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

June 17-19, 2008
Gas Technology Institute (GTI)
Des Plaines, Illinois

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 (USNWG) 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.

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A	2(a)*^{and}**	Summary of the March 2008 USNWG Meeting
B	2(b)*^{and}**	USNWG Guidelines – Final Draft
C	2(b)*^{and}**	USNWG Agenda Submission Form
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DEVICE STANDARDS AND TEST PROCEDURES SUBCOMMITTEE (DSTPS) MEETING
Tuesday, June 17, 2008, 8:30 a.m. – 5:00 p.m. (CT)
Gas Technology Institute (GTI), 1700 South Mount Prospect Road, Conference Rooms 126-1 and 126-2
Des Plaines, Illinois
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 by the meeting's sponsors was recognized. Participants were briefed on the facilities available at GTI, 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.

(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 March 2008 USNWG Meeting
The March 2008 DSTPS Meeting Summary was approved with no changes (see Appendix A).

(b) Approve the USNWG Guidelines
The guidelines describe the work group and its subcommittee's objectives, general membership, meeting and voting procedures, and timelines for projects and other tasks. The DSTPS reviewed the USNWG Guidelines and corresponding Agenda Submission Form. The DSTPS requested the Technical Advisor further clarify the guidelines to address: (1) active USNWG participation, (2) methods of balloting for a vote, (3) teleconference participation, and (4) quorum requirements (see Appendix B) by June 30, 2008.

The USNWG agreed to review the final draft of the Guidelines and submit final comments to the Technical Advisor by July 22, 2008.

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

(a) Device Standards
The DSTPS conducted an in-depth review of the specification requirements in Draft 3.0 of the Hydrogen Gas Meters Code. The DSTPS modified several specification paragraphs primarily to clarify how those design requirements apply.

Due to time limitations the DSTPS was not able to complete its review of Draft 3.0. Review of the Notes (N.), Tolerances (T.), and User Requirements (UR.) paragraphs will take place at the next meeting of the DSTPS.

(b) Test Procedures
Some current examination procedures use gravimetric test methods that are taken from procedures outlined for compressed natural gas (CNG) retail motor-fuel dispensers. Test procedures will need to be modified to address specific properties of hydrogen and eventually reference the appropriate code sections for hydrogen applications once they are included in NIST Handbook 44. Until that time test procedures will reference existing Handbook requirements that apply to like applications such as CNG.

The DSTPS was asked to consider other plausible test methods such as the use of pressure transducers.

The California Division of Measurement Standards reported on its observation of the set up and operation of a mobile station test apparatus that uses the gravimetric test method for determining the accuracy of hydrogen delivery. The procedures in this demonstration remain proprietary. As a result of their report a number of issues were raised about the procedure from a metrological standpoint (uncertainties, repeatability, etc.). These issues will be discussed in future meeting sessions of the USNWG.

The composition of a test tank will affect its cost, strength rating, heat distribution during fill, and weight. Test equipment specifications may need to address DOT requirements for transport of these units on public roads. Test units mounted to vehicles in enclosed trailers may need hydrogen sensors to detect any product that has accumulated in the trailer during the test as well as multiple ports to vent/dispose of product delivered into the tank after the test is complete. Venting options will need to be examined along with relevant code requirements such as the NFPA and CGA standards for hydrogen. Also in question is whether or not to permit the venting of product from the reference standard after a test of the refueling equipment in highly industrial areas.

Diane Lee (NIST WMD) will request stakeholders such as OEMs, R&D laboratories, other international standards developing organizations, etc. provide information on current test procedures/equipment.

(c) Test Data
To date the DSTPS has not received any test data on the performance of hydrogen refueling equipment that demonstrates these systems can attain the 1.5 % tolerance proposed in the Draft Hydrogen Gas Meters Code.

(d) Revisions to the Draft Code
Paragraphs modified by the DSTPS during the June 2008 meeting and the rationale for their actions are as follows:

<table>
<tr><th colspan="3">June 2008 DSTPS Modifications to
Draft 3.0 of the NIST Handbook 44 Hydrogen Gas Meters Code</th></tr>
<tr><td>Change to Requirement:
Modified code title</td><td>Requirement Title: Sec. 3.3X. Hydrogen Gas Meters</td><td>Reason for Change: Changed "meters" to "measuring devices" so that the code applies to all technologies used for measurements in this application to include meters and/or systems measuring hydrogen.</td></tr>
<tr><td colspan="3">3.3X. Hydrogen Gas <s>Meters</s>Measuring Devices</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Change to Requirement:
Modified title of paragraph S.1.2.</td><td>Requirement Title:

Hydrogen Gas Dispensers Computing Type Device</td><td>Reason for Change: Retitled paragraph from "Computing-Type Device" to "Vehicle Dispensers." Use of the term computing-type in the paragraph title appeared to define a computing type device, when the intent of the paragraph was to clarify the display information that is required for a</td></tr>
</table>

		computing type device.

S.1.2. ~~Hydrogen Gas Dispensers~~ ~~Computing Type Device~~Vehicle Dispensers. – A hydrogen gas dispenser used to ~~re~~fuel vehicles shall be of the computing type and shall indicate the mass, the unit price, and the total price of each delivery. ~~The dispenser shall display the mass measured for each transaction either continuously on an external or internal display accessible during the inspection and test of the dispenser, or display the quantity in mass units by using controls on the devic~~

Change to Requirement: Modified text in paragraph S.2.7.	Requirement Title: . Recorded Representations, Point of Sale Systems	Reason for Change: Modified text to clarify it is the printed receipt or recorded representation that must include specific information about the delivery.

S.2.7. Recorded Representations, Point of Sale Systems. – – A printed receipt shall be available through a built-in or separate recording element for transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash. The ~~sales information recorded by cash registers when interfaced with a retail motor-fuel dispenser~~ **printed receipt** shall contain the following information for products delivered by the dispenser:

(a) the total mass of the delivery,

(b) the unit price,

(c) the total computed price, and

(d) the product identity by name, symbol, abbreviation, or code number.

Change to Requirement: Modified text in paragraph S.3.2.	Requirement Title: Adjustment Means	Reason for Change: Modified paragraph to reflect the original intent, which was to specify requirements for the means to change the *ratio* for indicated quantities not the accuracy of the measuring instrument. This change aligns the wording with that in corresponding paragraphs in other measuring devices codes.

S.3.2. Adjustment Means. - An assembly shall be provided with means to change the ratio between the indicated quantity and the quantity of gas measured by the assembly~~adjustment means to change the accuracy of the measuring instrument~~. A bypass on the measuring assembly shall not be used for these means.

Change to Requirement: Modified text in paragraph S.3.2.1.	Requirement Title: Discontinuous Adjusting Means	Reason for Change: Modified paragraph to reflect the original intent, which was to specify requirements for the means to change the *ratio* for indicated quantities not the accuracy of the measuring instrument. This change aligns the wording with that in corresponding paragraphs in other

		measuring devices codes.

S.3.2.1. Discontinuous Adjusting Means. - When the ~~accuracy~~ adjusting means changes ratio between the indicated quantity and the quantity of measured gas in a discontinuous manner, the consecutive values of the ratio shall not differ by more than 0.1 %.

Change to Requirement: Deleted text from paragraph S.3.4.	Requirement Title: Provision for Sealing	Reason for Change: Deleted the word "will" from subparagraph (d).

S.3.4. Provision for Sealing. - Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that no adjustment may be made of:

(a) each individual measurement element~~;~~.

(b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries~~;~~ ~~or~~

(c) the zero adjustment mechanism, and

(d) any metrological parameter that ~~will~~ detrimentally affects the metrological integrity of the device or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal. Audit trails shall use the format set forth in Table S.3.4.

~~Audit trails shall use the format set forth in Table S.3.4.~~

Change to Requirement: Added text to paragraph S.3.6.	Requirement Title: Pressurizing the Discharge Hose	Reason for Change: Added the text "or greater than" to widen the scope of the requirement for automatic pressurization to cover multiple types of systems. Reworked the sentence prohibiting advancement of indications to clarify that pressurization nor purging/bleeding of the discharge hose shall advance the indications.

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.

~~The discharge hose shall be repressurized at the beginning of a delivery when venting occurs at the end of the fueling operation. Purging/Bleeding of the discharge hose shall not advance the indication.~~

Change to Requirement: Modified title of paragraph	Requirement Title: Zero-Set-Back Interlock, Retail Motor	Reason for Change: Changed the word "motor-fuel" to "vehicle"

S.3.7.	Fuel Devices	because this is a more appropriate term to describe the type of fueling system where the interlock feature is required.

S.3.7. Zero-Set-Back Interlock, Retail ~~Motor~~ Vehicle Fuel Devices.

Change to Requirement: Added text to paragraph S.3.7.	Requirement Title: Zero-Set-Back Interlock, Retail Motor Fuel Devices	Reason for Change: Added the word "and" because the conditions in (a), (b), and (c) apply to all systems.

S.3.7. Zero-Set-Back Interlock, Retail ~~Motor~~ Vehicle Fuel Devices. - A device shall be constructed so that:

(a) ~~after a delivery cycle has been completed by moving the starting lever **or similar mechanism** to any position that shuts off the device~~, when the device is shut-off at the end of a delivery, an automatic interlock prevents a subsequent delivery until the indicating elements, and recording elements if the device is equipped and activated to record, have been returned to their zero positions~~;~~,

(b) ~~the discharge nozzle cannot be returned to its designed hanging position (that is, any position where the tip of the nozzle is placed in its designed receptacle and the lock can be inserted) until the starting lever **or similar mechanism** is in its designed shut off position and the zero set back interlock has been engaged; and~~it shall not be possible to return the discharge nozzle to its start position unless the zero set-back interlock is engaged or becomes engaged, and

(c) in a system with more than one dispenser supplied by a single ~~pump~~ source, an effective automatic control valve in each dispenser prevents product from being delivered until the indicating elements on that dispenser are in a correct zero position.

Change to Requirement: Removed examples from paragraph S.7.	Requirement Title: Totalizers for Retail Motor-Fuel Devices	Reason for Change: Removed the examples from paragraph S.7., but will include examples (1), (2), (4), and (5) in the summary discussions and possibly the type evaluation checklist, examination procedure outline, and/or training materials for hydrogen refueling equipment. Example (3), which addresses blending for octane values, was not included because it is not applicable to hydrogen applications.

S.7. Totalizers for Retail Motor-Fuel Devices. - Retail motor-fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through each separate metering device.

~~Note: Examples of possible uses that necessitate a nonresettable totalizer include, but are not limited to: (1) tracking product dispensed during test, (2) detecting diversion of product after it is metered, (3) detecting discrepancies between blend settings and posted octane values, (4) detecting use after the device is removed from service, and (5) collection of motor fuel taxes.~~

Time limitations in the June 2008 meeting did not allow the DSTPS to complete its review of Draft 3.0. A separate agenda will be developed for the more technically complex N. T. and UR. paragraph requirements not addressed in the June 2008 meeting as follows:

The DSTPS identified the following requirements as needing further research and/or discussion to ensure they are appropriate and/or properly address the gaseous hydrogen application.

Nonresettable Totalizers
The draft code includes a requirement for a nonresettable totalizer similar to those in other corresponding NIST Handbook 44 Codes that apply to motor-fuel dispenser applications. However, equipment manufacturers questioned where to derive quantity values to achieve agreement between the totalizer and dispenser indications. This feature may not be able to be patterned after what is currently in use for the gasoline dispenser, where taxes, inventory control, etc. are managed through totalizer readings.

At this point, the DSTPS agreed that dispensers must have a nonresettable totalizer. However, examples of uses for a nonresettable totalizer such as tracking product dispensed during performance test/sampling, detecting diversion of product after it is metered, detecting discrepancies between blend settings and posted octane values, and in tracking product sold for the collection of motor-fuel taxes will be listed in test procedures and training materials rather than become an extensive list in the code language.

Minimum Measured Quantity
The DSTPS discussed marking requirements for the “minimum measured quantity,” (MMQ) which are a part of international requirements for all meter technologies (e.g., OIML R 139 "Compressed gaseous fuel measuring systems for vehicles") and a NIST Handbook 44 requirement for mass flow meter technology. The MMQ is used to determine the limits for other requirements in international standards. Consequently, the DSTPS is looking for the best technical approach to include MMQ requirements in the draft code.

Flow Rate Control
The DSTPS discussed conducting performance tests of the MMQ at the minimum flow rate which precipitated questions about how to maintain a steady flow rate. The DSTPS closely examined how quantities delivered at minimum and maximum flow rates are specified in the code either by weight and volume, which may not be the appropriate basis for specifying quantities in this application. The size of the test tank or vessel may be the only means to control the flow rate. Is the design all hydrogen refueling equipment such that it is affected by changes in flow rates? The design of some refueling systems for pressurization of the hose and high pressure deliveries may affect the ability to control the flow rate during test. The DSTPS will consider the best approach to resolve these concerns.

(4) Upcoming NIST WMD Outreach Projects

(a) NIST WMD Hydrogen Web Page
Information on the NIST WMD Hydrogen Web Page was emailed to the DSTPS. In July 2008, NIST WMD launched a link from its home page to a new web page titled "Developing Commercial Hydrogen Measurement Standards." The web page will be the U.S. weights and measures and hydrogen communities' source for the latest information and status of ongoing work to develop uniform and appropriate legal metrology standards for commercial hydrogen measurements. The web page includes the following topics: (1) *U.S. National Work Group (USNWG) for the Development of Commercial Hydrogen Measurement Standard,* (2) *Development of International Standards,* (3) *NIST WMD Five Year Plan,* (4) *Quarterly Articles on Hydrogen New,* (5) *Helpful Hydrogen Links,* (6) *Current Hydrogen Events,* and (7) *Contacts in the NIST WMD for Commercial Hydrogen*

Measurement.

(b) Weights and Measures Administration Workshops

Information on the upcoming NIST WMD Hydrogen Workshops was emailed to the DSTPS. NIST WMD is planning two 2 ½-day workshops August 12-14, and September 23-25, 2008 on "Commercial Hydrogen Measurement Standards" at its Gaithersburg, Maryland campus. The workshops will familiarize weights and measures officials, who are responsible for field inspection and test of motor-fuel dispensers, with the latest developments in the operation, performance, and safety of hydrogen refueling equipment and related transportation technologies. Workshop participants will have the opportunity to tour hydrogen vehicles, observe vehicle refueling, and talk to experts on hydrogen technology and safety. NIST is seeking experts on hydrogen technology as presenters in the workshop.

(5) Next Steps/Tasks

The DSTPS agreed that another meeting might be possible and even necessary before the weights and measures community starts its fall 2008 cycle for the standards development process and to have a strategy for the 2009 National Conference on Weights and Measures. A separate project may be necessary to address the more technically complex issues on MMQ, nonresettable totalizers, control of flow rates and to analyze whether the language carried over from similar code applications are appropriate for hydrogen technology.

(6) Next Meeting

Two additional meetings are tentatively planned for August 2008 and the fifth is to be determined. It is anticipated that there may be a need to dedicate an entire meeting to one specific standards' 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 makes every effort to avoid scheduling conflicts with upcoming events and meetings in the weights and measures and hydrogen communities.

The Technical Advisors will poll the USNWG to determine if there are any scheduling conflicts and the group's preference on the following sites as the location for a late August 2008 meeting:

- Ft. Collins, CO
- APCI, Allentown, PA
- eTec, Phoenix, AZ
- Micro Motion, Inc., Boulder, CO
- NextEnergy, Detroit, MI
- Powertech, Vancouver, BC, Canada

A time and date will be announced after confirmation of the location and a majority of the USNWG provides feedback on their schedules.

(7) USNWG-Technology Tour

At the Gas Technology Institute (GTI), the DSTPS observed the operation of a Greenfield Compression, Inc. hydrogen refueling dispenser and the associated test standard that uses the gravimetric test method to verify the system's performance. The DSTPS also had the opportunity to visit the GTI lab and discuss the limits of laboratory equipment for detecting the contaminant/particulate levels specified in the interim fuel quality standard. The USNWG wishes to express its deepest appreciation to GTI and Greenfield Compression, Inc. for this learning experience.

FUEL SPECIFICATIONS SUBCOMMITTEE (FSS) MEETING
Thursday, June 19, 2008, 8:30 a.m. – 12 noon (CT)
Gas Technology Institute (GTI), 1700 South Mount Prospect Road, Conference Rooms 126-1 and 126-2
Des Plaines, Illinois
Chair – Vacant
Moderator/Technical Advisor – Kenneth Butcher (NIST)

NOTE: In addition to Items (3) and (4) see Appendix E "The Starting Point: A Discussion Paper Describing a Proposed Method of Sale and Quality Specification for Hydrogen Vehicle Fuel" which provides a more detailed discussion, analysis, and graphics on the method of sale and fuel quality issues for hydrogen refueling applications.

(1) Welcome and Introductions
The Moderator welcomed the participants and called the meeting to order, and covered its purpose. The collaborative work by the meeting's sponsors was recognized. Participants were briefed on the facilities available at GTI, the schedule of events, and background materials. Participants provided their name, affiliation, and stated their specific area of interest in the work to develop hydrogen fuel specifications and method of sale requirements.

(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 March 2008 USNWG Meeting
The March 2008 FSS Meeting Summary was approved with no changes (see Appendix A).

(b) Approve the USNWG Guidelines
The guidelines describe the work group and its subcommittee's objectives, general membership, meeting and voting procedures, and timelines for projects and other tasks. The FSS reviewed the USNWG Guidelines and corresponding Agenda Submission Form. The DSTPS requested the Technical Advisor further clarify the guidelines to address: (1) active USNWG participation, (2) methods of balloting for a vote, (3) teleconference participation, and (4) quorum requirements (see Appendix B) by June 30, 2008.

The USNWG agreed to review the final draft of the Guidelines and submit final comments to the Technical Advisor by July 22, 2008.

(c) Elect a Chair
The FSS has the task of establishing and promoting appropriate legal metrology requirements to address the method of sale, fuel quality specifications, and sampling/test procedures for deliveries of hydrogen in retail motor-fuel applications. Given the size of the task before the FSS it will be important to have a Chair to ensure the work progresses satisfactorily and in a timely fashion to develop appropriate uniform national legal metrology standards. No Chair was selected during the June 19 meeting session.

(3) Method of Sale for Hydrogen Dispensing Applications
The FSS was asked to consider proposals to amend NIST Handbook 130 to recognize hydrogen refueling applications to address (1) the method of sale, (2) define what products fall under this application, (3) sales to the end user should be made on the basis of mass (kilogram) in whole cents, and (4) device labeling for hydrogen dispensers and advertisements. The proposals were modified to reflect recommendations made by

the FSS at the March 2008 meeting

Proposals to modify NIST Handbook 130 Section IV. Uniform Regulations Part B. Uniform Regulations for the Method of Sale of Commodities Section 2 Non-food Products would reads as follows:

2.XX. Retail Sales of Hydrogen Fuel.

2.XX.1. Definition.

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

2.XX.2. Method of Retail Sale.

2.XX.2.1. Method of Retail Sale. – All hydrogen fuel kept, offered, or exposed for sale and sold at retail must be in terms of the kilogram.

2.XX.2.2. Retail Dispenser Labeling

(a) All retail hydrogen fuel dispensers must display the unit price in whole cents on the basis of price per kilogram.

(b) The service pressure(s) of the dispenser must be conspicuously shown on the user interface in terms of bar

2.XX.2.3. Street Sign Prices and Advertisements

When the unit price for hydrogen fuel is shown on street signs or in advertisements:

(a) 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").

(b) The sign or advertisement must include the service pressure(s) at which the dispenser(s) delivers hydrogen fuel.

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 (bar, mPa, and psi) 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 reference documents to ensure uniform implementation of SI units.

Although a definition for hydrogen fuel is proposed for the method of sale requirements a corresponding definitions is also proposed for NIST Handbook 130 Section IV. Uniform Regulations Part G. Uniform Engine Fuels, Petroleum Products, and Automotive Lubricants Regulations Section 1. Definitions to include a definition for the term hydrogen fuel that reads as follows:

1.XX. Hydrogen Fuel. – a fuel composed of the chemical hydrogen intended for consumption in an

internal combustion engine or fuel cell.

Additional proposed new definitions for the following related terms would read as follows:

1.XX Fuel Cell. – an electrochemical device used to convert hydrogen and oxygen into electrical energy to power a motor vehicle.

1.XX Internal Combustion Engine. - a device used to ignite hydrogen in a confined space to create mechanical energy to power a motor vehicle.

(4) Engine Fuel Quality

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 reference standards for fuel quality at the August 2008 meeting.

The FSS did not modify the interim hydrogen fuel quality standard developed by California Department of Food and Agriculture (CDFA) and will be asked to consider the interim standard as a starting point for its discussions on a fuel quality specification. At its March 2008 meeting, the FSS indicated that there was tentative agreement with the values for Items 6, 7, 8, 9, 12, 14, and 16 listed in Table 1 Hydrogen Fuel Quality Specification. The FSS also agreed that it could not support the values in Table 1 listed under Items 1, 2, 3, 4, 5, 10, 11, 13 and 15 because there was either not enough research data or test methods available to support a decision. Table 1 once adopted would be added to NIST Handbook 130 Section IV. Uniform Regulations Part G. Uniform Engine Fuels, Petroleum Products, and Automotive Lubricants Regulations Section 2. Standard Fuel Specifications as follows:

Table 1. Hydrogen Fuel Quality Specification

	Property	Value	Unit	Limit	Test Method(s)
1	Ammonia	0.1	ppm v/v	Maximum	To be Specified
2	Carbon Dioxide	2	ppm v/v	Maximum	To be Specified
3	Carbon Monoxide	0.2	ppm v/v	Maximum	To be Specified
4	Formaldehyde	0.01	ppm v/v	Maximum	To be Specified
5	Formic Acid	0.2	ppm v/v	Maximum	To be Specified
6	Helium	300	ppm v/v	Maximum	To be Specified
7	Hydrogen Fuel Index	99.97	% (a)	Minimum	To be Specified
8	Nitrogen and Argon	100	ppm v/v	Maximum	To be Specified
9	Oxygen	5	ppm v/v	Maximum	To be Specified
10	Particulate Concentration	1	µg/L @ NTP (b)	Maximum	To be Specified
11	Particulate Size	10	µm	Maximum	To be Specified
12	Total Gases	300	ppm v/v ©	Maximum	To be Specified
13	Total Halogenated Compounds	0.05	ppm v/v	Maximum	To be Specified
14	Total Hydrocarbons	2	ppm v/v (d)	Maximum	To be Specified
15	Total Sulfur Compounds	0.004	ppm v/v	Maximum	To be Specified
16	Water	5	ppm v/v	Maximum	To be Specified

(a) The Hydrogen Fuel Index is the value obtained with the value of total gases (%)
(b) Particulate Concentration µg/L @ NTP = micrograms per liter of hydrogen fuel at 0 °C and 1 atmosphere pressure
(c) Total Gases = Sum of all impurities listed on the table except particulates

(d) Total Hydrocarbons may exceed 2 ppm v/v only due to the presence of methane, provided that the total gases do not exceed 300 ppm v/v.

The FSS also discussed sampling procedures for hydrogen fuel quality. The FSS questioned the ability of field officials to obtain samples from systems that operate at 700 bar pressure (approximately 10 000 psi). By comparison compressed natural gas sampling is conducted at pressures 0.1 % of the rating for high pressure hydrogen installations.

The CDFA Division of Measurement Standards reported on the set up and operation of a hydrogen quality sampling apparatus (HQSA) it took possession of in March 2008. Questions were raised about the level of training necessary to properly use the equipment under field conditions and advancements in technology that make sampling equipment readily available that is capable of detecting contaminants/particulates at the levels specified in the interim standard. Perhaps there is something to be learned from the clean room standards in place for the semiconductor industry.

The FSS discussed sources of environmental contaminants that are dependent on where in the flow stream a sample is taken, "clean stations," and the effects of humidity on test equipment filters. The FSS will continue its discussion on factors that affect hydrogen quality as it works to establish the appropriate hydrogen fuel quality standard.

(5) Laboratory Manual

During the June 2008 meeting, the FSS briefly discussed the possibility of establishing a list of existing fuel quality laboratories able to 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

(6) Field Sampling Procedures

The USNWG anticipates there are two separate tests that will need to be performed by weights and measures/fuel quality officials. The first is an accuracy test of the dispenser system and the second is sampling hydrogen for compliance with quality specifications.

The FSS may wish to consider 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 Practices

(c) Handling, Storage, and Transportation

(d) Minimum Training Standards for Field Officials

The FSS discussed sampling procedures for hydrogen fuel quality. The California Division of Measurement Standards reported on the set up and operation of a hydrogen quality sampling apparatus it took possession of in March 2008. The FSS also agreed to discuss alternative resources for the determination of fuel quality if state and local agencies are not able to perform this function at its next meeting.

(7) Next Steps

The FSS may wish to consider how future work should progress to establish appropriate hydrogen fuel quality standards for the properties with contaminant levels it could not support. The FSS agreed to work on identifying the appropriate units of measurement and a starting point for the fuel quality standard at its next meeting.

(8) Next Meeting

Two additional meetings are tentatively planned for August 2008 and the fifth is to be determined. It is anticipated that there may be a need to dedicate an entire meeting to one specific standard 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 makes every effort to avoid scheduling conflicts with upcoming events and meetings in the weights and measures and hydrogen communities.

The Technical Advisors will poll the USNWG to determine if there are any scheduling conflicts and what are their preferences on the following sites for a late August 2008 meeting:

- Ft. Collins, CO
- APCI, Allentown, PA
- eTec, Phoenix, AZ
- Micro Motion, Inc., Boulder, CO
- NextEnergy, Detroit, MI
- Powertech, Vancouver, BC, Canada

A time and date will be announced after confirmation of the location and a majority of the USNWG provides feedback on their schedules.

Name	Agency	Device Standards and Test Procedures Sub-commitee Member Yes (Y)	Fuel Specifications Sub-committee Member Yes (Y)	Attended Device Standards and Test Procedure Sub-committee Meeting Yes (Y)	Attended Fuel Specifications Subcommittee Meeting Yes (Y)
Jacquelyn Birdsall	California Fuel Cell Partnership		Y		
Robert Boyd	Hydrogen Solutions – Linde Group	Y	Y	Y	Y
Kenneth Butcher	NIST-TS WMD		Y	Y	Y
Tina Butcher	NIST – TS WMD	Y	Y	Y	Y
Marc Buttler	Micro Motion/Emerson Process Management	Y	Y	Y	Y
Joseph Cohen	Air Products and Chemicals, Inc.	Y	Y		
Jared Hightower	Greefield	Y	Y	Y	Y
Robert Ingram	CA – Food and Agriculture, Division of Measurement	Y	Y	Y	Y
Michael Keilty	Endress & Hauser Flowtec AG	Y	Y	Y	Y
Kristin Macey	CA – Food and Agriculture, Division of Measurement Standards	Y	Y	Y	Y
Jonathan Munetz	Sentech, Inc.	Y	Y		

Name	Agency	Device Standards and Test Procedures Sub-commitee Member Yes (Y)	Fuel Specifications Sub-committee Member Yes (Y)	Attended Device Standards and Test Procedure Sub-committee Meeting Yes (Y)	Attended Fuel Specifications Subcommittee Meeting Yes (Y)
G. Diane Lee	NIST – TS WMD	Y	Y	Y	Y
David Pearce	Greenfield Compression				
Kenneth Ramsburg	MD Dept of Agriculture, Weights and Measures Program	Y	Y		
Ralph Richter	NIST – TS WMD	Y	Y		
Antonio Ruiz	DOE	Y	Y		
Michael Steinbach	Instrutech, Inc.	Y	Y	Y	Y
Kevin Sterling	Florida Dept. Of Agriculture, Division of Standards	Y	Y		
Curt Williams	Georgia Dept. Of Agriculture		Y		
Juana Williams	NIST – TS WMD	Y	Y	Y	Y
John Wright	NIST Chemical Science and Technology Laboratory, Process Measurements Division	Y	Y	Y	Y
David Wyatt	Wyatt Engineering	Y	Y		