4) Update on the January 2009 National Conference on Weights and Measures

Proposals to introduce Draft 3.3 of the NIST Handbook 44 Hydrogen Gas Measuring Devices Code and Draft 2.3 of the NIST Handbook 130 Laws and Regulations and Engine Fuel Quality for Hydrogen (See Appendix B) were submitted to the January 2009 National Conference on Weights Measures, Inc. (NCWM). This was the first time the draft codes appeared on a national agenda. Since 1905, the NCWM is the forum whereby national weights and measures standards have been introduced, discussed, and formally recognized by the states.

The USNWG received updates on the status of the proposals. The device code proposal is a developing item on the NCWM Specifications and Tolerances Committee Agenda, which means the USNWG must notify the NCWM when the proposal is ready for adoption. The NCWM Laws and Regulations Committee made the fuel quality and method of sale requirement an information item, which means it will now work with the USNWG to fully develop the proposal. Draft 2.3 of the Fuel Quality and Method of Sale Requirement was not modified by the January 11-14, 2009 NCWM or after its distribution to the USNWG on January 22, 2009. The USNWG hearing no recommendations to modify the proposed code, agreed that Draft 2.3 will be published in NCWM Publication 16 the "Committee Reports for the 94th Annual Meeting-July 12-16, 2009 San Antonio, Texas." Since both proposals are a work in progress the July 2009 NCWM will be updated on all changes made by the USNWG during the period of February through July 2009.

The status of both items on the NCWM agendas will result in their appearance on all four regional weights and measures association meeting agendas in Fall 2009. NIST will have representatives present at the annual meetings of the regional weights and measures associations ready to address questions or to provide hydrogen presentations to these groups. The USNWG agreed that the proposals will need to be finalized and ready for a vote of the July 11-15, 2010 NCWM Annual Meeting in St. Paul, MN (see <http://www.ncwm.net>). The USNWG is encouraged to participate in the regional and national meetings in support of the proposed requirements. Agenda items adopted by the NCWM are then published in NIST Handbooks, which are adopted in part or entirety by the States as law and regulation.

(5) Opportunity for Reports on Related Activities for Hydrogen Devices and Fuel Quality

(a) Update on Work at the California Department of Food and Agriculture Division of Measurement Standards (CA DMS)

Kristin Macey (CA DMS) reported that the California Energy Commission released a draft Investment Plan as directed in Assembly Bill 118. The plan describes how funding will be spent in the development of an Alternative and Renewable Fuel and Vehicle Technology Program. Most notable and encouraging were several mentions of CA DMS projects as necessary even though they are not part of greenhouse gas reductions.

Al Hebert indicated that California continues to move forward with the interim standard for fuel quality and will revisit the document to recognize changes that reflect the latest industry practices as these standards and procedures become available.

(b) Update on Work at Other Agencies/Organizations

(i) SAE

Bob Boyd (Linde NA, Inc.) reported on the efforts of the SAE 2719 Hydrogen Quality Guidelines for Fuel Cell Vehicles Task Force to ensure that the fuel quality specification adequately defines the permissible properties and their levels in hydrogen fuel. The specifications should address the impurities that are the result of various production methods, as well as those that are detrimental to a fuel cell and that have an adverse affect on a measurement system. The SAE also plans to modify the 10 micrometer limit on particulate contaminant size in row 11 of the proposed table of specifications to read g/kg. The intent is to eliminate the need for optical scanning of 10 micron filters that would be placed at the end of a nozzle. The Task Force findings are that the filters create noise, heat, pressure drops, and result in a nozzle design that is too heavy to hold. The Task Force also noted that it is difficult to avoid catching particulates from the environment in the filter. The Task Force plans to revise the specification to clarify the maximum limit of 100 ppm v/v for total non-helium and non-hydrogen constituents other than nitrogen and argon. The Task Force encourages the recognition of a single uniform specification.

(ii) International Organization of Legal Metrology Recommendation 139 (R 139)

Juana Williams (NIST WMD) reported that the first working draft (1 WD) for corresponding international model regulation R 139 for "Compressed Gaseous Fuel Measuring Systems for Vehicles" was distributed January 9, 2009 to solicit input from stakeholders to establish a U.S. position on the document. NIST WMD which is responsible for developing the U.S. position will also work to harmonize the Hydrogen Gas Measuring Devices Code wherever possible with R 139. Comments on the 1 WD for R 139 are due March 1, 2009.

(6) Administrative Business

(a) Upcoming April and August 2009 Meeting Status

The USNWG Subcommittees identified the dates listed in the table below for upcoming USNWG meetings. It is anticipated that there may be a need to dedicate an entire meeting to one specific device or fuel quality related project that is identified by the USNWG. Future meeting locations will be based on logistics and technical tasks that the USNWG must accomplish. The USNWG will make every effort to post meeting information and to avoid scheduling conflicts with upcoming events and meetings in the weights and measures and hydrogen communities. The sites of: (1) NIST-Gaithersburg, MD, (2) Palm Springs, CA, (3) Grand Forks, North Dakota, and (4) Santa Monica, CA were tentatively selected for the April and August 2009 meetings. The USNWG received updates on three of four sites and also discussed the California Fuel Cell Partnership, Sacramento, CA as a possible meeting site for the April 2009 meeting. The Sacramento California location will lessens travel for multiple USNWG members and guests and is in good proximity to hydrogen dispensing stations. NIST has reserved meeting rooms for both April and August 2009. On February 2, Jackie Birdsall confirmed that the California Fuel Cell Partnership will host the April 28-30, 2009 meeting.

Schedule for the USNWG 2009 Meetings	
Date(s)	Location
February 24, 2009/1:00 p.m. - 4:00 p.m. EST	Tele/Web Conference Meeting
April 28-30, 2009 /Day1&2 8:30 a.m. – 5:00 p.m. EDT DSS Meeting; Day 3 8:30 a.m. – 12 noon EDT FSS Meeting	California Fuel Cell Partnership, Sacramento, CA
August 18-20, 2009 /Day1&2 8:30 a.m. – 5:00 p.m. EDT DSS Meeting; Day 3 8:30 a.m. – 12 noon EDT FSS Meeting	In-Person Meeting TBD

The USNWG wishes to express its sincerest thanks to Julie Cairns, CSA America, Inc. for hosting and organizing the January 30, 2009 conference, and providing technical assistance with the meeting report.

(b) USNWG Guidelines

The USNWG requested that the Technical Advisor redistribute the August 2008 version of the guidelines and agenda submission form and ballot the USNWG in December 2008 for its approval of both documents. The USNWG was updated on the voting results. Members who did not respond by the deadline agreed that their vote would count as acceptance of the guidelines and form.

The Technical Advisor reported that the vote was scanty but unanimously in favor of the guidelines. The USNWG requested that Technical Advisor notify the group of the voting results by email within a week and post the guidelines on the USNWG web site at <http://www.nist.owm.gov>.

Technical Note: The Technical Advisor moved the deadline for the vote on the guidelines to January 21, 2009 due to scheduling conflicts that multiple members of the USNWG had with the original January 9 deadline.

(c) Approve the Summary of the December 2008 USNWG Meeting (See Appendix C)

The USNWG December 2008 Meeting Summary was distributed on January 30. The USNWG required more time to complete a sufficient review of the summary. The USNWG requested the Technical Advisor ballot the entire group by email to vote on approval of the December 2008 USNWG Meeting

Summary by February 13. The USNWG should review the write up the summary of it December 2008 decisions for clarity, accuracy, completeness, then return their comments and vote within two weeks.

(7) Next Steps/Tasks

The USNWG discussed ideas regarding how the work should progress to fully develop hydrogen measurement standards and to find opportunities for holding equipment to the draft code and subsequent test procedures. The USNWG identified Fall 2009 as the target date for introducing a final draft of the device and fuel quality code that is ready for national adoption. This means that the work needs to escalate to have the code ready by mid August 2009 so that it can be distributed at all four fall 2009 regional weights and measures association meetings which starts the weights and measures standards adoption cycle for 2010. USNWG project work and target dates were identified (See Appendix E).

(8) Next Meeting

The next meeting will be a tele- and webconference on Tuesday 1:00 p.m. to 4:00 p.m. (EST), February 24, 2009. Please note that the meeting will adjourn at 4:00 p.m. (EST) rather than 3:00 p.m.

4:00 P.M. (EST) Meeting Adjourned

Please contact Juana Williams (NIST-WMD) at juana.williams@nist.gov if you have questions about this summary or wish to participate in the USNWG work.

Appendix D		
Comparison of Corresponding National and International Requirements for the Minimum Measured Quantity		
[Text in bracket describes the difference(s) in the national and international requirement]		
OIML R 139 "Compressed Gaseous Fuel Measuring Systems for Vehicles	Draft 3.3 NIST Handbook 44 Hydrogen Gas Measuring Devices Code	Requirement
T.3.5 Minimum Measured Quantity of a Measuring System	Appendix D Minimum Measured Quantity	▪Defines the "minimum measured quantity" of a measuring system
2.3.1 Field of Operation; Characteristics		▪Specifies the MMQ as one of nine parameters used to determine the operational range* of a measuring system
2.3.2 Field of Operation; Minimum Measured Quantity Form	S.8. Minimum Measured Quantity [No requirement for the format of MMQ in specific scale division units]	▪Describes the format for expressing the MMQ, and ▪Describes the relationship of the MMQ's numerical value relative to the measuring system's flowrate
3.1.3 Maximum Permissible Errors (MPEs) and Other Metrological Characteristics; MPE Applicable to the Minimum Measured Quantity	T.4.1.(b) Tolerance Application; Type Evaluation Examination [Tolerances are the same for MMQ as other quantities (the MPEs for accuracy tests at the MMQ do not have the less restrictive tolerance of R 139)]	▪Specifies that the maximum permissible errors that apply during a delivery of the MMQ are twice that stated in paragraph 3.1.1. ▪Provides a formula for calculating the absolute value of the maximum permissible error for the MMQ of a system
5.2.1 Power Supply Device; Indicated Mass Error		▪Specifies an additional permissible error for the indicated mass that is based on the MMQ value. This error is applied to the indicated mass used to complete a transaction during a loss of power
6.1.7 Technical Requirements for Measuring Systems with Self-		▪Specifies that the totalizer's scale interval used in self service

service Arrangement; Affect of Scale Interval		deliveries shall not affect the MMQ
7.1.1 Marking; Information	S.5. Markings [MMQ is one of ten rather than one of seven parameters to be marked]	▪Specifies that the MMQ* is one of seven parameters that shall be marked on the measuring system
8. Metrological Control; Errors on Indications of Mass		▪In part, this paragraph, exempts tests at the MMQ or twice this value from the application of an expanded uncertainty on the determination of errors for mass indications
8.3.2. Subsequent Verification; Test Quantity		▪Prescribes repeating a test of the meter, if seals are not present on the measuring element at the start of a subsequent verification. ▪This stage of the test may be replaced by a test of the measuring system if: (1) seals are in place and undamaged, and (2) the measuring system can be tested at quantities equal to and greater than the MMQ
B.2.3 Accuracy Tests Involving Only One Bank		▪Prescribes specific conditions for the receiving vessel pressure and station storage pressure when conducting four tests of a measuring system without sequential controls and involving only one storage bank ▪One of four test conditions apply to tests at the MMQ
Annex B B.2.5 Endurance Test		▪Prescribes the required volume that must be measured during the Endurance Tests at the MMQ
Annex C		▪Prescribes the minimum quantity

Conclusion		<p>that must be measured in relationship to the total number of scale intervals when performing six particular test cases</p> <ul style="list-style-type: none"> ▪ Specifies the minimum quantities of scale divisions that do not apply to tests performed at the MMQ
Annex D D.3.1 Low Flow Cut Off		<ul style="list-style-type: none"> ▪ Paragraph recognizes that it is desirable to see all flow indications; therefore the low flow cut off value may be set to zero ▪ In real world situations the value depends on <ul style="list-style-type: none"> (1) zero stability of the meter, (2) MMQ of the system, and (3) Each particular application
	S.1.3.3. Maximum Value of Quantity-Value Divisions	<ul style="list-style-type: none"> ▪ Prescribes the maximum value of the quantity division relative to the MMQ
	S.4.2. Directional Flow Valves	<ul style="list-style-type: none"> ▪ Requires that a mechanism shall be in place to prevent the reversal of flow, if the reversal of flow results in errors greater than the permissible error for the MMQ
	N.1. Minimum Measured Quantity	<ul style="list-style-type: none"> ▪ Requires a test at the minimum measured quantity*
	N.3. Test Drafts	<ul style="list-style-type: none"> ▪ Prescribes a minimum of two tests and ▪ Prescribes the corresponding draft size for each test in quantities relative to the MMQ
	N.4.1. Master Meter (Transfer) Standard Test	<ul style="list-style-type: none"> ▪ Recognizes the Master Meter Standard Test Method ▪ Prescribes a minimum of two tests and ▪ Prescribes the corresponding

		draft size for each test in quantities relative to the MMQ
	N.4.2. Gravimetric Test	<ul style="list-style-type: none"> ▪Recognizes the Gravimetric Test Method ▪Prescribes a minimum of two tests and ▪Prescribes the corresponding draft size for each test in quantities relative to the MMQ
	N.4.3. PVT Pressure Volume Temperature Test	<ul style="list-style-type: none"> ▪Recognizes the Pressure Volume Temperature Test Method ▪Prescribes a minimum of two tests and ▪Prescribes the corresponding draft size for each test in quantities relative to the MMQ
	N.5. Minimum Measured Quantity	▪Requires a test at the MMQ when a device is likely to be used to dispense deliveries at the MMQ
	UR.2.3.(c) Minimum Measured Quantity; Condition of Use	▪Requires the user to operate the device/measuring system within the relationship of the MMQ's numerical value relative to the measuring system's flowrate as declared by the manufacturer
* as specified by the manufacturer		

Appendix E
Task List of the
U.S. National Work Group (USNWG)
for the Development of Commercial Hydrogen Measurement Standards
January 30, 2009

Note: This is a list of tasks the USNWG Subcommittees agreed to accomplish at their January 2009 tele-/webconference meeting.

	Responsible Party(s)	Task	Details of Task	Deadline
(1)	Marc Buttler, Juana Williams	Develop MMQ criteria	Rework paragraph S.8 Consider formulae Eliminate conflicts	
(2)	USNWG	Explore proposal for location of required marking information		February 24, 2009
(3)	USNWG	Assess level of interest Submit comments	Establish U.S. stakeholder position on a corresponding international requirement for gaseous fuel measuring systems for vehicles	March 1, 2009
(4)	Juana Williams	Email final USNWG Guidelines to include voting results		February 6, 2009
(5)	Jackie Birdsall, Kristin Macey, Juana Williams	Confirm location of April 2009 USNWG meeting	Secure the California Fuel Cell Partnership, Sacramento, CA	
(6)	Juana Williams	Ballot the USNWG by email for approval of the December 2008 meeting summary		February 13, 2009
(7)	Juana Williams	Distribute the January 2009 meeting summary for the USNWG's review and		February 20, 2009

USNWG COMMERCIAL H2 MEASMT STANDARDS
2009 JAN FINAL MTG SUMMARY

		approval	
(8)	USNWG	Provide input on draft meeting summary	14 days from receipt

Appendix F Attendee List-January 30, 2009 Teleconference/Webconference Meeting USNWG Hydrogen Device Standards and Fuel Specifications Subcommittees				
Name	Agency	Device Standards Subcommittee (DSS) Member Yes (Y)	Fuel Specifications Subcommittee (FSS) Member Yes (Y)	Attended Joint Tele-/Webconference Yes (Y)
Jackie Birdsall	California Fuel Cell Partnership		Y	Y
Robert Boyd	Hydrogen Solutions – Linde Group	Y	Y	Y
Tina Butcher	NIST – TS WMD	Y	Y	Y
Marc Buttler	Micro Motion/Emerson Process Management	Y	Y	Y
Julie Cairns	CSA America	Y	Y	Y
Ronald Hayes	Missouri Dept. of Agric.-Weights and Measures Div.		Y	Y
Jared Hightower	Greenfield Compression	Y	Y	Y

Robert Ingram	CA – Food and Ag., Div. of Measurement Standards	Y	Y	Y
Diane Lee	NIST – TS WMD	Y	Y	Y
Kristin Macey	CA – Food and Agriculture, Division of Measurement Standards	Y	Y	Y
Lisa Warfield	NIST – TS WMD	Y	Y	Y
Curt Williams	CP Williams Energy Consulting LLC-Consultant for Georgia Dept. of Agric., State Oil Laboratory	Y	Y	Y
Juana Williams	NIST – TS WMD	Y	Y	Y
John Wright	NIST Chemical Science and Technology Laboratory, Process Measurements Division	Y	Y	Y

Appendix F

**Guest List-January 30, 2009
USNWG Hydrogen Device Standards and Fuel Specifications Subcommittees**

Name	Agency	Attended Joint Tele-/Webconference Yes (Y)
Bill Collins	UTC Power	Y
Al Hebert	CA – Food and Agriculture, Division of Measurement Standards	Y
John Mough	CA – Food and Agriculture, Division of Measurement Standards	Y
Dan Reiswig	CA – Food and Agriculture, Division of Measurement Standards	Y
Van Thompson	CA – Food and Agriculture, Division of Measurement Standards	Y