

**U.S. National Work Group
for the
Development of Commercial Hydrogen Measurement Standards
December 15, 2009**

**Joint Device Standards Subcommittee (DSS) and Fuel Specifications Subcommittee (FSS)
Tele/Web Conference Meeting**

MEETING SUMMARY

Time: Tuesday, December 15, 2009/3:00 p.m. – 4:30 p.m. ET-USA & Canada (GMT - 05:00)

To join the meeting online: <http://nist.na6.acrobat.com/hydrogenusnwg/>

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This meeting was sponsored by the U.S. Department of Energy and U.S. Department of Commerce's National Institute of Standards and Technology.

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

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Appendix	Related Agenda Item(s)	
A	(2)(a)	Draft Summary of the April 2009 USNWG Meeting
B	(2)(b)	Draft Summary of the August 2009 USNWG Meeting
C	(4)(b)	Preliminary USNWG's Responses to Input on the Draft Hydrogen Codes from the Fall 2009 Regional Weights and Measures Associations
D	(4)(b)	Draft 5.0 of the NIST Handbook 44 Hydrogen Gas-Measuring Devices Code
E	(4)(b)	Draft 3.0 of the NIST Handbook 130 Uniform Laws and Regulations and Hydrogen Fuel Quality Codes
F	(3)(a)	ASTM D03.14 Hydrogen and Fuel Cells December 2009 Meeting Minutes
G	(1)	Attendee List
*Device Standards Subcommittee (DSS)		
**Fuel Specifications Subcommittee (FSS)		

Glossary of Acronyms			
ASTM	American Society of Testing and Materials International	MPa	megapascal
CaFCP	California Fuel Cell Partnership	NGV	Natural Gas Vehicle
CDFA DMS (also CADMS)	California Department of Food and Agriculture, Division of Measurement Standards	NHA	National Hydrogen Association
CSA	Canadian Standards Association, Incorporated	NIST	National Institute of Standards and Technology
DSS	Device Standards Subcommittee	NTP	Normal Temperature and Pressure
EPO 29	Draft Hydrogen Gas Retail Motor-Fuel Dispenser Examination Procedure Outline (EPO) 29	OEM	Original Equipment Manufacturer
FSS	Fuel Specifications Subcommittee	OIML	International Organization of Legal Metrology
HB 44	NIST Handbook 44 Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices (2009)	OIML R 139	Recommendation for Compressed gaseous fuel measuring systems for vehicles
HB 130	NIST Handbook 130 Uniform Laws and Regulations in the Area of Legal Metrology and Engine Fuel Quality (2009)	RMFD	Retail Motor-Fuel Dispenser
HGV	Hydrogen Gas Vehicle	SAE	Society of Automotive Engineers
ISO	International Organization for Standardization	SI	International System of Units

Glossary of Acronyms

MMQ	Minimum Measured Quantity	USNWG	U.S. National Work Group
MOS	Method of Sale		
This table is meant to assist the reader in the identification of acronyms used in this summary and does not imply that these terms are used solely to identify these organizations or technical topics.			

AGENDA TOPICS

3:00 P.M. (ET)

(1) Welcome Current/New Members and Roll Call

Members of the USNWG and visitors were welcomed and the meeting was called to order. Roll was called for the meeting participants (see Appendix G) and the meeting's purpose was reviewed. The collaborative work by the meeting's sponsors was recognized.

The membership roster was corrected to include current member Mark McDougall (Powertech Labs, Inc.) and add new member Dan Reiswig (CADMS) to the both Device Specifications and Fuel Specifications Subcommittees. Charlie Nelson (CADMS) was added as a new member to the Device Specifications Subcommittee.

(2) Administrative Business

The USNWG addressed the following items:

(a) Approve the Summary of the April 2009 USNWG Meeting

A draft summary of the April 28-30, 2009 USNWG in-person meeting at the California Fuel Cell Partnership in West Sacramento, CA (see Appendix A) was emailed on December 12, 2009 to the group for its review. The USNWG agreed to review, compile any comments, and be ready to vote on approval of the summary by the upcoming January 13, 2010 tele/web conference meeting.

(b) Approve the Summary of the August 2009 USNWG Meeting

A draft summary of the August 11-13, 2009 USNWG in-person meeting at NIST, Gaithersburg, MD (see Appendix B) was emailed on December 12, 2009 to the group for its review. The USNWG agreed to review, compile any comments, and be ready to vote on approval of the summary by the upcoming January 13, 2010 tele/web conference meeting.

(c) Agenda Updates for the December 2009 Meeting

A new item was added by Michael Keilty (Endress & Hauser Flowtech AG) to the discussions under Agenda Item (4)(b), which are the most recent comments on the latest drafts of the Hydrogen Codes. These comments may require the USNWG's input before the January 24-27, 2010 National Conference on Weights and Measures (NCWM) Interim Meeting. This new item will be designated as USNWG #1 and included in the December meeting discussions under the summary for Agenda Item (4)(b).

(3) Opportunity for Reports on Related Activities

The USNWG is working to harmonize, wherever possible, with related standards to encourage uniformity and to avoid contradictory requirements and trade barriers for U.S. industry. The USNWG Subcommittees received updates on related activities underway by the following organizations:

(a) ASTM D03.14

Jackie Button (CaFCP) provided a report (see Appendix F) on multiple ASTM D03.14 Hydrogen and Fuel Cells Committee work items with either a January 15, 2010 (three work items) or March 5, 2010 (five work items) deadlines for committee ballot. These dates were set to ensure standards are published by June 2010.

The USNWG also received updates on other projects of the ASTM D03.14 and related work addressed at the December 7-9, 2009 meeting of the D03.14 in Anaheim, CA. ISO TC 197 Working Group 12 Hydrogen Fuel – Product Specification and ASTM are working toward a Draft International Standard for publication in June 2010.

Additionally, Work Item 5847 Standard Practice for Sampling of High Pressure Hydrogen and Related Fuel Cell Feed Stocks, with Technical Lead John Mough (CADMS), is in the process of addressing three comments before that document's publication. Official Item D7550-09 under Work Item 9211 Standard Test Method Ion chromatograph Based Determination of Cations in Hydrogen and other Fuel Cell Feed Gases was published. A new work item is being initiated for Pulsed Discharge Helium Ionization Detection, to include CO, CO₂, Ar, N₂, and O₂, as an alternative test method to ASTM Work Item 4548 Standard Test Method for Determination of Trace Contaminants in Hydrogen and Related Fuel Cell Feed Gases.

Please note that a follow up with Michael Steele (SAE/GM) on the reported expiration of SAE TIR 2719 Hydrogen Quality Guideline for Fuel Cell Vehicles indicates there is no expiration date on this document.

(b) CDFA

(i) County/State Liaison Office

Kristin Macey reported on her new appointment as County Liaison for CDFA. Kristin moved from her position as Assistant Director in CDFA's Division of Measurement Standards (DMS) in October 2009. The scope of her duties now includes agriculture and other hydrogen applications such as stationary fuel cells. Part of her new duties includes continued work with DMS. Kristin's new assignment will allow her to remain as Chair of the Device Standards Subcommittee.

The DMS funding from the California Energy Commission for work on device and fuel quality standard equipment is going through the contract process and will not be received until February 2010.

(ii) Division of Measurement Standards

Dan Reiswig indicated that he is having ongoing discussions with members of the hydrogen community interested in legal metrology standards and test procedures and equipment. Dan encouraged the full involvement of NIST in this work. He also suggested use of a format similar to the NIST 105 Handbook Series. The NIST 105 Handbooks are a series of reference standards that include specifications and tolerances for field standard test measures. The series contains the recommended minimum requirements for test standards used to verify commercial measuring equipment's performance.

(c) CSA Standards

Julie Cairns reported that CSA has entered into discussions with the CaFCP and CADMS on a test sled to validate dispensers to SAE J 2601 Compressed Hydrogen Vehicle Fueling Communication Devices which is targeting safe fueling protocols (time to fill, minimum % fill, and temperature, pressure and flow rate limits). CSA still has an interest in a single standard for performance test for SAE, CSA, NIST, and the USNWG which will allow organizations and agencies to pool their resources.

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

(a) Performance Data

USNWG members agreed to forward data from performance tests conducted between August 2009 through January 2010 to Diane Lee (diane.lee@nist.gov) and Juana Williams (juana.williams@nist.gov). Data is being gathered to further confirm at least one viable field test method and to verify the performance of hydrogen dispensers to tolerances in the proposed code. NIST continues its work to refine the guidelines for test procedures used to gather performance data. The USNWG received an update on the status of this project.

Mark McDougall (Powertech Labs, Inc.) reported he is in the process of compiling data collected from four different test methods (gravimetric, volumetric, master meter, and measured decant).

Diane Lee noted that at this time a NIST 105 specification and tolerance for master meters is at best only in the planning stages. Ms. Lee has also updated the Draft EPO 29 and will have a third revision ready by February 16,

2010 for distribution to the USNWG for its review. CADMS agreed to review the EPO before its distribution to the USNWG. Updates to the EPO are continuously being made as the USNWG makes revision to the draft code. Additionally, Ms. Lee has prepared a draft guideline for those gathering performance data with the more widely used gravimetric test method. This approach was taken to expedite getting procedures to everyone working in the communities to gather performance data. The guideline includes: (1) a scope, (2) safety alerts, (3) scale selection criteria, (4) procedures excerpted from Draft EPO 29, and (5) highlights on reducing uncertainties associated with the test equipment, process, and equipment under test. The guideline does not focus on identifying any one manufacturer's equipment, but are intended to provide instructions on how to collect comparable and usable uniform data. Ms. Lee will forward the guidelines to Dan Reiswig (CADMS) by December 16th. Ms. Lee will develop an excel spreadsheet test report shortly.

(b) Address Comments on Draft Hydrogen Codes/Input to the January 2010 National Conference on Weights and Measures (NCWM)

Fall 2009 Input on Draft Codes

In preparation for input to the January 24-27, 2010 NCWM, the USNWG was asked to address comments received on the draft hydrogen codes from the U. S. regional weights and measures associations that met in fall 2009. Three of four regional weights and measures associations supported moving the draft codes forward as voting items on the national agendas at the July 2010 NCWM Annual Meeting. The results are as follows:

Regional Weights and Measures Association	HB 44 Device Code	HB130 Fuel Quality	HB130 Method of Sale
Central (CWMA) IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, PR, SD, WI	Support	Support	Support
Northeastern* (NEWMA) CN, ME, MA, NH, NJ, NY, PA, RI, VT	Upgrade only to information item status. Will support the code if the proposal includes a test procedure and addresses safety	Maintain information item status	Maintain information item status
Southern*(SWMA) AL, AR, DC, DE, FL GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VI, VA, WV	Support with comments	Support, but asks for documents on the effects of constituents that exceed levels in the specification table	Support
Western (WWMA) AK, AZ, CA, CO, HA, ID, MT, NV, NM, OR, UT, WA, WY	Support the code and the collection of data	Support	Support

There were 23 comments* received from two of four regional associations that may require input from the USNWG. The reasons for these comments varied and are as follows:

- Clarify some text/terms borrowed from existing codes
- Address safety
- Provide an equipment test procedure

- Consider any limits imposed on other applications
- Select suitable corresponding terms/wording from alternative code sections
- Determine if some code sections apply to a laboratory environment
- Regroup paragraph(s) with similar technical requirement(s)

On November 13, 2009, a list containing each comment along with either a suggested response or possible action item (see Appendix C) was distributed to the USNWG for its review. The December 2009 USNWG meeting discussions on the draft hydrogen codes focused on the list of comments.

New Item USNWG #1 – Comment on the Draft Hydrogen Code Requiring the USNWG's Input

Michael Keilty (Endress & Hauser Flowtech AG) requested the USNWG revisit the draft code paragraph that addresses factors affecting product density. The new item will be designated as USNWG #1 and included in the list of comments on the Draft Hydrogen Codes needing the USNWG's input before the January 24-27, 2010 National Conference on Weights and Measures (NCWM) Interim Meeting.

In August 2009 the USNWG deleted examples of factors that affect the density of hydrogen gas from proposed new NIST Handbook 44 Section 3.39 Hydrogen Gas Measuring Devices Code paragraph S.3.4. Automatic Density Correction as shown below:

S.3.4. Automatic Density Correction. - An automatic means to determine and correct for changes in product density shall be incorporated in any hydrogen gas measuring system where measurements are affected by changes in the density (e.g., the effects of temperature, pressure, or variations in composition due to feedstock, processing, storage, or the environment) of the product being measured.

Mr. Keilty announced plans that he would request the January 2010 NCWM, which meets to consider the code's readiness for adoption, to place these examples back into draft hydrogen code paragraph S.3.4. This action would align the draft hydrogen code requirement with those for volume-measuring devices in corresponding paragraph S.3.6. Automatic Density Correction in Section 3.37 Mass Flow Meters Code.

The USNWG December 2009 meeting concluded without the USNWG reaching a consensus on the final wording of this paragraph.

Background: The following discussions cover the history on how the weights and measures community developed corresponding requirements for automatic density correction and how the USNWG arrived at similar language in the draft hydrogen code. The discussions were included in this agenda item to assist the USNWG in its deliberations on arriving at appropriate equipment requirements and to encourage a fair and competitive environment where all technologies used in the delivery of gaseous hydrogen are accurate, suitable for this application, and do not facilitate fraud.

USNWG August 2009 Meeting Discussions

Many requirements in the draft hydrogen code were taken from similar dispenser applications that are part of NIST Handbook 44. Initially, the USNWG found hydrogen dispensing systems were equipped with mass flow meter technology for use to measure the quantity of gas delivered into a vehicle. Consequently, many requirements were taken from current sections of the NIST Handbook 44 Mass Flow Meters Code. The draft hydrogen code is now intended to apply to other measurement technologies.

The USNWG's provided a rationale for modifying paragraph S.3.4. Given the dynamics of hydrogen dispensing systems, the effects of heating, high pressures, and extreme changes in flow rates are possible, therefore the operator of the equipment should attempt to reduce to the greatest extent possible *all* factors, not just those examples that were listed in paragraph S.3.4., which are likely to introduce errors in the system's measurement results. Draft 5.0 of the HB 44 hydrogen code (see Appendix D) which went before the regional weights and

measures association in fall 2009 did not include any examples of factors that affect changes in hydrogen gas density.

The August 2009 USNWG discussions also focused on how jurisdictions ensure fuel quality. Many jurisdictions have motor-fuel quality programs; however, this enforcement branch may not always be part of the office having statutory authority over device accuracy. Hydrogen fuel specifications will apply to deliveries into both fuel cell and internal combustion engine vehicles. Because of hydrogen's use in fuel cells its quality standard is comparably much higher than that set for other fuels stored and used on-board vehicles as an automotive fuel. The only other product application where purity levels are this high are those in the Cryogenic Measuring Devices Code. Can the weights and measures community rely on a consistent supply of hydrogen that meets this quality standard? Typically NIST HB 130 addresses fuel properties and/or characteristics; however, not all jurisdictions have adopted HB 130 as law and regulation. The USNWG modified the marking requirements (see paragraph S.5.(j) Markings) to recognize that some equipment may need to be marked to indicate limitations in its use with a specific fuel quality. In this case any factor, to include constituent levels that can take the device's performance outside of acceptable tolerances must be considered.

1993-1994 NCWM on Mass Indicating Volume-Measuring Devices

In 1993 the NCWM adopted requirements for a compressed natural gas (CNG) fuel quality specification and to recognize the Gasoline Gallon Equivalent (GGE). The fuel specification was deemed necessary due to the variations in the composition of natural gas and the effects these properties had on the suitability of CNG for storage and use onboard vehicles as an automotive fuel and their exhaust emissions. The composition of CNG does not fall into a narrow range like formulations of other automotive fuels. CNG composition is affected by the (1) field of origin, (2) withdrawal rate from the field, (3) processing prior to transmission, (4) mixing of products during shipment and storage, and (5) differences in region, locale, and season.

The NCWM considered a CNG method of sale in units related to the joule, mass, and GGE. Exact conversions of CNG to arrive at a GGE value varied with the composition of CNG and that of the refined gasoline used to arrive at units that consumers could relate to for motor-fuel sales. Multiple conversion factors (based on mass) were developed using scientific data determined using a mean natural gas composition based on the Wobbe number and lower heating value as well as the lower energy content of gasoline (114, 118.8 Btu/gallon). The weights and measures community recognized that there is variation in the energy value of CNG supplies. However, the NCWM was encouraged by the Natural Gas Vehicle Coalition to use the GGE conversion factor of 5.660 lb as the standard. The requirement for the conversion factor was included in the Mass Flow Meters Code. The factor eliminated the need to document the energy content of each supply, allowed for consumer comparison, and facilitated taxing the motor-fuel.

Prior to the establishment of a Mass Flow Meters Code mass flow meter requirements appeared in multiple measuring devices codes. In 1994 the NCWM recognized volume-measuring devices in the Mass Flow Meters Code. Since only CNG was required in GGE units, which is a unit based on mass, automatic correction for changes in the composition of CNG would be required for more accurate measurement. The NCWM permitted volume-measuring device manufacturers with equipment affected by changes in product density, five years to move from manual corrections to equipment capable of an automatic means to determine and correct for these changes.

Update From the Submitter of Comments on SWMA #4 – S.1.4. Value of Smallest Unit

The DSS Technical Advisor sought further clarification from the weights and measures official who expressed concerns that the division size of 0.01 kg specified in subparagraph S.1.4.(b) may not be small enough to achieve mathematical agreement. The submitter indicated never working with kilogram units and wanted to be certain that the 0.01 kg for devices with flow rates of more than 30 kg/min is small enough. The official noted a requirement in Section 3.30 Liquid Measuring Devices paragraph S.1.6.5.2. Money-Value Division, Digital which requires digital devices to comply with General Code paragraph G.S.5.5. Money Values, Mathematical Agreement and specifies the total price computation shall be based on quantities not exceeding 0.05 L. The total

quantity of hydrogen when multiplied by the correct unit price must result in a dollar amount that is indicated to the nearest cent, e.g., 1.56 kg x \$3.29/kg = \$5.1324, then the total price must be \$ 5.13. On December 1, 2009, the official now believes the value to be small enough. Unless, members of the USNWG wish to discuss this paragraph further it will be removed from the list requiring input from the work group.

Conclusion

The USNWG agreed to review the suggested approaches to comments on the draft codes in Appendix C and consider grouping the comments under four possible courses of action (see table below) to: (1) provide discussion/historical background that explains why no action is necessary; (2) develop new code language that requires only a moderate amount of effort by the USNWG (using email), (3) update the codes to include the suggested text in Appendix C; and (4) conduct additional research and/or work on these issues (to include a schedule indicating how the work will progress).

Approach on Hydrogen Code Input			
(1) No Modification to the Draft Code	(2) Low to Moderate Level of Modification to Draft Code Warranted; Language Needs Development	(3) Respond to Comment(s) as Suggested in Appendix C	(4) Response Requires Further Research and Work
SWMA #2 Kilogram	SWMA #5 Display; Unit Price/Product ID	SWMA #1 Computing Type	NEWMA #1 Test Procedure
SWMA #4 Smallest unit value (see discussion above)	SWMA #6 Agreement Between Indications	SWMA #3 Division Description	NEWMA #2 Safety
SWMA #8 Max and Min Flow Rates	SWMA #7 Indication of Delivery	SWMA #10 Sealing	SWMA #17 Type Evaluation
SWMA #18 Transfer Standard Test Method	SWMA #9 Discontinuous Adjustment Means; Define	SWAMA #12 Markings	SWMA #19 Discharge Hose Length
SWMA #20 Dispenser Labeling	SWMA #16 Repeatability	SWMA #13 Printed Receipt	SWMA #21 Effects of Constituent
			USNWG #1
Comments left open for USNWG discussion: SWMA # 11 Zero Set-Back Interlock; Diversion of Product SWMA # 14 Totalizers; Each Dispenser SWMA # 15 MMQ; Achievable Test at MMQ			
USNWG Comments on the above approach should be emailed to the Technical Advisor by January 6, 2010. Please use the table at the end of Appendix C to indicate a preference for an approach, code language, etc. or include additional comments.			

(c) Wholesale vs. Retail Applications

Due to time constraints the USNWG did not have the opportunity to discuss the ongoing work to develop requirements to address wholesale applications (a delivery not made to the end user where product is resold). During past USNWG meetings several dispenser manufacturers indicated there is a need to ensure that existing draft code requirements are not so prescriptive that most wholesale applications would have difficulty complying.

The USNWG had the opportunity to review documents that either identified specific areas of the draft code that may not fully address wholesale applications and others that with some modification might provide guidelines or possible alternative remedies to ensure that both retail and wholesale applications are addressed in the draft code. The documents reviewed were a/an:

- Analysis of Paragraphs That Do Not Apply to Wholesale/Bulk Deliveries (April 2009, Cohen & Boyd)
- Draft 4.1 (R/W) NIST Handbook 44 Hydrogen Gas-Measuring Devices Code with Recommendations for Retail and Wholesale (R/W) Application Requirements (June 2009)
- 2009 NIST Handbook 44 Retail/Wholesale Code Requirements (June 2009)
- HB 130 prescribed method of sale for compressed gas cylinders in Section IV Uniform Regulations Part B. Uniform Regulation of the Method of Sale of Commodities Section 2. Non-food Products paragraph 2.16. Compressed or Liquefied Gases in Refillable Cylinders through subparagraph 2.16.3.4 (see page 123, 2009 Ed.)(June 2009)

The USNWG has acknowledged that both wholesale and retail applications are regulated by the weights and measures authority. The current draft code would be the only code available to apply to wholesale devices used in hydrogen gas deliveries. The USNWG recognized there was a greater urgency for developing requirements for retail refueling applications. It should be noted that in August 2009 the USNWG modified the preamble to the draft code to include the text "Requirements that apply to wholesale applications are under study and development by the U.S. National Work Group for the Development of Commercial Hydrogen Measurement Standards." In light of the differences in retail and wholesale methodologies, units of measurement, etc., the USNWG agreed to conduct additional research to ascertain the best approach for fully developing legal metrology requirements that apply to wholesale applications.

(5) Next Steps/Tasks

The USNWG discussed upcoming events and the next steps in the weights and measures standards development process that may affect its work to fully develop hydrogen measurement standards and test procedures. Tasks, strategies, and target dates are identified below to ensure that the USNWG meets its goals.

Task 1

The USNWG is working to reach a consensus in its response to comments received fall 2009 from the weights and measures community (see Appendix C) on Draft 5.0 of the NIST Handbook 44 and Draft 3.0 of the NIST Handbook 130 hydrogen codes. At the conclusion of the December 15, 2009 meeting, the 24 comments received were placed into groups of four possible approaches (see Agenda Item (4)(b) above). The USNWG agreed to review and comment on all four groups to determine if the comments are grouped under the most appropriate approach, and if not, then provide alternative code language or strategies. USNWG comments on these approaches should be emailed to Technical Advisor Juana Williams at juana.williams@nist.gov by **January 6, 2010**. The USNWG is asked to use the table at the end of Appendix C to indicate a preference for an approach, provide alternative code language, etc. and for any additional comments.

Task 2

The USNWG agreed to review the April 2009 meeting summary by the **January 13, 2010** USNWG meeting.

Task 3

The USNWG agreed to review the August 2009 meeting summary by the **January 13, 2010** USNWG meeting.

Task 4

Diane Lee (NIST WMD) will prepare a first draft of Guidelines for the Gravimetric Test Method for use to verify the accuracy of Hydrogen Dispensers by **December 16, 2009** for Dan Reiswig's (CADMS) review. An MS Excel spreadsheet test report will also be developed shortly.

Task 5

Diane Lee will incorporate input on the April 2009 version of EPO 29 into a third draft. This draft will be ready for review by Juana Williams the week of December 28th and emailed to the USNWG for its review that week. The USNWG's comments on this version of the EPO will be due by **February 16, 2010**. The original Task 5 deadline of February 15th was changed because it falls on a Monday government holiday, President's Day, when many State and Federal offices may be closed.

(6) Next Meeting

The next tele/web conference meeting is scheduled for 3:00 p.m. – 4:30 p.m. Wednesday, January 13, 2009.

4:45 P.M. (ET) Meeting Adjourned

Appendix G

Attendee List-December 15, 2009

Meetings of the 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 Yes (Y)
Marc Buttler	Micro Motion/Emerson Process Management	Y	Y	Y
Jackie Button	Calif. Fuel Cell Partnership		Y	Y Y
Julie Cairns	CSA Standards	Y	Y	Y
Joseph Cohen	Air Products and Chemicals, Inc.	Y	Y	Y Y
Michael Keilty	Endress & Hauser Flowtec AG			
Diane Lee	NIST – TS WMD	Y	Y	Y Y
Kristin Macey	CA – Food and Agriculture, County/State Liaison Office	Y	Y	Y Y
Mark McDougall	Powertech Labs, Inc.	Y	Y	Y
Dev Patel	Kraus Global, Inc.	Y	Y	Y
Dan Reiswig	CA – Food and Ag. Div. of Measurement Standards	Y	Y	Y
Lisa Warfield	NIST – TS WMD	Y	Y	Y Y
Curt Williams	Georgia Ag. Dept./ CPW Energy Consulting	Y	Y	Y Y
Juana Williams	NIST – TS WMD	Y	Y	Y Y