

## **Proposal for New NIST Handbook 130 Laws and Regulations (L&R) To Address Hydrogen Refueling Applications**

The U.S. National Work Group (USNWG) for the Development of Commercial Hydrogen Measurement Standards is recommending for adoption new engine fuel quality requirements for NIST Handbook 130 (H130) to address gaseous hydrogen refueling applications. This proposed hydrogen fuel quality specification will appear on the 2011 agenda of the National Conference on Weights and Measures Laws and Regulations Committee.

### ***Background***

In July 2010 a corresponding NIST Handbook 44 Tentative Hydrogen Gas-Measuring Devices Code and NIST Handbook 130 Method of Sale Regulation for hydrogen were adopted and will be published in the 2011 edition of the handbooks. The proposed codes and definitions for hydrogen fuel address legal metrology requirements for the newly emerging hydrogen refueling technology. The USNWG believes the code has merit and continues to recommend the weights and measures community consider approving this proposal as an interim requirement since 24 states now have hydrogen refueling stations in operation.

The USNWG began work on this project in October 2007. Draft 3.1 of the H130 Code shown below is the result of work by the USNWG Fuel Specifications Subcommittee (FSS) at its January 2010 meeting.

An in-depth summary of L&R issues is available in the paper titled “The Starting Point: A Discussion Paper Describing a Proposed Method of Sale and Quality Specification for Hydrogen Vehicle Fuel” (August 2009) developed by Ken Butcher and updated by Lisa Warfield, past and present NIST Technical Advisors to the USNWG Fuel Specifications Subcommittee, respectively.

More information on the discussion paper and work by the USNWG is available on the NIST WMD web site at <http://ts.nist.gov/WeightsAndMeasures/index.cfm>, under the W&M Resources link to “Developing Commercial Hydrogen Measurement Standards.” To comment on this proposal, contact Lisa Warfield, NIST WMD, at [lisa.warfield@nist.gov](mailto:lisa.warfield@nist.gov), by telephone at (301) 975-3308, by fax at (301) 975-8091 or by postal mail at NIST WMD, 100 Bureau Drive, MS 2600, Gaithersburg, MD 20899-2600.

**Recommendation:** Add new definitions for NIST Handbook 130 Section IV. Uniform Regulations Part G. Uniform Engine Fuels, Petroleum Products, and Automotive Lubricants Regulations Section 1. Definitions to address gaseous hydrogen refueling applications to read as follows:

**1.XX. Fuel Cell. - an electrochemical energy conversion device in which fuel and an oxidant react to generate energy without consumption of its electrodes or electrolyte.**

**1.XX. Hydrogen Fuel. - a fuel composed of the chemical hydrogen intended for consumption in a surface vehicle with an internal combustion engine or fuel cell**

**1.XX. Internal Combustion Engine. - a device used to generate power by converting chemical energy bound in the fuel into mechanical work to power a vehicle.**

Cite the appropriate reference for the hydrogen fuel quality standard below that was developed by the California Division of Measurement Standards and modified by the April 2010 FSS in 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:

<b>Table 1. Hydrogen Fuel Quality Specification* (version 19JAN2010)</b>						
	<b>Property</b>	<b>Value</b>	<b>Unit</b>	<b>Limit</b>	<b>Test Method(s)</b>	<b>Responsible Standards Committee and Status of test method</b>
1	Ammonia	0.1	ppm v/v	Maximum	to be specified	WK 10196 under ASTM D03.14
2	Carbon Dioxide	2.0	ppm v/v	Maximum	to be specified	Wk 10196 and WK 4548 under ASTM D03.14
3	Carbon Monoxide	0.2	ppm v/v	Maximum	to be specified	WK 10196 under ASTM D03.14
4	Formaldehyde	0.01	ppm v/v	Maximum	to be specified	WK 10196 under ASTM D03.14
5	Formic Acid	0.2	ppm v/v	Maximum	ASTM D7550-09	WK 10196 under ASTM D03.14
6	Helium	300.0	ppm v/v	Maximum	to be specified	ASTM D03.14
7	Hydrogen Fuel Index	99.97	% (a)	Minimum	to be specified	
8	Nitrogen and Argon	100.0	ppm v/v	Maximum	to be specified	WK 4548 under ASTM D03.14
9	Oxygen	5.0	ppm v/v	Maximum	to be specified	WK 4548 under ASTM D03.14
10	Particulate Concentration	1.0	mg/kg	Maximum	to be specified	WK 9688 and WK 21611 under ASTM D03.14
11	Total Allowable Non-Hydrogen, Non-Helium, Non-particulate constituents	100.0	ppm v/v	Maximum	to be specified	
12	Total Non-Hydrogen Gases	300.0	ppm v/v (b)	Maximum	to be specified	
13	Total Halogenated Compounds	0.05	ppm v/v	Maximum	to be specified	WK 23815 under ASTM D03.14
14	Total Hydrocarbons	2.0	ppm v/v (c)	Maximum	to be specified	WK 22378 under ASTM D03.14
15	Total Sulfur Compounds	0.004	ppm v/v	Maximum	to be specified	WK 24073 under ASTM D03.14
16	Water	5.0	ppm v/v	Maximum	to be specified	WK 10196 and WK 4548 under ASTM D03.14
Footnotes to Table 1 –						
a. Hydrogen fuel index is the value obtained with the value of total gases (%) subtracted from 100 %.						
b. Total Gases = Sum of all impurities listed on the table except particulates.						
c. 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 FTC’s Fuel Rating Rule (16 CFR Part 309) see the requirements in “Labeling of Alternative Fuels” at <a href="http://www.ftc.gov/bcp/edu/pubs/business/autos/bus29.shtm">http://www.ftc.gov/bcp/edu/pubs/business/autos/bus29.shtm</a> requires dispensers to bear an declaration of minimum percent of hydrogen determined according to test methods described in “Standard Test Method for Analysis of Natural Gas by Gas Chromatography (ASTM D1946)						

The FSS agreed to move forward with the interim fuel quality specifications in the table. However, the FSS agreed to revisit the interim standard should a different fuel quality specification be published by a nationally recognized standards body.