International standards and regulations for hydrogen safety

Hydrogen Safety Seminar

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Karen Hall

National Hydrogen Association, USA

Introduction

- Standards
  - ISO/TC 197
  - IEC/TC 105
  - SAE
- Regulations
- National Coordination

What are Standards?

- Published documents that contain a technical specification or other precise criteria designed to be used consistently as a rule, guideline, or definition.
- Standards help to make life simpler and to increase the reliability and the effectiveness of many goods and services we use.
- Standards are designed for voluntary use and do not impose any regulations. However, laws and regulations may refer to certain standards and make compliance with them compulsory.
- Standards are created by bringing together the experience and expertise of all interested parties such as the producers, sellers, buyers, users and regulators of a particular material, product, process or service.

What are Regulations?

- Regulations are the rules, procedure, administrative codes etc. set by authorities or governmental agencies to achieve its objective.
- The regulations are therefore applicable only within the jurisdiction or purpose for which such regulation are made

International Activities

- ISO/TC 197 Hydrogen Technologies
- ISO/TC 11 Boilers and pressure vessels
- ISO/TC 20 Aircraft and space vehicles
- ISO/TC 22 Road vehicles
- ISO/TC 58 Gas cylinders
- ISO/TC 70 Internal combustion engines
- ISO/TC 118 Compressors, pneumatic tools and pneumatic machines
- ISO/TC 153 Valves
- ISO/TC 192 Gas turbines
- ISO/TC 193 Natural gas
- ISO/TC 203 Technical energy systems
- ISO/TC 207 Environmental management
- ISO/TC 220 Cryogenic vessels
- IEC/TC 31 Equipment for explosive atmospheres
- IEC/TC 105 Fuel cell technologies

And many of these have related subcommittees

ISO TC 197: Hydrogen Technologies

- Standardization in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen.
- First meeting held in June 1990 in Zurich, Switzerland
- Most recent meeting was held in Brisbane, Australia (June 13, 2008)
- Next meeting: Seoul, Korea (October 14, 2009)
- Has established liaison relationship with all applicable ISO and IEC Technical Committees, and where appropriate, with subcommittees.

Member Country Participation

- Member Countries have obligations:
  - Participate actively in the work, with an obligation to vote on all questions formally submitted for voting within the technical committee or subcommittee, on enquiry drafts and final draft International Standards, and participate in meetings (**P-member**)
  - National bodies have the responsibility to organize their national input in an efficient and timely manner, taking account of all relevant interests at their national level.
- Example: UK:
  - BSI is the official UK member body.
  - UKHA Chairs BSI/PVE/3/8 – Hydrogen Technologies

ISO/TC 197 Membership

- P-Member Countries:
  - ARGENTINA (IRAM)
  - JAPAN (JISC)
  - AUSTRIA (ON)
  - NETHERLANDS (NEN)
  - BELGIUM (NBN)
  - NORWAY (SN)
  - CANADA (SCC)
  - REPUBLIC OF KOREA (KATS)
  - CHINA (SAC)
  - RUSSIAN FEDERATION (GOST R)
  - DENMARK (DS)
  - SPAIN (AENOR)
  - EGYPT (EOS)
  - SWEDEN (SIS)
  - FRANCE (AFNOR)
  - SWITZERLAND (SNV)
  - GERMANY (DIN)
  - UNITED KINGDOM (BSI)
  - INDIA (BIS)
  - USA (ANSI)
  - ITALY (UNI)

ISO/TC 197 Membership

- O-Member Countries:
  - AUSTRALIA (SA)
  - JAMAICA (BSJ)
  - BRAZIL (ABNT)
  - LIBYAN ARAB JAMAHIRIYA (LNCSM)
  - CZECH REPUBLIC (CNI)
  - SERBIA (ISS)
  - FINLAND (SFS)
  - THAILAND (TISI)
  - HONG KONG, CHINA (ITCHKSAR)
  - TURKEY (TSE)
  - HUNGARY (MZST)

Previously Published ISO TC 197 Documents

- ISO 13984:1999 Liquid hydrogen—Land vehicle fuelling system interface
- ISO 14687: 1999, Corr 1:2001 Hydrogen fuel—Product specification
- ISO/PAS 15594:2004 Airport hydrogen fuelling facility
- ISO/TR 15916: 2004 Basic considerations for the safety of hydrogen systems
- ISO 17268:2006 Compressed hydrogen surface vehicle refuelling connection devices (SAE J2600)

Recently Published ISO TC 197 Documents

- **ISO 22734-1** Hydrogen generators using water electrolysis process — Part 1: Industrial and commercial applications
- **ISO 16111** Transportable gas storage devices — Hydrogen absorbed in reversible metal hydrides
- **ISO TS 14687-2** Hydrogen Fuel — Product Specification — Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles
- **ISO 14687: 1999, Corr 1:2001** Hydrogen fuel—Product specification
- **ISO 17268** Compressed hydrogen surface vehicle refuelling connection devices
- **ISO TS 15869** Gaseous hydrogen and hydrogen blends —Land vehicle fuel tanks

Active ISO TC 197 Documents

- **ISO 14687-2** Hydrogen Fuel — Product Specification — Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles – TS published – IS under development
- **ISO 17268** Compressed hydrogen surface vehicle refuelling connection devices – under revision
- **ISO 15869** Gaseous hydrogen and hydrogen blends —Land vehicle fuel tanks
- **ISO 22734-2** Hydrogen generators using water electrolysis process — Part 2: Residential applications

Active ISO TC 197 Documents - Continued

- **ISO 16110-2** Hydrogen generators using fuel processing technologies — Part 2: Test methods for performance
- **ISO 20100** Gaseous hydrogen — Fuelling stations
- **ISO 26142** Hydrogen detection apparatus

WG 5 Work item: ISO 17268

- Compressed hydrogen surface vehicle refuelling connection devices
- This International Standard applies to design, safety and operation verification of Compressed Hydrogen Surface Vehicle refuelling connection devices (nozzle and receptacle)
- The published Standard applies to devices which have working pressures of 25 MPa and 35 MPa
- The standard is under revision to address some technical issues that were deferred as well as the incorporation of the 70 MPa profile.

WG6: ISO 15869

- Gaseous hydrogen and hydrogen blends —Land vehicle fuel tanks
- Joint with ISO/TC 22 and ISO/TC 58/SC 3
- Published in February 2009 as a Technical Specification.
  - Lack of consensus on key technical issues resulted in a failed 3rd DIS.
- Specifies the requirements for light-weight refillable fuel tanks intended for the on-board storage of high pressure compressed gaseous hydrogen or hydrogen blends on land vehicles.
- Not intended as a specification for fuel tanks used for solid or liquid hydride hydrogen storage applications.

WG8: ISO 22734-2

- Convener: Randy Dey, TC 197 Chair
- Hydrogen generators using water electrolysis process — Part 2: Residential applications
- This standard is applicable to hydrogen generators intended for indoor and outdoor residential use (non-commercial and non-industrial use) in sheltered areas such as carports, garages, utility rooms and similar areas of a residence. This standard includes cord-connected equipment for outdoor and garage use only.

WG9: ISO 16110-2

- Convener: Falco Thuis, The Netherlands
- Hydrogen generators using fuel processing technologies — Part 2: Test methods for performance
- This International Standard provides test procedures for determining the performance of packaged, self-contained or factory matched hydrogen generation systems with a capacity less than 400 Nm3/hr (normal cubic meters per hour), herein referred as hydrogen generators, that convert a fuel to a hydrogen rich stream of composition and conditions suitable for the type of device or process using the hydrogen (e.g. a fuel cell power system, industrial application or a hydrogen compression, storage and delivery system).
- WG9 met in January 2009 to review comments on the FDIS. Publication is expected in soon.

WG11: ISO 20100

- Convener: Randy Dey, Canada
- Gaseous hydrogen — Fuelling stations
- This Technical Specification specifies the characteristics of outdoor **commercial** fuelling stations that dispense gaseous hydrogen used as fuel onboard land vehicles of all types. It covers, as applicable, the system that produces gaseous hydrogen on-site, the system that stores and dispenses gaseous hydrogen from the point of supply at the fuelling station property to the filling connector installed onboard the land vehicle.

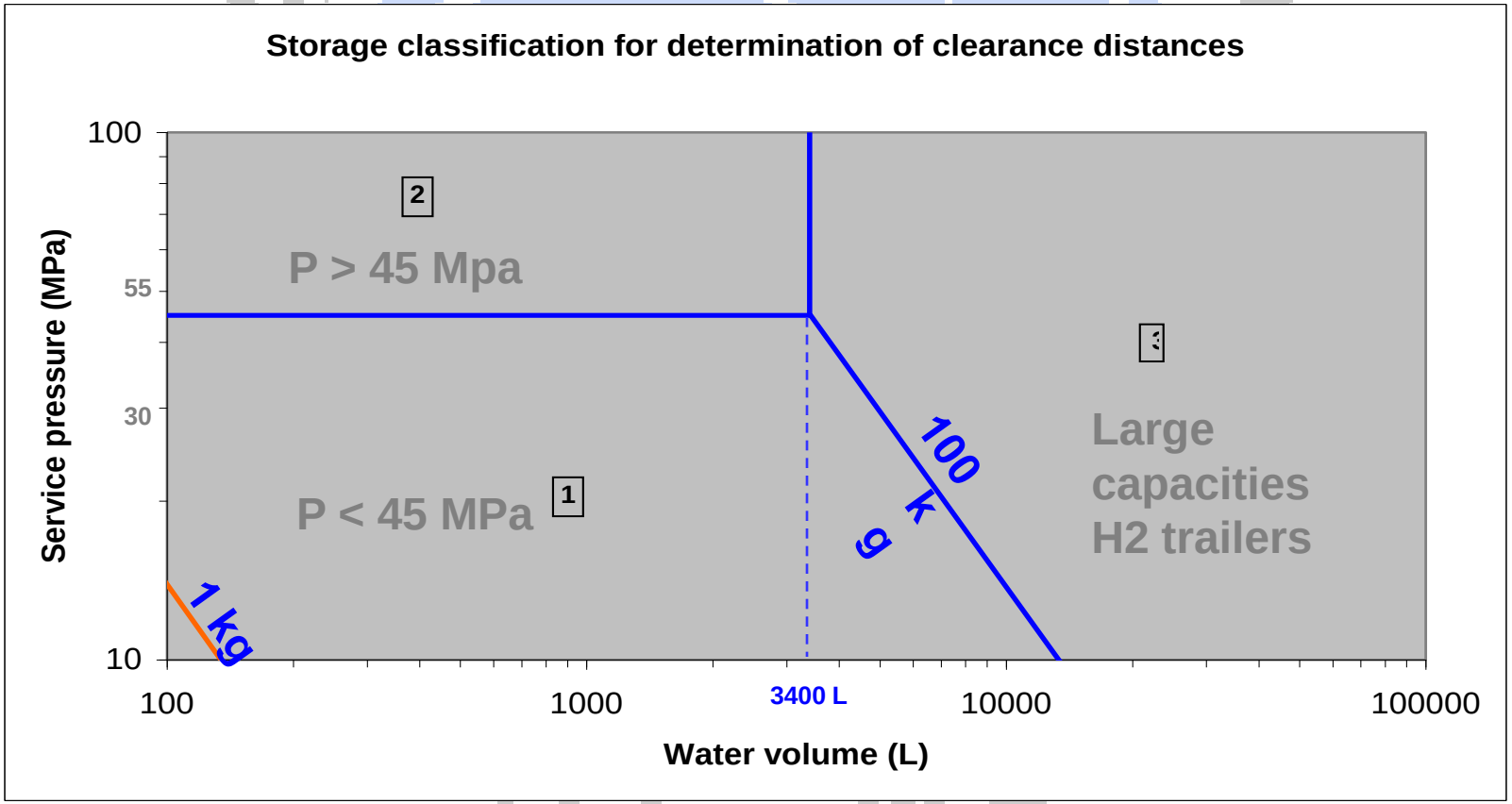
WG11 Status

- The working group submitted the first Draft Technical Specification (DTS), which was circulated for approval among the P-members.
- There were many comments on this document.
- The document was published as a Technical Specification while the WG continues development of an International Standard.
- Three task groups have been formed:
  - TG1 Separation Distances
  - TG2 Dispensing System and Fuelling Protocol
  - TG3 Remaining Technical Issues

Categorization of GH2 storage systems

- Pressure introduced as a parameter where most relevant for determining safety distances, i.e. small systems
- Boundaries defined according to actual equipment types

* Current thinking in WG 11 TG 1 – not final



Exposures and sources of hazard

Exposures	Criteria	Type	Comments
Buildings			
Occupied buildings openable openings and air intakes	4%H2	Critical	
Unoccupied buildings openable openings and air intakes	4%H2	Regular	
Building of combustible material	Therm. Eff.	Critical	Exposure is also a source of hazardous escalation*
Flammable material storage			
Flammable liquids above ground < 4000 L	Therm. Eff.	Regular	Exposure is also a source of hazardous escalation*
Flammable liquids above ground > 4000 L	Therm. Eff.	Critical	
Stock of combustible material	Therm. Eff.	Regular	Exposure is also a source of hazardous escalation*
Flammable gas storage above ground > 500 Nm3	Therm. Eff.	Regular	Exposure is also a source of hazardous escalation*
People and other activities			
Facility lot line	4%H2	Regular	
Place of unrestricted activity other than fuelling operation	4%H2	Regular	Exposure is also a source of hazardous escalation*
Pedestrian an vehicle passage ways	4%H2	Regular	
Sources of hazard			Sources of hazardous escalation for near-by H2 systems*
High voltage lines and trolley or train power line			Electro-magnetic field induced discharges or projected sparks
Other overhead power lines			
Public roadway			Vehicle impact
Underground flammable liquid storage - vents and fill openings			

* Large Storage Systems (LSS) are classified as critical exposure for sources of hazardous escalation

* Current thinking in WG 11 TG 1 – not final

WG12: ISO 14687-2

- Convener: Yasuo Takagi, Japan
- Hydrogen Fuel — Product Specification — Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles
- Removed this application from Part 1, and created a new Technical Specification to support early fuelling efforts.
- Published as a Technical Specification on 1 March 2008. This Technical
- Specification specifies the quality characteristics of hydrogen fuel in order to assure uniformity of the hydrogen product as dispensed for utilization in PEM fuel cell road vehicle systems.
- Draft International Standard is currently being developed.

* Current thinking in WG 12
– not final

Total gases [b]	300 µmol/mol	300 µmol/mol	
Water (H_2O)	5 µmol/mol	5 µmol/mol	7.4
Total hydrocarbons [c] (C_1 basis)	2 µmol/mol	2 µmol/mol	7,5
Oxygen (O_2)	5 µmol/mol	5 µmol/mol	7.6
Helium (He)	300 µmol/mol	300 µmol/mol	7.7
Nitrogen (N_2), Argon (Ar)	100 µmol/mol	100 µmol/mol	7.8
Carbon dioxide (CO_2)	2 µmol/mol	2 µmol/mol	7.9
Carbon monoxide (CO)	0,2 µmol/mol	0,2 µmol/mol	7.10
Total sulfur compounds [d]	0,004 µmol/mol [e]	0,004 µmol/mol [e]	7.11
Formaldehyde (HCHO)	0,01 µmol/mol	0,01 µmol/mol	7.12
Formic acid (HCOOH)	0,2 µmol/mol [e]	0,2 µmol/mol [e]	7.13
Ammonia (NH_3)	0,1 µmol/mol [e]	0,1 µmol/mol [e]	7.14
Total halogenated Compounds	0,05 µmol/mol	0,05 µmol/mol	7.15
Maximum particulates size	10 µm	10 µm	7.16
Maximum particulates concentration	1 µg/L at 20 ºC and 101,325 kPa	1 µg/L at 20 ºC and 101,325 kPa	7.17

Notes

NOTE For the constituents that are additive, such as total hydrocarbons and total sulfur compounds, the sum of the constituents are to be less than or equal to the acceptable limit. The tolerances in the applicable gas testing method are to be the tolerance of the acceptable limit.

a The hydrogen fuel index is determined by subtracting the total content of non-hydrogen gaseous constituents listed in Table 1 (total gases), expressed in mole percent, from 100 mole percent. It is less than the sum of the maximum allowable limits of all non hydrogen constituents shown in Table 1.

b The value of total gases is summation of the values of the non-hydrogen constituents listed in Table 1 except the particulates.

c Total hydrocarbons include oxygenated organic species. Total hydrocarbons are measured on a carbon basis (μmolC/mol). Total hydrocarbons may exceed 2 μmol/mol due only to the presence of methane, in which case the summation of methane, nitrogen and argon is not to exceed 100 ppm,.

d As a minimum, testing shall include H_2S, COS, CS_2 and mercaptans, which are typically found in natural gas.

e These values are based on detection limits of available instrumentation and test methods and serve as a basis for subsequent improvements in test methods and instrumentation. Recommended values for these constituents are subject to additional testing under realistic operational conditions and improved analytical procedures suitable for standardization

WG12 Status

- Comments received on the DTS were considered by the WG in the preparation of the International Standard.
- The WG is further advancing the preparation of the International Standard. Currently in CD phase.
- The current schedule anticipates publishing an International Standard in October 2010.
- Data on the impact of impurities on PEMFC membranes is currently being sought and/or developed.

Hydrogen Fuel Quality

- To support commercialization, efforts are underway to specify the maximum allowable concentration of impurities in hydrogen motor fuel
- SAE TIR J2719, Information report on the development of a hydrogen quality guideline for fuel cell vehicles, is proceeding in conjunction with activities within ISO TC197 WG12 as well as industry members and other NGOs.

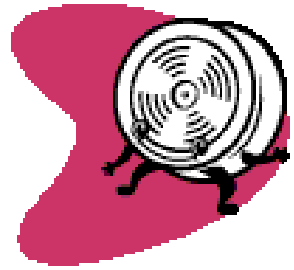
Hydrogen Fuel Quality

- International collaboration and data-sharing is critical.
- A workshop is planned for September in Germany
  - Identifying future R&D activities for further understanding fuel impurity problems
  - Information on choices of long perspective fuels
  - Inform community on fuel quality issues
  - Discuss correlation of fuel quality and cost
  - Establish fuel quality consensus among fuel cell users, hydrogen producers, and infrastructure operators
  - Establish program of work for standards and further pre-normative research
  - Suggest necessary technical improvements to fuel cell technology, fuel producers and fuel conditioning
  - Support standardization processes

New Work Item

- New work item proposal on ISO 14687-3 *Hydrogen fuel - Product Specification - Part 3: Proton exchange membrane (PEM) fuel cell applications for stationary appliances*

WG13: ISO 26142



- Convener: Ichiro Matsubara, Japan
- Hydrogen detection apparatus
  - Defines the performance requirements and the performance test methods of hydrogen detectors. The provisions in this standard cover the stationary hydrogen detectors used to achieve the single and/or multilevel safety operations such as nitrogen purging or ventilation and/or system shut-off corresponding to the hydrogen concentration. The requirements applicable to the control system as well as the installation requirements of hydrogen detectors are excluded.
  - This standard sets out only the requirements applicable to a product standard, which include the performance requirements and the test methods of performance for hydrogen detectors such as precision, response time, stability, measuring range, selectivity, and poisoning. This standard can be used for quality assessment or certification of the detectors and establishes the provisions for type test.

WG13 Status

- The DIS was unanimously approved by the ISO/TC 197 membership.
- Comments received were resolved by the WG in preparation of a Final Draft International Standard.
- Many comments related to ensuring the document is inclusive to competing sensor technologies.
- FDIS now at Technical Editing Stage, for circulation to member countries very shortly.

IEC/TC 105

- The Scope of IEC/TC105 *Fuel Cell Technologies* is to prepare international standards regarding fuel cell technologies addressing applications such as on-site power, portable power, and power for hand-held electronics. Many of these technologies are in transition from research and development to commercialization.

IEC/TC 105 MEMBERSHIP

- Canada (CA)
- China (CN)
- Denmark (DK)
- France (FR)
- Germany (DE)
- Israel (IL)
- Italy (IT)
- Japan (JP)
- Republic of Korea (KR)
- Netherlands (NL)
- Spain (ES)
- Sweden (SE)
- Switzerland (CH)
- United Kingdom (GB)
- United States of America (US)

Published IEC/TC 105 Documents

- WG #1 / IEC/TS 62282-1 (2005-03) Terminology
- WG #2 / IEC 62282-2 (2004-03) Fuel Cell Modules
- WG #3 / IEC 62282-3-1 (2007-04) Stationary Fuel Cell Power Systems - Safety
- WG #4 / IEC 62282-3-2 (2006-03) Stationary Fuel Cell Power Systems - Performance Test Methods
- WG #5 / IEC 62282-3-3 (2007-11) Stationary Fuel Cell Power Systems - Installation
- WG #7 / IEC 62282-5-1 (2007-02) Portable Fuel Cell Appliances - Safety
- WG #8 / IEC/PAS 62282-6-1 (2006-02) Micro Fuel Cell Power Systems - Safety
- WG #9 / IEC 62282-6-200 (2007-11) Micro Fuel Cell Power Systems - Performance
- WG #10 / IEC 62282-6-300 (2009-06) Micro Fuel Cell Power Systems - Fuel Cartridge Interchangeability

IEC/TC 105 Documents Under Development

Working Group #4 / IEC 62282-3-201 Small stationary polymer electrolyte fuel cell power system – Performance test method
Working Group #6 Fuel Cell Systems for Propulsion and Auxiliary Power Units
Working Group #11 Single Cell Test method for Polymer Electrolyte Fuel Cells
Ad Hoc Group #1 Identification of the market needs for standardization work of fuel cell systems for propulsion and auxiliary power units

WG 1- Terminology

- This report provides uniform terminology in the form of diagrams and definitions related to fuel cell technologies. It is intended as a resource for the Working Groups and users of the TC105 series of fuel cell standards.
- The 2005 TC105 Plenary voted to change the scope of this activity from “a resource for the Working Groups and users of the TC105 Series” to a “general fuel cell technology glossary”. This change is reflected in the 2009 update of this document.

WG 2-
Fuel Cell Module

- International standard providing minimum requirements for safety and performance of fuel cell modules in all applications.
- The first edition of IEC 62282-2 was published in 2004.
- The revision cycle Committee Draft was completed in June 2009 with the following major modifications under consideration:
  - Shock and vibration tests
  - Operation parameters to include fuel/oxidant differential pressure.
- The CD for the second edition was posted on the IEC TC105 website on July 17 for National Committee comments by October 23, 2009.

WG 3- Stationary Fuel Cell System-Safety

- International standard providing minimum design, construction, operating and quality requirements for stationary fuel cell power plants
- Published as IEC 62282-3-1 (2007-04). A technical corrigendum was approved in February 2008.
- The committee met in February and June to revise this standard. Major updates are planned in the electrical, leakage testing and strength testing sections, with the Committee Draft, CD, available by the end of 2009.

WG 4- Test Methods For the Fuel Cell Power System - Performance

- Describes how to measure the performance of stationary fuel cell power systems for residential, commercial and industrial applications.
  - IEC 62282-3-2 (2006-03)
    - A corrigendum was approved in February 2008, correcting a symbol error in a formula.
    - Second edition to harmonize the standard with ASME PTC50 especially in relation to the calculation formula for energy efficiency.
  - EN 62282-3-2:2006

WG 4 - IEC 62282-3-201

- This standard provides performance test methods for small stationary fuel cells that meet the following criteria:
- Rated less than 10 kW
- AC output less than 240 V
- Operating pressure less than 0.1 MPa
- Fuel –gaseous or liquid
- Oxidant – air
- The kickoff meeting was held in May 2009. The Committee Draft is scheduled March 2010

WG 5- Fuel Cell Power Systems – Installation

- Provides performance based requirements for the minimum safe installation of indoor and outdoor fuel cell power plants.
  - Published November 2007 as IEC 62282-3-3
  - The maintenance cycle began in 2008 for the next edition scheduled for 2010.

WG 6- Fuel Cell Systems for Propulsion and Auxiliary Power Units

- International standard providing performance, safety, EMC, quality assurance and environmental aspects of fuel cell systems for propulsion and auxiliary power units in vehicle (non-automotive) applications.
  - This committee voted to suspend all work on automotive applications in favor of joint work with ISO/TC22/SC21.
  - No activity at this time.

WG 7- Portable Fuel Cell Appliance – Safety

- Applies to all ac and dc type portable fuel cell appliances, not exceeding 600V, for commercial, industrial and residential indoor and outdoor use in non-hazardous locations. (Includes moveable, transportable and hand-held equipment. Does not include systems that are permanently connected, export to the grid, or for propulsion or auxiliary power for transportation.)
- IEC 62282-5-1 (2007-02).
  - Also adopted by the E.U. as EN 62282-5-1:2007.
  - The maintenance cycle began in 2008 for the next edition which is scheduled for 2010.

WG 8- Micro Fuel Cells - Safety

- Safety standard for micro fuel cell power systems. (Fuel cell power systems and fuel containers that are wearable or easily carried by hand, providing dc outputs that do not exceed 60 V d.c. and power output of 240 VA. These DC units power or recharge consumer electric devices.)
  - A PAS was published in 2006 as IEC/PAS 62282-5-1 (2006-02) and modified as IEC/PAS 62282-5-1 Corr. 1 (2007-04).
  - The Final Draft International Standard (FDIS), to be published as IEC 62282-6-100, has been submitted to IEC for processing.

WG 9- Micro Fuel Cell Power Systems – Performance

- International standard providing testing method for performance evaluation based requirement for micro fuel cell power systems such as laptops, cell phones and PDA's. Performance evaluation will include characteristics such as of output power, fuel consumption, operational durability, mechanical durability, starting uptime, load responding, etc. It excludes the field of safety.
- Published as IEC 62282-6-200 (2007-11)

WG 10- Micro Fuel Cell Power System - Fuel Cartridge Interchangeability

- International standard providing interchangeable based requirements for the micro fuel cell power unit to the electric devices and the fuel cartridge to the fuel cell power unit including the mechanical interface(s), electrical interface(s), communication protocol, retention feature, interface dimensions (as required), datum/orientation feature.
  - IEC 62282-6-3
  - The title will change to Interchangeability-Fuel Cartridges to make it clear that this document addresses fuel cartridges and their interface with the fuel cell power unit (not the interface between the fuel cell and its electronic device).
    The 1st edition covers only methanol and methanol/water.
    Later editions will expand to other fuels.

WG 11- Single Cell Test Method for Polymer Electrolyte Fuel Cells (PEFC)

- This Technical Specification (TS) identifies cell assemblies, test apparatus, measuring instrumentation and methods, test methods and test reports for PEFC single cells. It is intended to be used for evaluating:
  - performance of membrane electrode assemblies (MEA) for PEFC's
  - material or structures of other components of PEFC's
  - the influence of impurities in fuel and air on the fuel cell performance
- Technical Specification TS 62282-7-1

Items out for Review

- 105/244/CD - COMMITTEE DRAFT (CD) for IEC 62282-2, Ed.2 Fuel cell technologies - Part 2: Fuel cell modules
- 105/242/CD - COMMITTEE DRAFT (CD) for IEC 62282-5-1 Ed.2 Fuel cell technologies - Part 5-1: Portable fuel cell power systems - Safety
- 105/241/DTS - DRAFT TECHNICAL SPECIFICATION - IEC TS 62282-7-1 Ed. 1 Fuel cell technologies - Part 7-1: Single cell test methods for polymer electrolyte fuel cell (PEFC)
- 105/240/CD - COMMITTEE DRAFT (CD) - IEC 62282-3-3 Ed.2 IEC 62282-3-3: Fuel cell technologies - Part 3-3: Stationary fuel cell power systems - Installation

New Work Item Proposals

- A questionnaire is newly out to gage interest in new work items for emerging applications, including materials handling FCVs.

SAE Documents

- SAE International, through the voluntary work of more than 7,000 committee members and participants, maintains over 8,300 technical standards and related documents.
- The Fuel Cell Standards Committee addresses standards and recommended practices relating to fuel cell vehicles and infrastructure.

Photo from
www.fuelcellpartnership.org

SAE J2579

- Recommended Practice for Fuel Systems in Fuel Cell and Other Hydrogen Vehicles
  - The purpose of this document is to define design, construction, operational and maintenance requirements for hydrogen storage and handling systems in on-road vehicles. Performance-based requirements for verification of design prototype and production hydrogen storage and handling systems are also defined in this document. Complementary test protocols (for use in type approval or self-certification) to qualify designs (and/or production) as meeting the specified performance requirements are described.
  - Originally published December 2002. Updated and re-published January 2009. Available at www.sae.org

SAE J2600

- Compressed Hydrogen Vehicle Fueling Connection Devices (defines geometries of receptacles for different pressure levels)
  - This document applies to the design, safety and operation of nozzles and receptacles, having operating pressures of 250, 350, 500 or 700 bars, for hydrogen fuelled vehicles.
  - Published in 2002. Available at www.sae.org
    Presently being harmonized by the Interface Working Group to ISO 17268 (see **ISO TC197 WG#5**).
    Provision for 700 bar refueling is also included.

SAE J2601

- Compressed Hydrogen Vehicle Fueling Communication Devices (defines different fueling strategies)
  - Vehicle/refueling station wireless communication targeted for safety enhancement and achievement of a 100% fast fill (<3min).
  - This will be a performance based document, which means that fueling targets (time to fill, minimum % fill, etc.) and safety limits (temperature, pressure and flow rate limits) will be set forth; however, the document will not prescribe how to meet these targets and limits.
  - In order to establish realistic targets, the Interface Working Group is requesting hydrogen fueling data from developers.

SAE J2719

- Hydrogen Quality Guideline For Fuel Cell Vehicles
  - Develop an evolving Hydrogen Fuel Quality guideline for the vehicle refueling interface, which will mature as technology advances toward commercial feasibility. The latest guideline would form the basis of a proposed standard for hydrogen fuel purity for H Powered vehicles, possibly including ICE's.
  - Published April 2008. (Originally published November 2005.)
  - Ongoing revisions and coordination with ISO/TC 197 WG 12 activity.

SAE J2783

- Liquid Hydrogen Surface Vehicle Refueling Connection Devices
  - This standard will be the liquid counterpart to J2600. Just as J2600 is related to ISO 17268, J2783 will be related to ISO 13984.

Photo from www.fuelcellpartnership.org

SAE J2799

- 70 MPa Compressed Hydrogen Surface Vehicle Refueling Connection Device and Optional Vehicle to Station Communication
  - Technical Information Report for the 70 MPa nozzle and station to vehicle *wireless* communication.
  - Published May 2007. Available at www.sae.org

International Regulation Adopts ISO 16111

- Transportable gas storage devices — Hydrogen absorbed in reversible metal hydrides
- Defines the requirements applicable to the safe design and use of transportable hydrogen gas storage canisters including all necessary shut-off valve, pressure-relief devices (PRD), and appurtenances, intended for use with reversible metal hydride, hydrogen storage systems. Applies only to refillable storage canisters where hydrogen is the only transferred media. Storage canisters intended to be used as fixed fuel storage onboard hydrogen fuelled vehicles are excluded.
- Adopted by the United Nations Economic and Social Council's Sub-Committee of Experts on the Transport of Dangerous Goods (UN/SCETDG) for UN Model Regulations to allow metal hydride assemblies to be shipped or transported without special permit.

UN WP.29 GTR Effort

- An effort to achieve a Global Technical Regulation for hydrogen fuel cell vehicles in underway.
- The United States, Germany and Japan collaboratively developed a roadmap for the GTR presented to WP.29.
- Automobile OEMs have been involved in sharing their needs in the development of the roadmap. US NHTSA has also generated a research plan.
- The United States, Germany and Japan want the GTR for hydrogen fuel cell vehicles to be at the whole vehicle level; and they want the requirements to be performance-based.
- A GTR would need to work whether a country uses the Self-Certification process or the Type-Approval process.

Global Technical Regulations

- The three major areas of focus are:
  - Electrical safety
  - Fuel System Integrity (leakage in use and post crash)
  - Storage systems (cylinders up to 10,000 psi).

Global Technical Regulations

- Difficulty in achieving agreement on approval requirements, as some countries use the Type-Approval process while others use Self-Certification
- The information from the meetings of the informal groups on HFCV SGS and Electric Safety and can be found on the below web site:
  - http://www.unece.org/trans/main/wp29/wp29wgs/wp29grsp/grspage.html

National vs. International

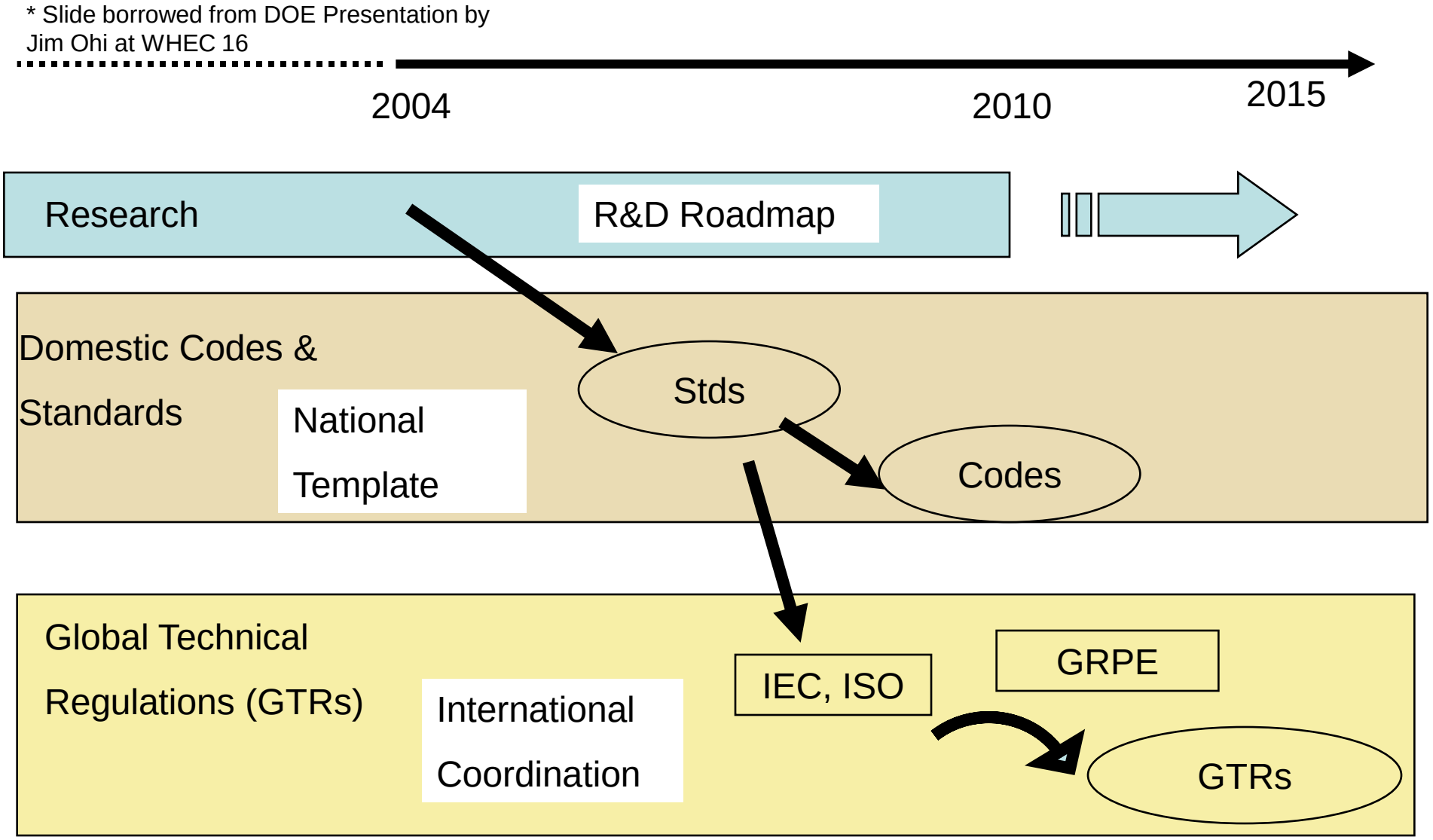
- Industry desires international requirements whenever possible.
- National efforts provide an opportunity for national consensus for discussions in international forums.
- International efforts allow for information exchange and development of international consensus.
- National bodies may adopt international standards with or without national exceptions.

National Experts

- National experts are needed to develop national or international requirements.
- Experts can participate at Working Group levels and Technical Committee Levels.
- Experts include industry experts, regulatory body experts, safety experts, and others.
- Collaboration is the key to success.

Development of Standards, Codes & Regulations

* Slide borrowed from DOE Presentation by Jim Ohi at WHEC 16



Information Resources

- National Hydrogen Association website
  - www.hydrogenassociation.org – News, links, fact sheets, announcements, much more
- The Hydrogen & Fuel Cell Safety Report
  - www.hydrogenandfuelcellsafety.info
  - Free monthly electronic publication
  - Links to technical resources, including workshop proceedings, data tables, useful websites, updates on document development, much more.


Hydrogen and Fuel Cell Safety - Microsoft Internet Explorer
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Address http://www.hydrogenandfuelcellsafety.info/ Go Links Groupwise on the Web NetStorage
Hydrogen and Fuel Cell Safety
US Fuel Cell Council
An Online Resource for the National Hydrogen and Fuel Cells Codes & Standards Coordinating Committee
Produced by the National Hydrogen Association in association with the US Department of Energy and US Fuel Cell Council
Latest Issue
Archives
Committee Resources
Next Committee Meeting
In-Person Proceedings
Issues for Review
Documents for Review
Committee Roster
Mission Statement
Members Only
HIPOC
Meetings/Minutes
ICC Proposals
NFPA Proposals
Submitting a Proposal
Key Dates
About the HIPOC
Technical Resources
NHA Safety Workshops
Hydrogen Safety Training
Meetings/Events
About this Site
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Bob Mauro, US TAG Chair, and Debbie Angerman, US TAG Administrator
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In conjunction with the 2007 Fuel Cell Seminar
November 13, 2006
Honolulu, Hawaii
US Fuel Cell Council
Codes and Standards
FUEL CELL STANDARDS
Department of Energy
Internet
start
Hydrogen a...
3 Windows...
2 Microsoft...
Novell Group...
Microsoft Po...
5:22 PM

Information Resources

- Matrix of Codes & Standards for Fuel Cells, Hydrogen Technologies and Infrastructure
  - www.fuelcellstandards.com
- US Model Code Changes
  - HIPOC – Hydrogen Industry Panel on Codes
  - www.hydrogenandfuelcellsafety.info/hipoc
- US DOE
  - www.hydrogen.energy.gov

Thank You

For more information:

Karen Hall

Vice President – Technical Operations
National Hydrogen Association (USA)
+44 (0) 191 490 9440 (European office)
Email: hallk@hydrogenassociation.org
www.hydrogenassociation.org