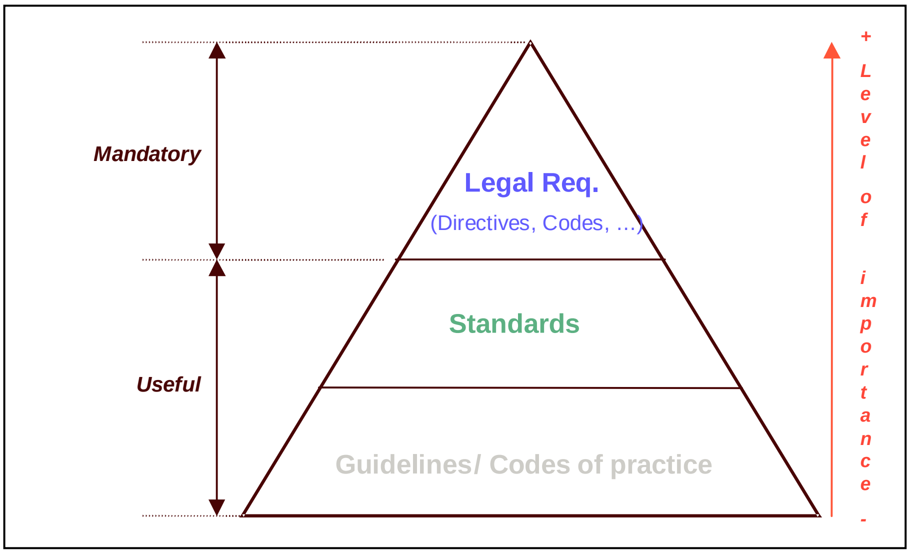
TEMPLATE FOR HYSAFE WEBSITE DEDICATED TO RCS and WP16

1. Definitions

1.1. General



	Regulations	Standards
Purpose	to protect the public, workers, the environment, values	to support the free exchange of goods and services
Legal power	compelling	not a legal requirement, but
Created by	policital bodies (parliament, government) as they are usually	made by the interested parties (companies, associations)

As shown in the figure above, the main difference between legal requirements (regulations and codes) and standards is their legal status. Regulations are made by political bodies (parliaments, governments), they are legally binding, and prescribe an acceptable level of, for example, safety or emissions for the technology in question. In contrast following standards is voluntary, but they are a useful instrument for the industrial organisations or interest groups dealing with the technology in question.

1.2. What is a standard?

A standard is a document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context. An international standard is a standard developed and adopted by an international standardisation organisation and made available to the public (as defined in IEC/ISO Guide 2).

The application of a standard is not obligatory, unless a regulation refers to that standard. Even then the legal power comes from the regulation, not from the standard.

1.3. What is a legal requirement?

A legal requirement (directive, regulation or code, etc.) is a national or European statutory text which is imposed by authority. It states requirements that are written and adopted by legislative bodies, so as to regulate a particular kind of activity.

Legal requirements are intended to guarantee that a product or system or activity will not impact on the human safety / health or on the environment.

1.4. What are the other types of documents?

1.4.1. Code

In legally terms, a code is a collection of rules, requirements or standards that have been made binding and mandatory by a local or national government (as defined in the ISO / TR 15916). In practical use of language the term code often refers to a North American document.

In this report, we distinguish “code” (with compelling power) and “code of practice” (which is a voluntary instrument – see paragraph 6.1.5.1. Code of practice).

1.4.2. Code of practice

Codes of practice are usually a set of best practices for a specific product or system so as to ensure safe handling, maintenance and operation.

1.4.3. Guideline

A guideline or a guide is a document generally written for a given organisation, whether for its own needs, or for its customers’ needs. Guidelines provide guidance to appropriate behaviour so as to ensure safety of people (workers, users and general public). It may also give information about codes, standards and regulations to comply with and about the recommended way to meet those requirements. For example, it gives information related to material properties, adequate installation, use of equipment and safety procedures. Guidelines may be intended:

- to authorities, who have to verify the conformity with applicable regulations and standards of a system and to approve it,
- to end-users of a given system, so that they can run the system in accordance with safety and performance requirements,
- to maintenance employers, so as to give them principles to observe during maintenance and cleaning up.

1.4.4. State of the art

State of the art is the most advance technique or method used at a given time.

1.4.5. Best engineering practices

Best engineering practices means the best practices performed in the design, construction, or operation of structures, machines, or other devices of industry and everyday life. Best engineering practices are defined from the industrial organisations and key implementers of a given technology.

2. Standardisation

2.1. Standardisation panorama

A common marketplace with common regulations needs also common or at least harmonised standards. While ISO[1] is doing this on a world wide scale, there is also CEN for the domain of the EU and associated countries. A similar situation prevails with IEC[2] and CENELEC for the field of electrotechnical standards.

The following table clarifies the standardisation situation:

	GENERAL	ELECTRICAL	OTHER
WORLD	ISO	IEC	…
INTERFACE	Vienna agreement		
EU	CEN	CENELEC	…

The Vienna agreement between ISO and CEN[3] and between IEC and CENELEC[4], respectively, is to prevent duplicate work and contradictory results. It contains basically two things:

- A topic which is dealt with in ISO or IEC (or CEN or CENELEC, depending who starts first) must not be dealt with by CEN or CENELEC (or ISO or IEC) at the same time.
- Papers produced by one body can (and preferably should) be adopted by the corresponding partner body in a simplified and accelerated procedure.

International standards, which are published by IEC and ISO should be transposed by CENELEC and CEN respectively and then would be applied at a national level. The illustration below shows the interfaces between International, European and national standardisation levels.

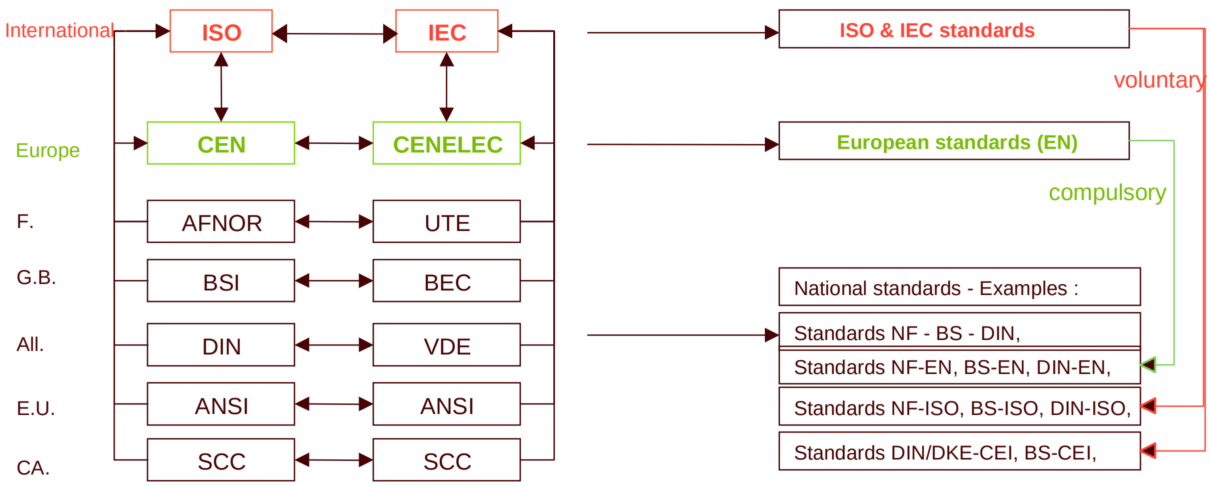


Illustration 1: liaisons between international, European and national standardisation

1 International Standardisation Organisation
2 International Electrotechnical Commission
[3] European Committee for Standardisation
[4] European Committee for Electrotechnical Standardization

2.2. Who develops ISO and IEC standards?

International standards are developed by experts coming from industries, technical and business sectors, government agencies, laboratories, consumer associations, etc. These experts participate :

- at an international level, to the ISO or IEC technical committee,
- at a national level, to the national standardisation committee of their country.

Each country can participate to the ISO and IEC standardisation activities:

- Whether as a P-member, in this case it can vote drafts which circulate for vote,
- Or as an O-member, in this case it can only participate to meetings without voting.

Example :

A German Manufacturer of fuses wants to participate to the elaboration of standards for fuses. So an expert, from this industry, will :

- join, in Germany, the DKE (Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN & VDE) who participates as P-member, to the IEC Technical Committee IEC TC 32 « Fuses »,
- and then participate as an expert to the IEC Technical Committee « IEC TC 32- Fuses ».

Technical committees or subcommittees may also establish working groups, which will be in charge to develop standards for a specific task. In this case, national experts take part to the working groups, which deal with their field of interest.

2.3. How is a standard made?

During the standardisation process, several steps have to be made before the publication of a new standard as an International Standard. These steps are listed in the table hereafter.

Stage	Contents	Voting period
Proposal	A new work item proposal (NP) is submitted for vote by the members of the relevant TC/SC[5] to determine the inclusion of the work item in the programme of work	3 months
Preparatory	A working group is set up Successive working drafts (WD) may be considered until the working group is satisfied that it has developed the best technical solution to the problem being addressed.	
Committee	First committee draft (CD) is available, it is registered by the ISO Central Secretariat. It is distributed for comments and, if required, voting, by the P-members of the TC/SC. Several CD may be required until consensus is reached.	3 to 6 months
Enquiry	A Draft International Standard is proposed and voted. If DIS is disapproved, a new one circulates for vote	5 months
Approval	Final DIS circulates for final vote. If FDIS is disapproved, a new one circulates for vote	2 months
Publication	The final text (with minor editorial changes, if necessary) is sent to the ISO Central Secretariat which publishes the International Standard.	2 months
Review	All International Standards are reviewed at least once every five years by the responsible TCs/SCs. P-members vote if the IS should be confirmed, revised or withdrawn	

Table 1: Main stages of standardisation process

[5] Technical Committee and Sub-Committee

The national delegations of experts (also called mirror committees) of a technical committee meet to discuss on a new work item proposal until consensus is reached on a draft agreement. Then, the final draft circulates as a Draft International Standard (DIS) to ISO's membership for comment and balloting.

The ISO members transmit their position on the draft standard. If the vote is positive, eventual modifications and comments will be integrated before the draft circulated to the ISO members as a Final Draft International Standard (FDIS). If that vote is in favour, the document is then published as an International Standard.

2.4. What are the main type of normative documents?

According to the ISO-IEC Directives, a published standard must be published 36 months after the proposal of the draft.

Nevertheless, sometimes, it may be very urgent to have a consensual intermediate document (such as a technical specification) and to publish it quickly, before the International Standard is made available. Therefore, to meet such needs, ISO and IEC have developed other « deliverables », allowing publication at an intermediate stage of development before full consensus.

The table below lists these output documents.

Deliverable	Type	Contents
International Standard (IS)	Normative Consensus at international level	Standardisation in a specified technological field
Technical Specification (TS)	Normative Consensus within the technical committee or subcommittee	Similar to the standard but international consensus is not reached or standardisation is not possible yet
Technical Report (TR)	Informative Consensus within the TC or SC	An informative document containing information of a different kind from that normally published in a normative document.
Publicly Available Specification (PAS)	Normative Consensus within the working group	It is published to facilitate the development of a technology, before IS is published.

Table 2: Main deliverables of ISO and IEC

The illustration below illustrates the standards development process and associated deliverables.

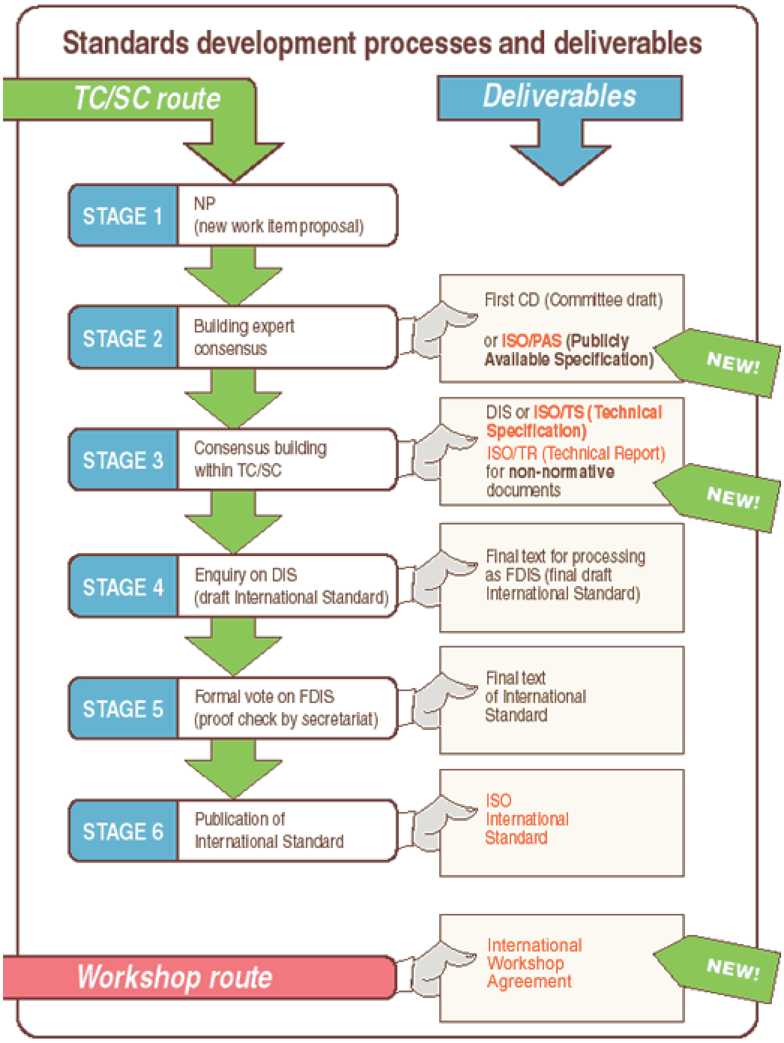


Illustration 2

3. Standardisation related to hydrogen and fuel cells

3.1. Which committees deal with Hydrogen technologies and Fuel cell technologies?

Standardisation related to Hydrogen systems is in the hands of the International Standardisation Organisation, which initiated in 1990 the ISO TC 197 dedicated to "Hydrogen Technologies". The scope of ISO TC 197 working group is to develop and edit standards in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen.

As for fuel cell systems, they are considered as an electric device and therefore fall within the scope of the International Electrotechnical Committee. This Committee created in 1996 the IEC TC 105 dedicated to fuel cell systems, with the purpose of preparing international standards regarding fuel cell (FC) technologies for all FC applications such as stationary FC power plants, FC for transportation, FC propulsion systems, auxiliary power units or portable FC power generation systems.

Since there is a Technical Committee on "Hydrogen Technologies" in ISO (TC 197), there is no such committee in CEN. The European experts rather participate in the ISO working groups. A similar situation prevails for fuel cells with IEC TC 105 "Fuel Cell Technologies".

3.2. Who participates to ISO TC 197? and to IEC TC 105?

3.2.1. ISO TC 197

Mrs S. Gingras, from the SCC (Standards Council of Canada) is in charge of the secretary of ISO TC 197. Mr. Randy Dey (Canada) is the chairman until end 2008.

Participating countries (P-members) of ISO TC 197 are:

Argentina	India	Spain
Austria	Italy	Sweden
Belgium	Japan	Switzerland
Denmark	Korea, Republic of	USA
Egypt	Netherlands	United Kingdom
France	Norway	
Germany	Russian Federation	

Observer countries (O-members) are:

Australia	Hungary	Thailand
Brazil	Jamaica	Turkey
China	Libyan Arab Jamahiriya	
Czech Republic	Republic of Serbia	

3.2.2. IEC TC 105

Mr Wolfgang WINKLER, from Germany is in charge of the secretary of ISO TC 197. Dr. Hiromichi Fujisawa (Japan) from Hitachi Ltd is the chairman.

Participating countries of IEC TC 105 are:

Japan	China	France
Korea (Republic of)	Denmark	Switzerland
Netherlands	Spain	Germany
Canada	Sweden	Israël

United Kingdom	Italy	United States of America

Observer countries are :

Australia	Egypt	Portugal
Austria	Finland	Serbia
Belgium	Norway	Thaïland
Czech Republic	Poland	

3.3. Mirror committees of ISO TC 197 and IEC TC 105 in Europe

The table below gives the name of the national mirror committee for European countries, which are P-members or O-members of the ISO TC 197 and IEC TC **105.**

	ISO TC 197		IEC TC 105	
Country	**National standardisation committee**	**ISO TC 197 Participating Observer**	**National standardisation committee**	**IEC TC 105 Participating Observer**
Belgium	IBN - Institut Belge de Normalisation	P	CEB - Comité Electrotechnique Belge	O
Czech Republic	CNI - Czech Standards Institute	O	CNI - Czech Standards Institute	O
Denmark	DS - Dansk Standard	P	DS - Dansk Standard	P
Finland		-	Sesko Standardization	O
France	AFNOR - Association Française de NORmalisation	P	UTE – Union Technique de l'Electricité	P
Germany	DIN - Deutsches Institut für Normung	P	DKE - Deutsche Kommission Elektrotechnik Elek-tronik	P
Hungary	MSZT - Magyar Szabványügyi Testület	O		-
Italy	UNI – Ente Nazionale Italiano di Unificazione	P	Comitato Elettrotecnico Italiano	P
Netherlands	NEN – Nederlands Normalisatie-instituut	P	NEC - Netherlands Electrotechnical Committee	P
Norway	SN - Standards Norway	P	NEK - Norsk Elektroteknisk Komite	O
Poland		-	PKN - Polish Committee for Standardization	O
Portugal		-	IPQ – Instituto Portugues da Qualidade	O
Spain	AENOR Asociación Española de Normalización y Certificación	P	AENOR	P
Sweden	SIS - Swedish Standards Institute	P	SEKOM – Svenska Elektriska Kommissionen	P
Switzerland	SNV - Swiss Association for Standardization	P	CES - Swiss Electrotechnical Committee	P
United Kingdom	BSI - British Standards Institution	P	BSI / BEC - British Electrotechnical Committee	P

3.4. What are the ISO and IEC standards : published and under construction?

The work of ISO TC 197 is organised in (at this time) twelve working groups, but not all of them are active. Some of them have finished their task a while ago and exist only formally. Only the active ones are given in the table 4 hereafter.

3.4.1. ISO TC 197

a. Published standards

Reference	Title
ISO 13984 : 1999	Liquid Hydrogen - Land vehicle fuelling system interface
ISO 14687 : 1999 & ISO 14687 : 1999/Cor 1 : 2001	Hydrogen fuel - Product specification
ISO/PAS 15594	Airport H2 fuelling facility
ISO/TR 15916 : 2004	Basic considerations for the safety of hydrogen systems *The standard 15916 was created to give all groups a common reference they could refer to. The other objective is to give interested persons with technical background an overview about which safety matters are really important in connection with hydrogen and which are not.* *This Technical Report provides guidelines for the use of hydrogen in its gaseous and liquid forms. It identifies the basic safety concerns and risks, and describes the properties of hydrogen that are relevant to safety.*

Table 3: Documents already published by ISO TC 197

b. Current standardisation activities of ISO TC 197

The following table proposes an update of ISO TC 197 working groups, activities and progress.

WG	Standard	Convener	Scope	Target date for IS	Safety items
1	ISO 13985 Liquid H_2 - Land vehicle fuel tanks	Dr Robert Hay Canada	This standard specifies the construction requirements for refillable fuel tanks for liquid hydrogen used in land vehicles as well as the testing methods required **to ensure that a reasonable level of protection from loss of life and property resulting from fire and explosion is provided.** It is applicable to fuel tanks intended to be permanently attached to land vehicles.	2006	- Behaviour of the tank when submitted to stresses - Safety accessories (PRD) - Material compatibility - Type tests to be carried out (eg : inner tank burst pressure test) - Control and inspection
5	ISO 17268 Gaseous H_2 - Land vehicle filling connectors	Livio Gambone Canada	This standard applies to design, **safety** and operation verification of (a) receptacle and protective cap (mounted on vehicle), and (b) nozzle having working pressures of 25 and 35 MPa.	2006	- Specifications for nozzles - Design verifications and test procedures (part. 10)
6	ISO/DIS 15869-1 to 15869-5 Gaseous H_2 and hydrogen blends - Land vehicle fuel tanks - Part 1: General requirements	Craig Webster Canada	This International Standard 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. This International Standard is not intended as a specification for fuel tanks used for solid or liquid hydride hydrogen storage applications. It is applicable for fuel tanks of steel, stainless steel, aluminium or non-metallic construction material, using any design or method of manufacture suitable for its specified service conditions. This WG is a joint working group (JWG) with ISO/TC 58/SC 3 (Gas cylinders- Design) and ISO/TC 22	2007	- Behaviour of the tank when submitted to stresses - Safety accessories (PRD) - Material compatibility - Type tests to be carried out (eg : bonfire test, impact damage test, etc.) - Control and inspection

WG	Standard	Convener	Scope	Target date for IS	Safety items
8	ISO 22734-1 H_2 generators using water electrolysis process. Part 1 : Industrial and commercial applications ISO 22734-2 H_2 generators using water electrolysis process. Part 2 : Residential applications	Randy Dey Canada	These standards define the construction, **safety** and performance requirements of packaged or factory matched hydrogen gas generation appliances, herein referred to as hydrogen generators, using electrochemical reactions to electrolyse water to produce hydrogen and oxygen gas. They are applicable to hydrogen generators intended for indoor and outdoor commercial and industrial use (non residential use). Reversible fuel cells are excluded from the scope of the standard. These standards are intended to be used for certification purposes.	2007 2008	- Fire and explosion hazards protection - Electrical equipment - Safety considerations for use of H2 in residential applications - Safety considerations for use of H2 in industrial applications
9	ISO 16110-1 H_2 generators using fuel processing technologies. Part 1 : Safety ISO 16110-2 H_2 generators using fuel processing technologies. Part 2 : Procedures to determine efficiency	Falco Thuis Netherlands	These standard apply to packaged, self-contained or factory matched hydrogen generation systems with a capacity less than 400 Nm^3/hr (normal cubic meters per hour) that convert a fuel to a hydrogen rich stream of composition and condition suitable for the type of device using hydrogen (e.g. a fuel cell power system or a hydrogen compression, storage and delivery system).	2007 2008	§ 4 of the Part 1 is specific to safety : "**Safety requirements and protective measures » :** - Material selection - Prevention of fire and explosion hazards - Prevention of electrical hazards - Ventilation, detection - Etc. § 5"Test methods" is also related to safety aspects The Part 2 (Efficiency) deals especially with tests methods for performance, including tests for the safe operation

WG	Standard	Convener	Scope	Target date for IS	Safety items
10	ISO 16111 Transportable gas storage devices—H_2 absorbed in reversible metal hydride	Ned Stetson USA	This international standard defines the requirements applicable to the **safe** design and use of transportable hydrogen gas storage canisters including all necessary shutoff valve, pressure-relief devices (PRD), and appurtenances, intended for use with reversible metal hydride, hydrogen storage systems. This technical specification only applies 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.	IS : end 2007 TS : 06/2006	- Safe design of the canister, including service conditions (pressure), accessories (PRD, valves, etc.) - Safety in general : safety of the personnel, type tests
11	ISO TS 20012 Gaseous H_2 – Service Stations	Randy Day Canada	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.	TS : 2007	Safe design of the hydrogen refuelling station : - Safety distances - Hazardous area classification - Hydrogen compatibility - Safety and emergency shut-off system
12	ISO 14687-2 Hydrogen Fuel — Product Specification — Part 2: Proton exchange membrane (PEM) fuel cell applications for road vehicles	Yasuo Takagi Japan	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. This activity is to update the current standard ISO 14687-1999.	TS : 2006 IS : 2010	-

WG	Standard	Convener	Scope	Target date for IS	Safety items
13	ISO 26142 Hydrogen detectors	Ichiro Matsubara Japan	Work has just started for this new working group. This international standard 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 multilevel safety operations such as nitrogen purging or ventilation and/or system shut-off corresponding to the hydrogen concentration.	2008	- Safety and performance requirements of hydrogen detection

Table 4: Current ISO TC 197 activities

3.4.2. IEC TC 105

The work of IEC TC 105 is organised in (at this time) ten working groups, but not all of them are active. Some of them have finished their task a while ago and exist only formally. Only the active ones are given in the table 6 hereafter.

a. Published standards

Reference	Title	Scope / **Safety**
IEC/TS 62282-1 (2005-03) English and French	Fuel cell technologies - Part 1: Terminology Revision of the document is planned in 2006, so as to integrate documents of FCTESTNET Project [6] The glossary will be available as Edition 2 of IEC/TS 62282-1	Provides uniform terminology in the forms of diagrams, definitions (**also terms related to safety**) and equations related to fuel cell technologies in all applications including but not limited to stationary power, transportation, portable power and micro power applications.
IEC 62282-2 (2004-07) English and French	Fuel cell technologies - Part 2: Fuel cell modules	Provides the **minimum requirements for safety** and performance of fuel cell modules. Applies to fuel cell modules with the following electrolyte chemistry: alkaline; proton exchange membrane (including direct methanol fuel cells); phosphoric acid; molten carbonate; solid oxide fuel cell modules.
IEC 62282-3-2 (2006-03) English and French	Fuel cell technologies - Part 3-2: Stationary fuel cell power systems - Performance test methods	
IEC/PAS 62282-6-1 (2006-02) English	Fuel cell technologies - Part 6-1: Micro fuel cell power systems - Safety	Establishes requirements for all fuel cell power systems, units and cartridges to ensure a reasonable degree of safety for normal use, reasonably foreseeable misuse, and consumer transportation of such items. It covers fuel cell power systems, power units and fuel cartridges that are wearable or easily carried by hand, providing d.c. outputs not exceeding 60 V d.c. and power outputs not exceeding 240 VA.

Table 5: Documents already published by IEC TC 105

[6] FCTESTNET is a European Project (achieved in 006) which aimed at compiling and harmonising testing procedures for fuel cells, stacks and systems

b. Current standardisation activities of IEC TC 105

The following table proposes an update of IEC TC 105 working groups, activities and progress.

WG	Draft Standard	Convener	Scope	Target date for IS	Safety items
3	IEC 62282-3-1 Stationary fuel cell power systems – **Safety**	Gerhard Huppmann Germany	This document is a product safety standard suitable for conformity assessment (as stated in IEC Guide 104:1997, ISO/IEC Guide 51:1999 and ISO/IEC Guide 7:1994). It provides minimum requirements for **safety** and performance of fuel cell modules in all applications.	2007	- Safety Requirements and Protective Measures (safety strategy, fire and explosion risks, etc.) - Type tests - …
5	IEC 62282-3-3 Stationary fuel cell power systems – Installation	Kelvin Hecht USA	Provide performance based requirements for the minimum safe installation of indoor and outdoor fuel cell power plants.	2009	-
7	IEC 62282-5-1 Fuel cell technologies - Part 5-1: Portable fuel cell power systems - **Safety**	Gerard Boudiere France	This standard covers construction, marking and test requirements for AC and DC type PORTABLE FUEL CELL SYSTEMS. 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.)	2006	Safety requirements, such as : - Material compatibility - Protection against mechanical hazards - Protection against fire and explosion hazards - … Type tests …

WG	Draft Standard	Convener	Scope	Target date for IS	Safety items
9	IEC 62282-6-2 Fuel cell technologies - Part 6-2: Micro fuel cell power systems - Performance	Hiroshi Yokoyama Japan	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 will exclude the field of safety.	2008	-
10	IEC 62282-6-3 Fuel cell technologies - Part 6-3: Micro fuel cell power systems - Interchangeability	Fumio Ueno Japan	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.	2009	-

Table 6: Current IEC TC 105 activities

3.5. How is safety taken into account into ISO and IEC standards?

The tables 4 and 6 above identify what are the main safety tasks in the standards under development in ISO TC 197 and IEC TC 105.

4. Regulation

4.1. What is the difference between directives and regulations ?

European laws, such as Directives, Regulations, European rules prevail over national laws. In order to carry out their task and in accordance with the provisions of the Treaty establishing the European Community (the EC Treaty), the Parliament acting jointly with the Council, the Council and the Commission make regulations and issue directives.

European Directive (art. 189 of the EC Treaty)

A directive shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods (national transcription).

Regulation (art. 189 of the EC Treaty)

A regulation shall have general application. It shall be binding in its entirety and directly applicable in all Member States. The EU has for example submitted a first draft of a regulation for the type approval of hydrogen cars for discussion.

4.2. What are UNECE regulations ?

To facilitate global commerce in road vehicles, it has long been recognised that there is a necessity to harmonise regulatory requirements across the major markets. These activities were initially undertaken on a European level by WP.29 a subsidiary body of the United Nations, Economic Commission for Europe, Inland Transport Committee, but that role has now expanded to a global one. WP.29 was originally titled Working Party On The Construction Vehicles but latterly has been renamed World Forum For Harmonisation Of Vehicle Regulations.

UNECE Regulation (1958 Agreement)[7]

In the framework of the United Nations' Economic Commission for Europe (UNECE) in Geneva, and for mobile applications, WP.29[8] and its subsidiary bodies are developing Regulations under the 1958 Agreement in cooperation with all Contracting Parties to the Agreement and non-governmental organisations (NGOs).

The 1958 Agreement is entitled “Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions.” UNECE Regulations are not applicable on a mandatory basis to all Contracting Parties to the 1958 Agreement, but if a Contracting Party decides to apply a UNECE Regulation, the adoption becomes a binding act. A contracting party, that has adopted a Regulation under the 1958 Agreement is allowed to grant type approvals pursuant to that Regulation and is required to accept the type approval of any other contracting party that has adopted the same Regulation. European and some non-European countries require an authority together with a technical service undertaking approval testing, to assess compliance of components and the vehicle with the legal requirements. The process is known as “ type approval “. In contrast, North America uses the self-certification process.

The 1958 Agreement was revised in 1995 (Revision 2) to promote the participation of non-European countries and became a global agreement. Japan and the United States did not adhere to this Agreement.

UN ECE 1998 Agreement (Global Technical Regulation)

Global Technical Regulations (GTR) apply to road vehicles. GTR contain technical requirements and are established under the 1998 Agreement ("Agreement concerning the

[7] Reference : http://www.unece.org

[8] Working Party 29 : New Vehicles Construction

establishing of global technical regulations for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles", done at Geneva on 25 June 1998). GTR are different from the EU Directives and UN ECE regulations because they do not call for mutual recognition of type approvals or certifications; they permit existing approval procedures to be utilised by harmonising only the technical requirements. The 1998 Agreement allows all regions of the world to participate in the development of GTRs for vehicles and their components. Canada, China, EC, Japan, Korea and the USA are included in the contracting parties to this Agreement.

4.3. What are New approach directives ?

The European Union introduced a series of measures to ensure the free movement of goods throughout the European Union (EU) and the European Free Trade Area (EFTA). New Approach Directives are one of these measures. These Directives aim at controlling product design and above all, at ensuring technical harmonisation of product safety requirements across Europe, so as to guarantee a high level of protection to the public.

European harmonised standard provides the detailed technical information enabling manufacturers to meet the essential requirements of the directive. "Harmonised Standard" has a specific meaning in the context of the ECs “New Approach” to regulation [9]:

- that is in support of one or more Directives,
- that has been produced by CEN or CENELEC,
- when the reference has been published in the Official Journal of the EC (OJ),
- and that has been published by at least one national standards body.

A harmonised standard provides a presumption of conformity with the essential requirements covered by the standard. These standards - produced under a mandate from Member States through the Commission - give the technical measures to meet the essential.

The New Approach Directives also explain to the manufacturers, how to demonstrate conformity with the essential requirements. Products which meet the essential requirements are to display the CE marking, as described in the particular directive. CE marking means that the product can be sold anywhere in the Community/EEA[10].

When a product bears a CE marking , it means that:

- It complies with all applicable Directives,
- It can move freely in any member state.

Application of harmonised standards or other technical specifications remains voluntary, and manufacturers are free to choose any technical solution that provides compliance with the essential requirements. (source Guide to the Implementation of Directives Based on New Approach and Global Approach – European Commission).

[9] Source : www.dti.gov.uk
[10] European Economic Area

5. Regulation related to hydrogen and fuel cell applications

5.1. Which European directives for hydrogen systems ?

Handling flammable, compressed, or cryogenic substances may be dangerous not only for the person doing it but also for others or the society as a whole. Industrialisation brought about not only much larger amounts of such substances used for processes of all kinds but also a more complex structure of the society which is more vulnerable from technical problems. The purpose of the regulations discussed here is at first to prevent damage to persons working with dangerous substances.

There is, of course, no such thing as a European Hydrogen Directive. Apart from a few exceptions for very important substances regulations are usually not substance specific, but application specific. So the correct question is not: “Which regulations apply to hydrogen?”, but rather: “Which regulations apply to what I want to do with hydrogen, and to the environment where I intend to do it?”.

Among the most important European directives applicable to hydrogen are those on pressure equipment. There are the Pressure Equipment Directive (PED) and separately the Transportable Pressure Equipment Directive (TPED). The latter is closely connected to international agreements on the transport of dangerous goods (ADR, RID, …).
Another important field of regulation when flammable gases are involved is the prevention of damage by explosions in case the gases are released unintentionally. This is mainly covered by the directives 94/9/EG (formerly ATEX 100) and 99/92/EG (formerly ATEX 118).
Prevention of major accidents and associated releases of harmful substances in the environment or the mitigation of the effects, respectively, is the subject of the Seveso II directive.
While these are the most important and specific ones, there are numerous directives which might be applicable in a certain context or situation. The Machinery directive is an example for a document of very general character which applies to almost anything, including hydrogen technology.

Apart from the directives of Europe, there are also other regulations from other sources. International transport of dangerous goods is dealt with in a number of international agreements which comprise ADR (road), RID (rail), IMO (sea) and ADNR (inland waterways). Air traffic is cared for by IATA and ICAO. To make sure that motor vehicles can be used internationally, there are different provisions; one of them involves the UN ECE.

5.2. Which regulation for hydrogen vehicles ?

5.2.1. UN WP29 GRPE Draft ECE Regulations

Work on proposals for harmonised hydrogen vehicle regulations for Europe was initiated in 1998 by the European Integrated Hydrogen Project (EIHP). After a survey of existing regulations identified none applicable directly to the use of hydrogen in vehicles, EIHP initiated the process of developing initial proposals for new, flexible harmonised regulations. The draft proposals were based as far as possible on performance requirements rather than historical technical solutions with the aim of encouraging rather than restricting the development and introduction of safe, new technologies. Various analyses were undertaken by the EIHP partners to provide a base from which to develop draft harmonised regulations.
For the basis of the draft harmonised regulations, EIHP chose United Nations’ Economic Commission for Europe (ECE) at the time GTR were not possible. Additionally the ECE was the drafting body for related alternative fuel regulations for CNG and LPG.
Due to differences in the technologies between compressed gaseous (CGH_2) and liquid hydrogen (LH_2) storage, two drafts were developed. The drafts cover vehicle storage, on-

board refilling and fuel supply components and installation of the components/systems within vehicles.

A primary objective of the regulations was to avoid defining technical solutions by developing performance requirements. In a similar manner, efforts were made to avoid limiting the development of future hydrogen technologies, e.g. by avoiding specifying upper limits for CGH_2 storage pressures. The aim of the draft regulations was to enhance the safe and economic manufacture and use of hydrogen fuelled vehicles.

Validation of the draft hydrogen regulations was an ongoing process:

1. A workshop was held in 1999 to discuss the basis of the draft regulations, to which representatives were invited from national authorities, industry and research institutions.
2. Later comments on the proposals were obtained from national authorities and external experts which were integrated into the proposals.
3. The continuous development process was continued into EIHP2 and resulted in a number of iterations until wide consensus was achieved. In particular the gaseous hydrogen draft was heavily revised to avoid difficulties experienced during the certification of CNG components/vehicles to ECE R110.
4. Additionally, the draft resulting from the first phase of EIHP was further validated within EIHP2, by following the test and approval procedures for storage vessels and the installation of the associated hydrogen system onboard vehicles by BMW and DaimlerChrysler.
5. The proposals were presented to UN ECE WP29 (http://www.unece.org/trans/main/welcwp29.htm) in 2001 and were subsequently forwarded to the subsidiary group, Working Party on Pollution and Energy (GRPE) which established an ad-hoc or informal group to coordinate the further technical development of the drafts and to achieve wide international consensus. The informal group is now known as Informal Group "Hydrogen/Fuel Cell Vehicles" (IG-HFCV). Work included harmonisation meetings with ISO experts developing standards with similar scopes. The scope of the draft ECE regulations includes the hydrogen storage, refilling and fuel supply components and systems, and their installation within a road vehicle as OEM equipment but excludes, for example, the fuel cell system.
6. The draft ECE LH_2 regulation was introduced as a formal working document at the GRPE in 2003 (http://www.unece.org/trans/doc/2003/wp29grpe/TRANS-WP29-GRPE-2003-14e.pdf) together with latest amendments (http://www.unece.org/trans/doc/2003/wp29grpe/TRANS-WP29-GRPE-2003-14a1e.pdf).
7. The draft ECE CGH_2 regulation was introduced as a formal working document at the GRPE in 2004 (http://www.unece.org/trans/doc/2004/wp29grpe/TRANS-WP29-GRPE-2004-03e.pdf) together with latest amendments (http://www.unece.org/trans/doc/2004/wp29grpe/TRANS-WP29-GRPE-2004-03a1e.pdf).
8. During 2005, UN ECE WP29 took the decision not to proceed with ECE Regulations for hydrogen vehicles and instead develop a completely new GTR(UN ECE 1998 Agreement).

5.2.2. UN ECE WP29 GTR

During 2005 UN ECE WP29 took the decision to proceed directly to a completely new GTR and initiated development work following support from the major markets of Europe, Japan and USA amongst others. Authorities and manufacturers in all major countries or regions including Europe, North America and Japan have agreed that long term legal requirements for the use of hydrogen in motor vehicles should be based on Global Technical Regulations (GTR) under the UN ECE WP29 "1998 Agreement". A GTR contains technical requirements allowing compliance to be "approved" in accordance with the normal system of each country, i.e. type approval or self-certification. The work is being undertaken by the Informal Group

“Hydrogen/Fuel Cell Vehicles” (IG-HFCV). Despite universal agreement on the ultimate aim of GTR for hydrogen vehicles, there are still significant open discussions regarding the scope, timescale and route to the introduction of such a document. Hydrogen GTR(s) are not likely to be in place until early in the next decade at the very earliest. The current roadmap to the introduction of a GTR can be seen at:
http://www.unece.org/trans/doc/2005/wp29/WP29-136-24e.pdf.

5.2.3. European Regulation

Following the WP.29 decision to abandon the development of ECE regulations, the EC has now initiated the development of a European Regulation based on the draft ECE hydrogen regulations. The first draft is to be published during 2006. The European Regulation adopts a split approach meaning that there will be:

- A political document presented for discussion and adoption by the European Parliament and the Council, including scope, reason, etc.
- A technical document presented for discussion and adoption at Commission level, through CATP (Committee for the Adaptation to Technical Progress), including technical requirements and testing procedures.

The approach means that the two documents will be discussed in parallel. Thus, some technical discussions can take place with the aim of improving the current drafts.

6. HYSAFE WP 16 activities in RCS

6.1. Objectives

The main objectives of the WP16 "Contribution to standards and legal requirements" are to :

1. Ensure by active participation to targeted standardisation (ISO, IEC) / UN ECE groups that consensual knowledge on hydrogen safety is adequately taken into account in the process of building new standards and regulatory requirements,
2. Promote consensus within EC countries on safety related standardisation / regulatory aspects,
3. Follow progress of appropriate RC&S related to hydrogen technologies,
4. Follow and report on the progress made by the European Hydrogen and Fuel Cell Technology Platform (EHFCTP) and the HarmonHy project,
5. Provide up to date information to HySafe partners on the status of standardisation and UN ECE regulatory development through our webpage,
6. Report on standardisation and regulatory development and related WP16 contribution to the HySafe partners.

The starting point for WP16 activities is the current state of the art of international standardisation Technical Committees (ISO TC 197 – Hydrogen Technologies and IEC TC 105 – Fuel Cell Technologies), of UNECE activities related to hydrogen vehicles and of the EHFCTP (group related to RCS activities).

6.2. Representation of HYSAFE delegates in international standardisation

The tables below list for each RCS activity who is involved among WP 16 partners.

RC&S group	Partner taking part to
ISO TC 197 “Hydrogen technologies”	BAM, NH, AL,INERIS, CEA, VOLVO, UNIPI
ISO TC 58 & CEN TC 23 « Pressure vessels »	BAM, Air Liquide
ISO TC 22 « Road vehicles »	VOLVO, BRE
ISO TC 20 « Aircraft and space vehicles »	BAM
ISO TC 92 «Fire safety »	BAM
ISO TC 220 « Cryogenic Vessels »	Air Liquide
CEN TC 197 « Road tankers »	BAM
ISO TC 21 « Equipment for fire protection and fire fighting »	BAM
IEC TC 105 « Fuel Cells »	Air Liquide, BAM, INERIS,CEA, INASMET
CEN TC 305 « Potentially explosive atmospheres – explosion prevention and protection »	BAM, INERIS
CEN Mandate group M349	AL, BAM
HFP IG RCS	AL, INERIS, VOLVO, CEA, BMW
UN ECE GRPE WP 29	VOLVO

Table 7 : HYSAFE delegates in RC&S activities

RCS Group	HYSAFE member Organisation / *Name*
ISO TC 197 “Hydrogen technologies”	BAM : *U. SCHMIDTCHEN*
IEC TC 105 « Fuel Cells »	INERIS : *L. PERRETTE*
CEN Mandate group M349	BAM : *U. SCHMIDTCHEN*
HFP IG RCS	INASMET
UN ECE GRPE WP 29	VOLVO : *P. ADAMS*

Table 8 : WP16 members in charge to represent HYSAFE in the RCS group and to inform WP16 about RCS activities

6.3. Position papers

As suggested by the European Commission, WP 16 decided to formalise its work into "position papers" targeting current drafts under vote (ISO TC 197, IEC TC 105, UNECE) so as to:

- Give HySafe opinion on safety drafts RC&S and identify main strength and deficiencies,
- Harmonise European position on international RC&S,
- Share views at a European level: B. CODA, WGs chairmen and convenors if European, national mirror committees' chairmen and convenors.

Thus, the last WP 16 meeting aimed at discussing the content and the dissemination of such papers. It was agreed that these position papers should contain following items:

1. Historical background of the standard
2. Objectives
3. General appreciation from HYSAFE consortium
4. Detailed comments

Concerning their dissemination, it has been decided that position papers will be:

- sent to the chairman of each national mirror committee
- available on the HYSAFE website dedicated to RCS
- sent to the chairman of ISO TC 197 or IEC TC 105, depending on the standard
- sent to the convenor of the WG, which has published the standard
- sent to the P and O members of ISO TC 197 or IEC TC 105, depending on the standard
- sent to the IG RCS of the Hydrogen and Fuel Cell Technology Platform
- sent to the Commission (Beatrice CODA for example).

7. First list of guidances on hydrogen safety :

- IGC 15/96/E, "Gaseous Hydrogen Stations", Industrial Gases Council, Brussels, Belgium
- IGC 06/93/E, "Safety in Storage, Handling and Distribution of Liquid Hydrogen", Industrial Gases Council, Brussels, Belgium
- ISO/TR 15916, "Basic considerations for the safety of hydrogen systems / Considérations fondamentales pour la sécurité des systèmes à l'hydrogène", First edition : 2004-02-15
- " Regulators' Guide to Permitting Hydrogen Technologies : hydrogen, fuel cells, and infrastructure", US Department of Energy, Energy Efficiency and Renewable Energy, PNNL-14518 Released 1/12/2004
- " Module 1 Permitting Stationary Fuel Cell Installations", US Department of Energy, Energy Efficiency and Renewable Energy, Version 1.0 PNNL-14518 Released 1/12/2004
- "Module 2 Permitting Hydrogen Motor Fuel Dispensing Facilities", US Department of Energy, Energy Efficiency and Renewable Energy, Version 1.0 PNNL-14518 Released 1/12/2004
- "Safety standard for hydrogen and hydrogen systems - Guidelines for Hydrogen System Design, Materials Selection, Operations, Storage, and Transportation" , NASA standard NSS 1740.16, Office of Safety and Mission Assurance ; Washington, DC 20546, February 1997. This standard has been cancelled but should be integrated in the standard STD 8719.16
- « Eléments pour un guide de sécurité hydrogène, Expérimentations spécifiques, choix d'appareils et matériels adaptés - Volume 1», Commission des Communautés Européennes, Rapport EUR 9689 FR, Luxembourg 1985
- « Eléments pour un guide de sécurité hydrogène, Aperçu d'ensemble - Volume 2», Commission des Communautés Européennes, Rapport EUR 9689 FR, Luxembourg 1985
- "Guidance for Safety Aspects of Proposed Hydrogen Projects", U.S. Department of Energy Hydrogen, Fuel Cells & Infrastructure Technologies Program, october 2005
- " Hydrogen ", FM Global, Property Loss Prevention Data Sheets 7-91 ; September 2000
- "Guide for Hydrogen Hazards Analysis on Components and Systems", NASA/TM—2003–212059, Harold Beeson (Lyndon B. Johnson Space Center White Sands Test Facility), Stephen Woods (Honeywell Technology Solutions Inc. White Sands Test Facility), published as TP-WSTF-937, October 2003
- "NASA Glenn Safety Manual, CHAPTER 6 – HYDROGEN", NASA, Revision Date: 9/03 - Biannual Review
- " Safety Guide for Hydrogen . Hydrogen Safety Committee", National Research Council Canada NRCC 27406, 1987
- "Emergency response guide – fuel cell vehicles and hydrogen fuelling stations", California Fuel Cell Partnership, August 2004, version 2.0
- "Design Guidelines for Bus Transit Systems Using Hydrogen as an alternative fuel", U.S. Department of Transportation - Federal Transit Agency , April 1999.

- “Sourcebook for hydrogen applications“, Hydrogen Research Institute and National Renewable Energy Laboratory, prepared by A. Bain (NASA retired) and Al., 1st edition. 1998
- “Support Facilities for Hydrogen-Fuelled Vehicles - Conceptual Design and Cost Analysis Study “, CAFCP commissioned technical report, July 2004