

**U.S. National Work Group (USNWG)
for the
Development of Commercial Hydrogen Measurement Standards
August 26-27, 2008
Air Products and Chemicals, Inc. (APCI)
Allentown, PA**

**Device Standards and Test Procedures Subcommittee (DSTPS)
and
Fuel Specifications Subcommittee (FSS)**

MEETING SUMMARIES

The USNWG Subcommittee meetings are 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 Subcommittees met to continue their 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) quality standards for equipment used in hydrogen measurements for vehicle and other refueling applications.

AGENDA ITEMS

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Appendix	Related Agenda Item(s)	Title
A	2(a) * and **	Summary of the June 2008 USNWG Meeting
B	2(b)* and **	USNWG Guidelines – Final Draft 2
C	2(b)* and **	USNWG Agenda Submission Form
D	3*	Draft 3.1 of NIST Handbook 44 Gas Measuring Devices Code
E	3** through 6**	The Starting Point: A Discussion Paper Describing a Proposed Method of Sale and Quality Specification for Hydrogen Vehicle Fuel
F	3* and ** and 4**	Comments on Hydrogen Codes-August 2008
G	3** and 4**	Draft 2.1 of NIST Handbook 44 Uniform Laws and Regulations, Engine Fuel Quality
H	2(b)* and ** 2(c)** 3* through 5* 3** through 8**	USNWG June 2008 Meeting 3 Task List
I	4**	Federal Trade Commission (FTC) Guide for Labeling Alternative Fuels
J		Attendee List
* Device Standards and Test Procedures Subcommittee (DSTPS)		
** Fuel Specifications Subcommittee (FSS)		

**DEVICE STANDARDS AND TEST PROCEDURES SUBCOMMITTEE (DSTPS)
MEETING**

Tuesday, August 26, 2008, 8:30 a.m. – 5:00 p.m. (ET)
Wednesday, August 27, 2008 8:30 a.m. – 2:30 p.m. (ET)
Air Products and Chemicals, Inc., 7201 Hamilton Boulevard, Admin 6
Allentown, PA
Chair – Kristin Macey (CDFA DMS)
Technical Advisor – Juana Williams (NIST WMD)

(1) Welcome and Introductions

The DSTPS participants were welcomed in-person and on audio conference, the meeting was called to order, and its purpose reviewed. The collaborative work of the meeting's sponsors was recognized. Participants were briefed on the facilities available at APCI, the schedule of events, meeting procedures, and materials. Participants provided their name, affiliation, and stated their specific area of interest in the work to develop hydrogen measurement standards (see Appendix J).

(2) Administrative Business

The DSTPS discussed procedures for managing and documenting its technical work. The following items were addressed:

(a) Approve the Summary of the June 2008 USNWG Meeting

The minutes (see Appendix A) of the June 2008 DSTPS meeting were approved with no changes.

(b) Approve the USNWG Guidelines

The Technical Advisor modified the June 2008 Draft of the USNWG Guidelines in response to requests from the USNWG Subcommittees for clarification of the topics: (1) active participation, (2) balloting, (3) teleconference, and (4) quorum (see Appendix B). The USNWG Subcommittees agreed that the revised draft would be distributed for comments by June 30, 2008 and the Technical Advisor would ballot the USNWG for its approval by July 22, 2008.

A draft of the Guidelines incorporating the June comments and associated Agenda Submission Form (see Appendix C) were distributed to the USNWG August 17, 2008. During the August 26-27, 2008 meeting the USNWG agreed the Technical Advisor should ballot the USNWG for its approval of the Guidelines and Agenda Submission Form due to time constraints.

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

The DSTPS reviewed Draft Version 3.1 of the NIST Handbook 44 Hydrogen Gas Measuring Devices Code (See Appendix D). This version of the draft code is the result of work by the DSTPS at its June 2008 meeting.

The DSTPS agreed to submit a request to the 2009 NCWM Specifications and Tolerances (S&T) Committee to include an item on the S&T Committee's "Developing Items Agenda to make the weights and measures community aware of upcoming proposals to change NIST Handbook 44 requirements to address hydrogen refueling applications.

The DSTPS resumed its review of the code sections that address Test Notes, Tolerances, and User Requirements, at the point where discussions ended in June 2008. The DSTPS revisited several specification paragraphs that apply to equipment design and discussed other paragraphs in the proposed Hydrogen Gas Measuring Devices code that apply to the performance test of hydrogen dispensers.

(a) Design Specifications

The DSTPS agreed that the design requirement specified in paragraph S.3.2. Adjustment Means, which permits making adjustments to the ratio between the indicated and actual delivered quantity of product is intended to apply to elements and features in the system that affect only the indications (e.g. change the flow calibration factor). The DSTPS is also considering further modification to the proposal to include definitions for "device" and "assembly" to further clarify where adjustments are permissible. The DSTPS discussed the inherent design of nozzles that might allow a small amount of air to be trapped during pressurization and result in contamination of the fuel entering the sample bottle. The FSS should consider this point as it establishes field sampling procedures. The DSTPS would like some guidance on how to ensure that no connection can occur between a nozzle and vehicle/storage tank when there is a difference in the pressure ratings for these two components.

(b) Performance Tests

The DSTPS recognized that it is possible during the fill process for hydrogen to heat the test tank which introduces uncertainty into the test procedure. This effect along with high pressures during fill may affect the geometry of a tank and affect the test results during performance verification using the volumetric test method.

The DSTPS agreed to postpone its discussions of the minimum test draft and tank sizes necessary to simulate various fills (e.g., 1/3, 2/3, and 3/3 fill) so that it can harmonize, wherever possible, with SAE guidelines on fill protocol to be published in December 2008. The DSTPS agreed that flow rates and pressures achieved during the test should represent those that occur during typical deliveries and should include the scenario of topping off the tank to demonstrate any variables that might arise under this condition of normal use that have an effect on the systems' performance. It is anticipated the SAE report will address fill protocols that avoid over heating and over filling the vehicle tank. If controls on the flow rate are necessary to meet the fill protocol recommended by SAE, then the DSTPS will need to address the question of whether or not this feature will interfere with the test of the performance of the dispenser at the manufacturer's declared minimum measured quantity.

Test Medium

The DSTPS agreed the test medium should be hydrogen fuel although at this point there is no published fuel standard that can be referenced in the test notes of the draft code. Once the standard is developed and recognized the standard's document number will be included in the appropriate paragraph in the test notes.

Minimum Measured Quantity

The DSTPS reworked the test draft requirements to specify the minimum number and minimum quantity for test at flow rates and operating pressures that represent conditions that exist at for a typical delivery. The DSTPS made further modifications to all three test methods under consideration to base the required minimum test drafts on the manufacturer's declared minimum measured quantity and/or one kilogram rather than a design feature such as the flow rate (which can be an important parameter when developing test procedure to examine the performance of some meter technologies).

Master Meter Test Method

Language similar to existing requirements in the Farm Milk Tanks Code was included to specify the minimum verification intervals for master metering systems before and after the test.

The DSTPS will continue its discussion of tolerances and user requirements, test procedures, and collection of test data at the upcoming December 2008 meeting.

(c) Test Data

As the DSTPS began its review of accuracy requirements, equipment manufacturers were not in agreement on the ability of their equipment to achieve the proposed 1.5 % Acceptance Tolerance (for type evaluation and new equipment) and 2 % Maintenance Tolerance (for equipment in actual use). The proposed tolerances agree with the maximum permissible errors specified for compressed gases in corresponding NIST Handbook 44 Mass Flow Meters Code and OIML Recommendation 139 "Compressed gaseous fuel measuring systems for vehicles." A majority of manufacturers indicate obtaining accuracies of 3-10 % for equipment in use. To date no test data is available on the performance of hydrogen refueling equipment.

In October 2007, the USNWG agreed that simultaneous work should take place to develop equipment standards and test procedures for gaseous hydrogen refueling applications. NIST Handbook 44 Appendix A Fundamental Considerations Section 3.2. Tolerances for Standards specifies use of standards with an accuracy one-third that of the equipment under test (0.5 %). The determination of acceptable test methods is essential to the ability to verify commercial hydrogen measurements. Consequently, Diane Lee will email a request to all stakeholders for information on existing test procedures, safety practices, and test equipment design specifications.

(d) Revisions to the Draft Code

Paragraphs modified by the DSTPS during the August 2008 meeting and the rationale for their actions are as follows:

August 2008 DSTPS Modifications to Draft 3.1 of the NIST Handbook 44 Hydrogen Gas Measuring Devices Code		
Change to Requirement: Modified text in paragraph S.3.6.	Requirement Title: Pressurizing the Discharge Hose	Reason for Change: Delete the word "not" to correct the grammar by eliminating the use of double negatives
<p><u>S.3.6. Pressurizing the Discharge Hose. - The discharge hose for hydrogen gas shall automatically pressurize to a pressure equal to or greater than the receiving vessel prior to the device beginning to register the delivery. Neither initial hose pressurization or purging/bleeding of the discharge hose shall not advance the indications.</u></p>		
Change to Requirement: Modified text in paragraph N.2.	Requirement Title: Test Medium	Reason for Change: Specified hydrogen gas as the product acceptable as the test medium for type evaluation. Because of the properties of hydrogen gas this modified language enables the official to decide if the environmental conditions

		<p>encountered are such that only during type evaluation is it is more suitable to perform a test with hydrogen gas.</p> <p>NOTE: The paragraph will continue to include a notation that a hydrogen fuel specification is NOT YET PUBLISHED, until such time as it becomes available from a national consensus standard's body</p>
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N.2. Test Medium. - The device shall be tested with the product commercially measured except that, in a type evaluation examination, hydrogen gas as defined by(NOT YET PUBLISHED) may be used .

Change to Requirement: Modified paragraph N.3.	Requirement Title: Test Drafts	Reason for Change: Added language to clarify the minimum number, minimum quantities, and the flow rate and operating pressures that must be maintained when performing tests under conditions for typical deliveries
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N.3. Test Drafts. - The minimum test shall be one test draft at the ~~maximum flow rate of the installation and one test at the minimum flow rate~~ 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. (See T.3.)

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 meter or measuring system is maintained within the range specified by the manufacturer.

NOTE: Corresponding SAE requirements are under development and this paragraph will be revisited.

Change to Requirement: Modified title and text in paragraph N.4.1.	Requirement Title: Transfer Standard Test	Reason for Change: Added the term "master meter" to further clarify the type of standard acceptable for use with this test method. Added language to clarify the minimum number and minimum quantities required for
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		this method of test when verifying the performance of the meter or system at typical deliveries
<p>N.4.1. Master Meter (Transfer) Standard Test. - When comparing a meter with a calibrated transfer standard, the minimum test shall be one test draft shall be equal to at least the amount delivered by the device in two minutes at its maximum discharge rate 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.</p>		
Change to Requirement: Added new paragraph N.4.1.1.	Requirement Title: Verification of Master Metering System	Reason for Change: Added new requirements for verification of the master metering system used to either test or calibrate a hydrogen gas-measuring device
<p>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.</p>		
Change to Requirement: Modified text in paragraph N.4.2.	Requirement Title: Gravimetric Test	Reason for Change: Added language to clarify the minimum number and minimum quantities required for this method of test when verifying the performance of the meter or system at typical deliveries
<p>N.4.2. Gravimetric Test. – The weight of the test drafts shall be equal to at least the amount delivered by the device in two minutes at its maximum discharge rate 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.</p>		
Change to Requirement: Added a new paragraph N.4.3.	Requirement Title: PVT Pressure Volume Temperature Test	Reason for Change: Added language to clarify the minimum number and minimum quantities required for this method of test when verifying the performance of the meter or system at typical deliveries

<p><u>N.4.3. PVT Pressure Volume Temperature Test. – The minimum test with a calibrated volumetric standard shall be one test draft 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.</u></p>		
Change to Requirement: Modified paragraph N.5.	Requirement Title: Minimum Measured Quantity	Reason for Change: Modified paragraph so that test criteria are based on conditions that are relevant for this dispensing system technology rather than design features associated with the performance of other meter technology
<p><u>N.5. Minimum Measured Quantity. - The device shall be tested for a delivery equal to the declared minimum measured quantity when the device is likely to be used to make deliveries on the order of the declared minimum measured quantity. Any minimum measured quantity test shall be made at the minimum flow rate of the installation.</u></p>		
Change to Requirement: Deleted paragraph N.6. and corrected the numerical designation for all subsequent paragraphs	Requirement Title: Motor-Fuel Dispenser	Reason for Change: Deleted this paragraph because the test criteria are based on conditions associated with the performance of other meter technology rather than features that are relevant for this dispensing system technology
<p><u>N.6. Motor Fuel Dispenser. – When a device is intended for use as a fuel dispenser, the type evaluation test shall include a test for accuracy using five starts and stops during a delivery to simulate the operation of the automatic shut-off nozzle. This test may be conducted as part of the normal inspection and test of the meter.</u></p>		

Change to Requirement: Renumbered title paragraph and modified paragraph N.6.1.	Requirement Title: Testing Procedures.	Reason for Change: Added language to clarify the flow rate and operating pressures that must be maintained when performing tests under conditions for typical deliveries for this dispensing system
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N.76. Testing Procedures.		
N.6.1. Normal Tests General. - The normal device or system shall be tested under normal operating conditions of the dispenser. test of a meter shall be made at the maximum discharge rate developed by the installation. Any additional tests conducted at flow rates down to and including the rated minimum discharge flow rate shall be considered normal tests.		
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 meter or measuring system is maintained within the range specified by the manufacturer.		
Change to Requirement: Modified paragraph N.6.1.1.	Requirement Title: Repeatability Tests	Reason for Change: The dynamics of these dispensing systems with the effects of heating and high pressures and extreme changes in flow rates, the user of test equipment should attempt to reduce to the greatest extent possible all factors likely to introduce errors into the test results
N.6.1.1. Repeatability Tests. - Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as, temperature, pressure, and flow rate are reduced to the extent <u>minimize the effect on</u> that they will not affect <u>the results obtained.</u>		
Change to Requirement: Modified paragraph T.4.	Requirement Title: Tolerance Application	Reason for Change: Paragraph T.4.(b) modified so that the type evaluation tolerance applies to the device based on conditions that are relevant for this dispensing system rather than design features associated with the performance of other meter technology
T.4. Tolerance Application.		
T.4.1. Type Evaluation Examinations for Devices. - For type evaluation examinations, the tolerance values shall apply under the following conditions:		
(a) at any temperature and pressure within the operating range of the meter, and		
(b) <u>for at all quantities greater than the minimum measured quantity</u> flow rates within the range of flow rates.		

Change to Requirement: Added a title to paragraph T.4.2.	Requirement Title: Transfer Standard Test Method	Reason for Change: Paragraph needed a title to clarify that an additional tolerance should apply to the test results when performing this particular test method
<p>T.4.2 Transfer Standard Test Method. - To the basic tolerance values that would otherwise be applied, there shall be added an amount equal to two times the standard deviation of the applicable transfer standard when compared to a basic reference standard.</p>		
Change to Requirement: Modified paragraph UR..1.1.	Requirement Title: Computing-Type Device	Reason for Change: Added text to further clarify that a "computing type" device design is required when equipment is used or employed as the basis for a commercial sales transaction
<p>UR.1. Selection Requirements.</p> <p>UR.1.1. Computing-Type Device. – A hydrogen gas dispenser used to refuel vehicles in a commercial sales applications shall be of the computing type and shall indicate the mass, the unit price, and the total price of each delivery.</p>		

The changes made by the DSTPS in the above table will be included in Draft Version 3.2 to be distributed at the November-December 2008 USN WG Meeting.

4) Next Steps/Tasks

Both USN WG Subcommittees agreed to submit proposals for inclusion on the 2009 agendas of the National Conference on Weights and Measures Specifications and Tolerances and Laws and Regulations Committees as Developing Items. These new proposals for draft codes under development by the USN WG are intended to address the design, performance, and user requirements and test procedures for NIST Handbook 44 and corresponding new definitions and method of sale and fuel quality requirements for NIST Handbook 130 for gaseous hydrogen applications. These proposals are being disseminated to encourage input from the weights and measures community on draft criteria and to promote participation of all stakeholders in the further development of these requirements.

(5) Next Meeting

At the conclusion of the August 26-27, 2008, meeting both Subcommittees of the U.S. National Work Group (USN WG) for the Development of Commercial Hydrogen Measurement Standards agreed to meet in back-to-back sessions in the November-December 2008 time frame at MicroMotion, Inc. in Boulder, Colorado.

(6) USNWG-Technology Tour

At the Air Products and Chemicals, Inc. (APCI) Allentown, PA headquarters, the DSTPS gathered information about the operation of two APCI hydrogen refueling dispensers and the associated test standard that uses the gravimetric test method to verify the dispensing systems' performance. One dispenser is in use for research, the other in is use for vehicle refueling. The USNWG wishes to express its deepest appreciation to APCI for this learning experience.

FUEL SPECIFICATIONS SUBCOMMITTEE (FSS) MEETING
Wednesday August 27, 2008, 2:30 p.m. – 5 p.m. (ET)
Air Products and Chemicals, Inc., 7201 Hamilton Boulevard, Admin 6
Allentown, PA
Chair – Bob Boyd (Linde North America, Inc.)
Technical Advisor – Kenneth Butcher (NIST WMD)

(1) Welcome and Introductions

The FSS participants were welcomed in-person and on audio conference, the meeting was called to order, and its purpose reviewed. The collaborative work by the meeting's sponsors was recognized. Participants were briefed on the facilities available at APCI, the schedule of events, and materials. Participants provided their name, affiliation, and stated their specific area of interest in the work to develop a hydrogen fuel specification.

(2) Administrative Business

The FSS discussed procedures for managing and documenting its technical work. The following items were addressed:

(a) Approve the Summary of the June 2008 USNWG Meeting

The minutes (see Appendix A) of the June 2008 FSS meeting were approved with no changes.

(b) Approve the USNWG Guidelines

The Technical Advisor modified the June 2008 Draft of the USNWG Guidelines in response to requests from the USNWG Subcommittees for clarification of the topics: (1) active participation, (2) balloting, (3) teleconference, and (4) quorum (see Appendix B). The USNWG Subcommittees agreed that the revised draft would be distributed for comments by June 30, 2008 and the Technical Advisor would ballot the USNWG for its approval by July 22, 2008.

A draft of the Guidelines incorporating the June comments and associated Agenda Submission Form (see Appendix C) were distributed to the USNWG August 17, 2008. During the August 26-27, 2008 meeting the USNWG agreed that the Technical Advisor should ballot the USNWG for its approval of the Guidelines and Agenda Submission Form due to time constraints.

(c) Appointment of New Chair Robert "Bob" Boyd

The August meeting marked Robert "Bob" Boyd's (Linde North America, Inc.) first meeting as Chair of the Subcommittee.

(3) Method of Sale (MOS) for Hydrogen Dispensing Applications

The FSS was asked to review the discussion paper "The Starting Point: A Discussion Paper Describing a Proposed Method of Sale and Quality Specification for Hydrogen Vehicle Fuel" (see Appendix E) and be prepared to discuss the appropriate units for pressure and other relevant units of measurement. The FSS was asked to consider NIST Special Publication (SP) 330 "The International System of Units (SI)" and NIST SP 811 "Guide for the Use of the International System of Units (SI)" as the source for uniform implementation of SI units.

The FSS also considered proposals to amend NIST Handbook 130 to recognize hydrogen refueling applications to: (1) address the method of sale, (2) define what products fall under this application, (3) specify that sales to the end user should be made on the basis of mass (kilogram) in whole cents, and (4) identify acceptable device labeling for hydrogen dispensers and advertisements. The proposals for Handbook 130 requirements distributed in June 2008 were modified to include proposed new requirements for labeling the dispenser with the product name and NFPA labeling requirements (see Appendix G).

The USNWG agreed to submit a proposal to the 2009 NCWM Laws and Regulations Committees to include an item on the Committee's Developing Items Agenda to make the weights and measures community aware of upcoming changes to NIST Handbook 130 requirements to address hydrogen refueling applications.

Currently, the operating pressures for many hydrogen refueling dispensers are marked in "bar" units. Since 1982 one bar has been used as the standard pressure for tabulating all thermodynamic data. The bar is expressed as a unit of pressure (in SI units, 1 bar = 0.1 megapascal (MPa)) or force divided by area. It is permissible to use the bar, a non-SI unit, where its use is part of an established practice. The bar is widely used in industry. However, the SI unit should be used first and then followed by the bar value. The FSS agree on a conversion value in NIST SP 811 when the pressure value is derived from U.S. Customary units (psi).

During its review of the draft code proposals for the MOS and fuel quality requirements for commercial hydrogen refueling applications the FSS agreed to several modifications of the proposed new code as follows:

MOS - The FSS modified proposals in Draft Version 2.1 of the NIST Handbook 130 for marking and labeling equipment and signage in specific units of measurement for pressure. The FSS now recommends use of the "megapascal" or the abbreviation for that term "MPa" as the SI unit (metric) of measurement for labeling pressures on refueling equipment and corresponding price signage rather than using the term "bar." The numerical value for the pressure rating will follow the letter "H" which identifies the fuel as hydrogen (e.g., H35 or H70).

The FSS's latest modifications to the proposed method of sale requirements for NIST Handbook 130 Section IV. Uniform Regulations Part B. Uniform Regulations for the Method of Sale of Commodities Section 2 Non-food Products to address gaseous hydrogen refueling applications are as follows:

Section 2. Non-food Products [Note 1, page 103]

2.XX. Retail Sales. - Hydrogen Fuel (H).

2.XX.1. Definition – Hydrogen Fuel (H).

2.XX.1.1. Hydrogen Fuel. - A fuel composed of the chemical hydrogen intended for consumption in an internal combustion engine or fuel cell.

The symbol for hydrogen vehicle fuel shall be the capital letter "H" (the word Hydrogen may also be

used.)

The FSS agreed that the use of MPa is consistent with recent recommendations from the CSA America and SAE for labeling components with pressure ratings and should read as follows:

2.XX.2. Method of Retail Sale and Dispenser Labeling. - All hydrogen fuel kept, offered, or exposed for sale and sold at retail shall be in terms of the kilogram.

2.XX.3. Retail Dispenser Labeling.

2.XX.3.1. A computing dispenser must display the unit price in whole cents on the basis of price per kilogram.

2.XX.3.2. The service pressure(s) of the dispenser must be conspicuously shown on the user interface in bar or the SI Unit of Pascal (Pa) (e.g., MPa).

2.XX.3.3. The product identity must be shown in a conspicuous location on the dispenser.

2.XX.3.4. NFPA labeling requirements also apply.

2.XX.4. Street Sign Prices and Advertisements.

2.XX.4.1. The unit price must be in terms of price per kilogram in whole cents (e.g., "\$3.49 per kg" not \$3.499 per kg).

2.XX.4.2. The sign or advertisement must include the service pressure(s) at which the dispenser(s) delivers hydrogen fuel (e.g., H35 or H70 MPa).

This modification also agrees with the FSS's decision to follow guidelines in NIST Special Publication (SP) 330 "The International System of Units (SI)" and SP 811 "Guide for the Use of the International System of Units (SI)" for use of the SI measurement system.

The FSS changes to the text in Draft Version 2.1 of the proposed NIST Handbook 130 Codes are shown below in the dispenser display diagram in Figure 1 and advertising through street signage in Figure 2.

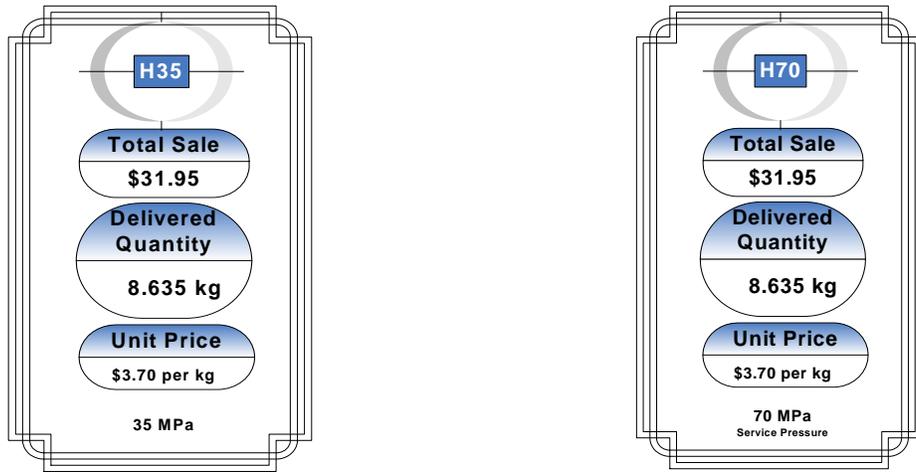


Figure 1. Examples of the Product Identity, Measurement Unit, Unit Price and Service Pressure on the User's Interface of a Hydrogen Fuel Dispenser

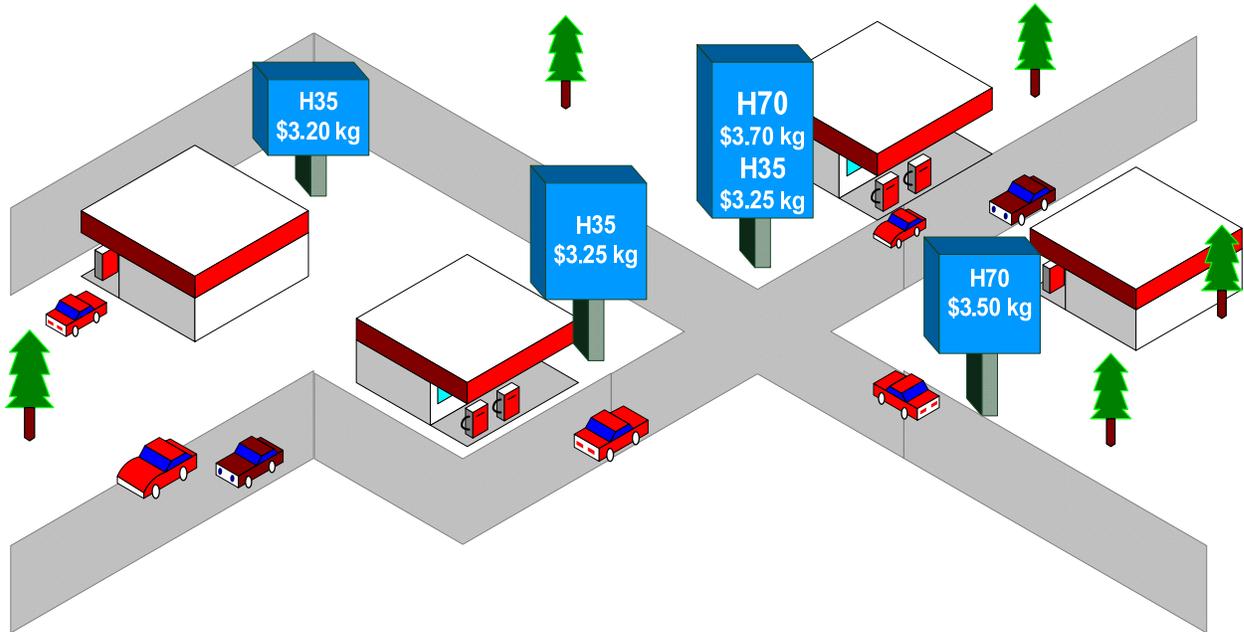


Figure 2. Showing the Use of the Uniform Unit of Measurement and Posting of Product Identity and Service Pressure to Enable Value Comparison

The FSS also has under review 16 CFR Part 309 "Labeling Requirements for Alternative Fuels and Alternative Fueled Vehicles," which includes the FTC requirements for posting the hydrogen fuel rating on dispensers. In

this instance a disclosure of the amount of the principal component of a fuel is expressed as a minimum percentage on a label in a fashion similar to what is now required in octane posting for gasoline pumps.

The FSS might consider schematic diagrams similar to those in Figures 1 and 2 or a table to illustrate acceptable symbols, terms, abbreviations for use to identify required information in labeling, signage, and advertisement in commercial hydrogen refueling applications.

The FSS will continue its work to align the Method of Sale requirements with those in related hydrogen standards to ensure the guidelines in NIST Handbook 130 adequately address hydrogen dispensing applications.

(4) Engine Fuel Quality

The FSS discussed the latest updates on hydrogen fuel quality standards and recent work to measure hydrogen fuel properties. The FSS was asked to consider a proposed fuel specification developed by California's Department of Agriculture. The fuel specification would be a starting point for a proposal to amend NIST Handbook 130. The interim fuel specification and background materials are part of the discussion paper (see Appendix E) that were reviewed by the FSS.

The FSS discussed the most appropriate reference standards for fuel quality at the August 2008 meeting. The FSS also agreed to discuss alternative resources for determination of fuel quality if state and local agencies are not able to perform this function.

Fuel Quality - The FSS also discussed separate fuel quality standards for hydrogen fuel cell and internal combustion engine vehicles and a starting point for a fuel quality laboratory manual. The FSS acknowledged there will be differences in the type and level of contaminants and particulates as a result of hydrogen production from different feedstock. However, the FSS agreed to focus on the current proposed standard rather than begin discussions on separate fuel quality standards based on production sources and whether or not the fuel composition is suitable for use in an internal combustion engine or fuel cell vehicle.

The FSS will monitor national and international standard activities, research, and other programs to avoid duplication of effort and to ensure that its work provides a fuel specification for hydrogen vehicle fuel that serves the needs of this emerging marketplace. In addition to the to the work in SAE J2719 "Hydrogen Specification Guideline for Fuel Cell Vehicles" and Working Group 12 of ISO's Technical Committee 197 on Hydrogen the FSS acknowledged that quality standards are currently under development in ASTM International (e.g., see www.astm.org for a list of the work underway in ASTM Committee D03.14 on Hydrogen and Fuel Cells and that organizations other committees).

The current fuel quality proposal is the culmination of work by SAE, ISO, and later work by California. Like California's Division of Measurement Standards (DMS), the FSS agreed to move forward with the currently proposed table that specifies the maximum levels for contaminants and particulates in hydrogen fuel. The DMS and FSS will work with this table as an interim standard until an accredited standards developing organization recognizes this or another fuel quality standard.

California law required the Division of Measurement Standards (DMS) to have hydrogen fuel quality standards in place on or before January 1, 2008. California's interim standard for hydrogen fuel quality took effect on September 11, 2008. To read more about this regulation go to <http://www.cdffa.ca.gov/dms/hydrogenfuel/hydrogenfuel.html> and click on "Hydrogen Fuel."

(5) Laboratory Manual

The FSS will discuss ongoing work to ensure fuel quality laboratories perform measurements that are traceable to recognized national standards. The FSS will work to promote the establishment of documented laboratory practices and procedures that encompass:

- (a) Test Methods and Reproducibility Limits**
- (b) Equipment (minimum and recommended) Source and Cost**
- (c) Documentation (e.g., Standard Operating Procedures)**
- (d) Handling and Storage of Hydrogen Fuel**
- (e) References and Good Laboratory Practices**
- (f) Minimum Training Standards for Laboratory Personnel**
- (g) Facilities**
- (h) Safety**

Quality Laboratory Procedures – The FSS agreed that it will consider and not attempt to reinvent laboratory procedures under development by the ASTM.

(6) Field Sampling Procedures

The FSS will monitor national and international work to establish field sample procedures to provide uniform inspection, sampling, and enforcement procedures to promote the protection of consumers (vehicles) and businesses from economic loss resulting from substandard product and to encourage safe practices by officials conducting inspections. It is recommended that these procedures/guidelines address:

- (a) Equipment/Source/Cost**
- (b) Good Sampling Practice**
- (c) Handling, Storage, and Transportation**
- (d) Minimum Training Standards for Field Officials**

DMS updated the FSS on its continued efforts to work on test procedures using the fuel sampling apparatus it obtained in March 2008. It should be noted that the DSTPS discussed the inherent design of nozzles that might allow a small amount of air to be trapped during pressurization and result in contamination of the fuel entering the sample bottle. The FSS will continue its work to address Field Sampling Procedures and a Laboratory Manual for hydrogen dispensing applications.

(7) Next Steps/Tasks

Both USNWG Subcommittees submitted proposals to the 2009 agendas of the National Conference on Weights and Measures Specifications and Tolerances and Laws and Regulations Committees to include items on both Committees' Developing Items Agendas. These new proposals for draft codes being developed by stakeholders in the hydrogen and legal metrology community are intended to address the design, performance, and user

requirements and test procedures for NIST Handbook 44 and new definitions and method of sale and fuel quality requirements for NIST Handbook 130 for gaseous hydrogen applications. These proposals are being disseminated to encourage input from the weights and measures community on draft criteria and to promote participation of all stakeholders in their further development.

(8) Next Meeting

Both Subcommittees of the U.S. National Work Group (USNWG) for the Development of Commercial Hydrogen Measurement Standards are scheduled to meet in back-to-back sessions in the November-December 2008 USNWG meeting at MicroMotion, Inc. in Boulder, Colorado.

Appendix J

Attendee List-August 26-27, 2008

USNWG Hydrogen Device Standards and Test Procedures and Fuel Specifications Subcommittees

Name	Agency	Phone	Email	Device Standards and Test Procedures Subcommittee Member Yes (Y)	Fuel Specifications Subcommittee Member Yes (Y)	Attended Device Standards and Test Procedure Subcommittee Meeting Yes (Y)	Attended Fuel Specifications Subcommittee Meeting Yes (Y)
Jacquelyn Birdsall	California Fuel Cell Partnership	916-375-7421	jbirdall@cafcp.org		Y		
Robert Boyd	Hydrogen Solutions – Linde Group	510-786-5903	bob.boyd@linde.com	Y	Y	Y	Y
Kenneth Butcher	NIST-TS WMD	301-975-4859	kenneth.butcher@nist.gov		Y		
Tina Butcher	NIST – TS WMD	301-975-2196	tina.butcher@nist.gov	Y	Y		
Marc Buttler	Micro Motion/Emerson Process Management	303-530-8562	marc.buttler@emersonprocess.com	Y	Y	Y	Y
Julie Cairns	CSA America	216-524-4990 Ext. 8213	Julie.Cairns@CSA-America.org	Y	Y	Y	Y
Joseph Cohen	Air Products and Chemicals, Inc.	610-481-7625	cohenjp@airproducts.com	Y	Y	Y	Y
Jared Hightower	Greefield	972-889-2400 Ext. 129	Jared.Hightower@us.atlascopco.com	Y	Y	Y	Y

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Name	Agency	Phone	Email	Device Standards and Test Procedures Subcommittee Member Yes (Y)	Fuel Specifications Subcommittee Member Yes (Y)	Attended Device Standards and Test Procedure Subcommittee Meeting Yes (Y)	Attended Fuel Specifications Subcommittee Meeting Yes (Y)
Robert Ingram	CA – Food and Ag., Div. of Measurement Standards	916-229-3016	ningram@cdfa.ca.gov	Y	Y	Y	Y
Michael Keilty	Endress & Hauser Flowtec AG	303-823-5796	michael.keilty@us.endress.com	Y	Y		
Kristin Macey	CA – Food and Agriculture, Division of Measurement Standards	916-229-3044	kmacey@cdfa.ca.gov	Y	Y	Y	Y
Jonathan Munetz	Sentech, Inc.	202-586-6644	jonathan.munetz@ee.doe.gov	Y	Y		
G. Diane Lee	NIST – TS WMD	301-975-4405	diane.lee@nist.gov	Y	Y	Y	Y
David Pearce	Greenfield Compression	972-889-2400 Ext. 134	dave.pearce@us.atlascopco.com				

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Name	Agency	Phone	Email	Device Standards and Test Procedures Subcommittee Member Yes (Y)	Fuel Specifications Subcommittee Member Yes (Y)	Attended Device Standards and Test Procedure Subcommittee Meeting Yes (Y)	Attended Fuel Specifications Subcommittee Meeting Yes (Y)
Kenneth Ramsburg	MD Dept of Agriculture, Weights and Measures Program	410-841-5790	ramsburk@mda.state.md.us	Y	Y		
Ralph Richter	NIST – TS WMD	301-975-3997	ralph.richter.@nist.gov	Y	Y		
Antonio Ruiz	DOE	202-586-0729		Y	Y		
Michael Steinbach	Instrutech, Inc.	303-651-0551 Ext. 110	mikes@instrutechinc.com	Y	Y		
Kevin Sterling	Florida Dept. Of Agriculture, Division of Standards	850-487-2634	sterlik@doacs.state.fl.us	Y	Y		
Curt Williams	Georgia Dept. Of Agriculture	404-363-7597	cwilliam@agr.state.ga.us		Y		
Juana Williams	NIST – TS WMD	301-975-3989	juana.williams@nist.gov	Y	Y	Y	Y

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John Wright	NIST Chemical Science and Technology Laboratory, Process Measurements Division	301-975-5937	john.wright@nist.gov	Y	Y	Y	Y
David Wyatt	Wyatt Engineering	401-334-1170	dwyatt@wyattflow.com	Y	Y		