BCGA CODE OF PRACTICE CP 33

The Bulk Storage of Gaseous Hydrogen

at Users' Premises

Revision 1: 2012

British Compressed Gases Association

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BRITISH COMPRESSED GASES ASSOCIATION

4a Mallard Way
Pride Park
Derby
DE24 8GX

Website: www.bcga.co.uk

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PREFACE

The British Compressed Gases Association (BCGA) was established in l971, formed out of the British Acetylene Association, which existed since l901. BCGA members include gas producers, suppliers of gas handling equipment and users operating in the compressed gas field.

The main objectives of the Association are to further technology, to enhance safe practice, and to prioritise environmental protection in the supply and use of industrial gases, and we produce a host of publications to this end. BCGA also provides advice and makes representations on behalf of its Members to regulatory bodies, including the UK Government.

Policy is determined by a Council elected from Member Companies, with detailed technical studies being undertaken by a Technical Committee and its specialist Sub-Committees appointed for this purpose.

BCGA makes strenuous efforts to ensure the accuracy and current relevance of its publications, which are intended for use by technically competent persons. However this does not remove the need for technical and managerial judgement in practical situations. Nor do they confer any immunity or exemption from relevant legal requirements, including by-laws.

For the assistance of users, references are given, either in the text or Appendices, to publications such as British, European and International Standards and Codes of Practice, and current legislation that may be applicable but no representation or warranty can be given that these references are complete or current.

BCGA publications are reviewed, and revised if necessary, at five-yearly intervals, or sooner where the need is recognised. Readers are advised to check the Association's website to ensure that the copy in their possession is the current version.

This document has been prepared by BCGA Technical Sub-Committee 1. This document replaces BCGA CP 33: 2005. It was approved for publication at BCGA Technical Committee 143. This document was first published on 29/06/2012. For comments on this document contact the Association via the website www.bcga.co.uk.

CONTENTS

* Throughout this document numbers in brackets refer to references in Section 7. Documents referenced are the edition current at the time of publication of this Code of Practice.

TERMINOLOGY AND DEFINITIONS

Shall	A mandatory requirement for compliance with this Code of Practice.
Should	A preferred requirement but this is not mandatory for compliance with the Code of Practice.
May	An option available to the user of this Code of Practice.
Hydrogen storage	A gaseous hydrogen storage system is one in which the contents have sufficient hydrogen to be flammable when mixed with air and are stored or discharged in a gaseous form. The system includes containers, pressure regulators, instruments, safety-relief devices, manifolds, inter-connecting piping and controls. The storage system terminates at the point where hydrogen, at nominal service pressure, enters the distribution piping.
Bulk storage	For the purposes of this document bulk storage is defined as hydrogen storage which consists of fixed cylinders manifolded together, or tubes which may be either fixed in place or mounted on a transportable trailer, or one or more medium pressure vessels.
Cylinder	Transportable pressure receptacle of up to 150 litres water capacity.
Tube	Seamless transportable pressure receptacle of between 150 and 3000 litres water capacity.
Medium pressure vessel	A hydrogen storage vessel designed for fixed installation only and working at up to 100 bar operating pressure.
Bundle	A cylinder bundle, or manifolded cylinder pallet, consists of a number of cylinders permanently manifolded to a common outlet and contained in a rigid, protective framework for ease of handling by forklift truck or crane.

BCGA CODE OF PRACTICE CP 33

The Bulk Storage of Gaseous Hydrogen at Users' Premises

1 SCOPE

This Code of Practice covers the location, design, installation, commissioning, operation and maintenance of equipment for the bulk storage and supply of compressed hydrogen gas at users' premises.

This includes:

a) The issues surrounding safety distances around hydrogen installations, including security, electrical classification, vehicle access, fire fighting, planning and notification of relevant authorities.

b) Criteria for the design of the storage vessels, pressure and flow control equipment.

c) Safety issues associated with the installation and commissioning of the equipment.

d) Guidance on safe operation of the installation, both for the user and the gas supplier.

e) Maintenance, including both preventive and routine, covering specific requirements of UK legislation. This includes frequency and method for in-service inspection.

f) Fixed systems refilled on site consisting of transportable pressure receptacles (including cylinders, tubes or bundles) or medium pressure vessels.

Reference is made to relevant legislation, Codes of Practice and Standards, which are listed in Section 7. The hazards and properties of compressed hydrogen are summarised in Appendix 1.

Compliance with the Pressure Equipment Regulations (PER) (4), The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations (1), The Dangerous Substances and Explosive Atmospheres Regulations (7) and the Pressure Systems Safety Regulations (PSSR) (6) is mandatory. The materials and pressurised equipment used for the installations will need to comply with the essential safety requirements specified in the Regulations.

Compliance with the Management of Health & Safety at Work Regulations (5) will require risk assessments to be carried out, which may include a formal HAZOP, during the process of installation of bulk hydrogen systems.

This code does not include:

g) Liquid hydrogen. A summary of the requirements for safe operation with liquid hydrogen is given in the European Industrial Gases Association (EIGA) document 6/02 (14) or the USA National Fire Protection Association document 55 (18).

h) Systems consisting only of transportable pressure receptacles that are not fixed storage. For these systems see BCGA Code of Practice CP 4 (16).

2. LOCATION OF HYDROGEN INSTALLATION

The installation should whenever practicable be located outside in the open air. Other locations may be considered after a suitable and sufficient risk assessment has been completed. Detailed guidance on considerations for location inside buildings is given in Appendix 3.

Hydrogen installations shall not be placed in pits where there is any restriction of the means of escape in an emergency.

The installation shall be located so that it is readily accessible to delivery vehicles, to authorised personnel and to emergency services. However, it shall be protected against physical damage and access by unauthorised personnel. Fencing shall be provided unless there is adequate control to prevent access by unauthorised persons.

On controlled sites with sufficient supervision fencing is optional.

Where fencing is provided the minimum clearance between the fence and the installation shall be 0.6 m to allow free access to and escape from the enclosure.

The safety distances given in Table 1 will apply regardless of the position of the fence.

Timber or other readily combustible materials should not be used for fencing. The height of the fencing should be at least 1.8 m.

Any gates should be outward opening and wide enough to provide for an easy access and exit of personnel.

a) The main gate should have two wings, each at least 0.6 m wide.

b) The emergency exit gate should have one wing, at least 0.8 m wide.

Gates shall be locked during normal operation. Consideration should be given to the provision of an additional emergency exit where the size of fenced area or equipment location necessitates this.

All the control equipment for the safe operation of the installation shall be easily accessible to the plant operations personnel and delivery driver and all instrumentation shall be clearly visible.

A site specific risk assessment shall be conducted to establish the acceptability of near by electrical equipment or other sources of ignition.

Minimum separation distances of the installation from various hazards are given in Table 1.

NOTE: Table 1 does not apply to a delivery vehicle when the driver is present throughout the delivery process.

Trailers which form part of the fixed installation shall comply with the safety distances.

Approval may be required for the installation from the local planning authority, the fire authorities and the Health & Safety Executive. These requirements should be resolved with the owners of the premises where the installation is planned.

3 DESIGN OF INSTALLATION

3.1 General

The design and installation shall comply with The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations (1), The Dangerous Substances and Explosive Atmospheres Regulations (7), The Pressure Systems Safety Regulations (6) and The Pressure Equipment Regulations (4).

3.1.1 The installation consists usually of fixed storage, which may be provided either by a number of high pressure cylinders, tubes or bundles manifolded together or by medium pressure vessel(s), together with a pressure control station feeding the customer pipeline. The refilling of the fixed storage is usually achieved by cascade from a transport trailer, with control of the cascade process also carried out via the pressure control station. An alternative is for the storage to be refilled by local hydrogen generation and compression. In certain circumstances the fixed storage is replaced by the use of multiple trailers. In all cases, the pressure-reducing and control equipment shall be as close as practicable to the storage.

3.1.2 The installation shall be designed with a proper allowance for the manoeuvring of the transport trailer and shall have adequate lighting.

3.1.3 The foundations of the fixed storage shall be designed to allow for the loading imposed by the cylinders or medium pressure vessel(s). If cylinders are used as the fixed storage they should be supported in a manner to prevent corrosion resulting from standing in water, for example on metal gratings or suitable supports.

3.1.4 In the case of multiple trailer installations, the trailers should be sited to achieve adequate separation. This will mean at least 3.5 m between centres.

3.1.5 To prevent damage to equipment from the trailer, it is required, where such a risk exists, to provide a "bump-stop" to alert the driver when the trailer is in position, with at least 1 m clearance from the hazard.

3.1.6 Where two or more medium pressure vessels are required in an installation the vessels shall be separated by at least 1 m at their closest point. This does not apply to bundles.

3.1.7 An area classification drawing shall be prepared, indicating the requirements for the use of appropriately classified electrical equipment, as required under The Dangerous Substances and Explosive Atmospheres Regulations (7). All electrical equipment shall then comply with these requirements. BS EN 60079 (12) provides information.

3.1.8 A fire risk assessment shall be carried out. The assessment shall identify fire-fighting requirements such as the volume and pressure of available water. An emergency procedure shall also be drawn up following completion of the risk assessment.

3.1.9 Adequate means of escape in case of emergency shall be provided. In cases where personnel could be trapped inside compounds there shall be not less than two separate outward opening exits remote from each other and strategically placed with respect to the source of the hazard.

3.1.10 Notices shall be positioned so that they are visible from all sides of approach to the installation. They should read:

HYDROGEN – FLAMMABLE GAS

NO SMOKING – NO NAKED FLAMES

These notices shall include "pictorial" symbols in accordance with the Health and Safety (Safety Signs & Signals) Regulations (2). Compliance with these Regulations is mandatory. These signs shall be supplemented by a flammable material warning triangle. Examples are shown in Figure 1.

Figure 1. Examples of pictorial symbols.

3.1.11 The area within 3 m of any hydrogen installation shall be kept free of weeds and vegetation. If weed killers are used, chemicals such as sodium chlorate, which is a potential source of fire danger, should not be used.

3.1.12 Adequate means of giving alarm in the event of a fire shall be provided. These should be clearly marked and suitably located at all emergency exit points.

3.1.13 When the hydrogen is supplied from a tube trailer, a suitable and sufficientanti-tow-away system must be provided.

3.2 Cylinders, tubes and medium pressure vessels.

Details of design requirement of cylinders, tubes and medium-pressure vessels are not included in this document. Attention is drawn to the EIGA document 15/06 (15) for information on medium-pressure vessel design requirements. Appendix 5 of that document specifies, in Clause A.2.1.1, a maximum yield-strength of 420 MPa. Compliance with this BCGA Code of Practice requires the adoption of 360 MPa for this type of vessel and the use of post weld stress relief by heat treatment.

3.3 Piping

3.3.1 Piping and fittings shall be suitable for hydrogen service at the pressure and temperature involved. Cast iron pipe and fittings shall not be used. The design shall be to an appropriate, recognised design code.

3.3.2 Permanent joints (i.e. welded or brazed) are recommended. Flanged or screwed joints are acceptable but their use should be minimised. Compression fittings are generally not recommended, except where essential for small bore instrument lines, when the manufacturer's instructions for assembly shall be strictly observed.

3.3.3 Vents shall be provided to enable the system to be depressurised in a safe manner, for purging and at high and low points for testing.

3.3.4 All vents, including those of pressure relief devices, shall be designed or located so that moisture cannot collect and freeze in a manner which could interfere with the proper operation of the device.

3.3.5 Vents, including those of pressure relief devices, shall be arranged to discharge in a safe place, into the open air. Normally this will be above head height so as to prevent impingement of escaping gas upon any personnel and structure. Pressure relief vents shall be piped individually without manifolding, though manual vents may be manifolded where design permits. They shall not discharge where gas could accumulate, such as below the eaves of buildings. It should be noted that hydrogen can easily ignite; vents should, therefore, be orientated to avoid any flame impinging on vulnerable equipment, or the effects of radiated heat.

3.3.6 Cabinets or housings containing hydrogen control or operating equipment shall be adequately ventilated, particularly at high level, to prevent accumulation of hydrogen in the event of leakage. They shall be positioned so that, in the event of a leak, the gas can disperse in a safe manner and the effects of any resultant fire can be minimised. If the necessary ventilation is provided by mechanical systems then the ventilation air shall be drawn from a safe place and an appropriate detection / alarm system should be installed to detect the failure of the ventilation system or the presence of hydrogen well before a flammable concentration is reached.

3.3.7 Relief valves shall be sized to allow for the worst foreseeable case, i.e. regulator failure combined with full storage developed pressure at 60 °C.

3.3.8 Pipes should be installed above ground whenever practicable. Where lines must be buried they shall be below the frost level. If pipes must be run under roads or railways they shall be placed in pipe sleeves, which are vented above ground to a minimum height of 3 m in a safe place. The distribution pipework shall be in accordance with BCGA Code of Practice CP 4 (16).

3.3.9 Isolation valves shall be provided so that the hydrogen source can be shut off safely in the event of an emergency. This is particularly important where hydrogen lines enter buildings.

3.3.10 The entire system must be continuously electrically earthed with a maximum resistance to earth of 10 Ω or in accordance with national standards whichever is the most stringent. The earthing connections should be in position prior to a flammable mixture being present and also during filling with, or emptying of, a flammable fluid. This shall include effective earthing of the delivery vehicle. The earth rod for static earthing must be solidly connected to earthing rods for electrical supplies or lightning discharges. For lightning protection the installation should comply with BS EN 62305 (13).

3.3.11 Pressure gauges. If bourdon tube type gauges are used the tube must be specified to be either beryllium copper or phosphor bronze.

3.4 Testing

3.4.1 After installation all piping and fittings shall be, where practicable, hydraulically and pneumatically tested. The system shall be thoroughly dried out after these tests. Where it is not practicable to carry out a hydraulic test prior to the pneumatic test, appropriate precautions shall be taken as described in HSE Guidance Note GS-4 (10). The system shall be helium leak tested or other suitable leak detection methods adopted prior to the introduction of hydrogen.

3.4.2 A final function test with hydrogen at maximum operating pressure should be carried out after all pressure tests have been completed. Before introducing hydrogen into the system all air shall be purged out using inert gas. It shall be noted that hydrogen is an intensely searching gas and this test should, therefore, be carried out in stages at progressively increased pressure, checking carefully at each stage using an approved leak-detection fluid.

4 COMMISSIONING

Before introducing hydrogen the whole system must be purged to ensure that air is removed to a level safe for hydrogen operation. This shall be established by testing that the residual oxygen concentration is less than 1 %.

Prior to the commissioning of a new hydrogen installation a thorough check shall be made to ensure that:

a) The appropriate pressure and leak tests have been carried out and documented.

b) A check has been made that the installation conforms to the process and instrumentation diagram.

c) A check has been made that the correct safety devices are fitted.

d) A check has been made that all warning and identification labels are clearly displayed and that they are correct for the product being stored.

e) An ageing pressure equipment assessment in accordance with BCGA CP 39 (17) has been conducted to identify the in-service requirements.

f) A written scheme of examination in accordance with the Pressure Systems Safety Regulations (6) has been drawn up by a competent person. A written scheme of examination shall be required for the system. The responsibility for providing and complying with this scheme lies with the user. Where systems are leased or hired the user may transfer his responsibility to the owner by written agreement (in accordance with the Pressure Systems Safety Regulations, Schedule 2 (6)).

g) An initial examination has been completed if required by the above written scheme.

h) Product release is minimised and controlled as far as is practicable.

i) Confirm that electrical equipment associated with the installation has been certified by a competent person.

j) Confirm with the user that downstream pipework and equipment is compatible with the default supply temperature and pressure conditions.

5 HANDOVER AND OPERATION

Operating instructions and flow sheets shall be permanently available at the installation and accessible to drivers and operators.

Emergency telephone numbers and emergency procedures shall be prominently displayed. Warning notices must be clearly visible from all sides of the installation.

The customer shall be instructed on the general safety aspects of hydrogen operation and on the detailed operating instructions for the specific installation. Copies of the safety data sheet shall be provided (Appendix 1 gives an example).

This may include warnings on the use of mobile phones, torches and test equipment, and the use of anti-static footwear and clothing i.e. no nylon jackets.

The requirements of the Dangerous Substances and Explosive Atmospheres Regulations (7) shall be complied with.

The owner or the installer shall be responsible for the handover to the user.

5.1 The handover. This shall include:

a) Training of user personnel in accordance with Section 6 , this may include a demonstration of the correct operation of the equipment.

b) The provision of a contact address and telephone number should the user have any questions about his installation.

c) An emergency telephone number.

d) A check to ensure that the user understands his responsibilities under the Pressure Systems Safety Regulations (6) and has made arrangements for them to be fulfilled.

5.2 Handover documents. These shall include a minimum of:

a) A manual covering safe operation of the installation.

b) An appropriate Safety Data Sheet, which gives information in accordance with the requirements of the CHIP Regulations (8) and the REACH Regulations (9). Safety Data Sheets provide information on hazardous substances to help users conduct risk assessments. They describe the hazards the product presents, and give information on handling, storage and emergency measures in case of accident.

6 PERIODIC EXAMINATION AND MAINTENANCE

The installation will constitute a Pressure System within the Pressure Systems Safety Regulations (6). As such a Written Scheme of Examination shall be drawn up by a Competent Person, covering necessary checks and maintenance activities to ensure continued safety from release of stored energy. Unless a written agreement exists with the customer and the installation remains in the ownership of the Gas Company, the responsibility for

producing this Written Scheme and of carrying out the inspections under it lies with the User, i.e. the customer. Many customers who do not wish to own the installation will prefer to agree in writing with the Gas Company that this responsibility should be transferred to the Gas Company.

Maintenance involving the use of heat or spark producing tools will require the system to be purged with inert gas. Where no such hazard exists maintenance can be carried out without purging.

Vessels, and other relevant parts of the system, shall periodically be examined in accordance with the Written Scheme of Examination. Cylinders not classed as transportable pressure receptacles, by virtue of their usage, shall also be included in the Written Scheme of Examination. They will be purged with nitrogen for transport, if necessary. Examples of Written Schemes of Examination for hydrogen installations are given in Appendix 2. An ageing pressure equipment assessment in accordance with BCGA CP 39 (17) shall be conducted to identify additional ageing related in-service requirements not included in the sample written scheme in Appendix 2.

In the case of installations including medium pressure vessel(s) a log shall be maintained of the pressure cycling experienced by the vessel(s) in service. This involves recording each fill carried out with the date and the pressure before and after filling. See Appendix 2.

7 REFERENCES

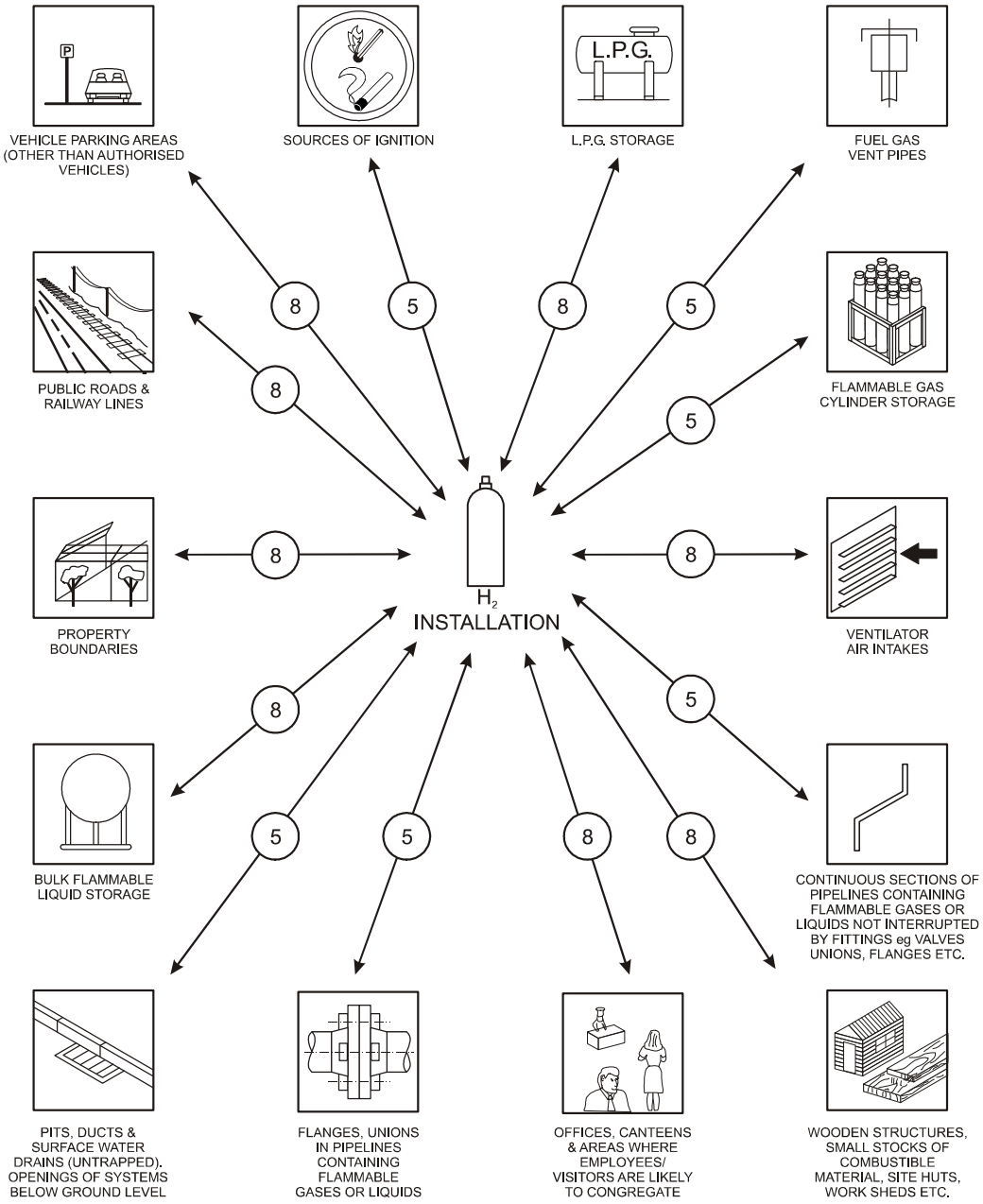
1.	SI 1996 No 192	The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996.
2.	SI 1996 No. 341	The Health and Safety (Safety Signs and Signals) Regulations 1996.
3.	SI 1997 No. 1713	The Confined Spaces Regulations 1997.
4.	SI 1999 No. 2001	The Pressure Equipment Regulations 1999.
5.	SI 1999 No 3242	The Management of Health and Safety at Work Regulations 1999, as amended.
6.	SI 2000 No. 128	The Pressure Systems Safety Regulations 2000.
7.	SI 2002 No 2776	The Dangerous Substances and Explosive Atmospheres Regulations 2002.
8.	SI 2009 No. 716	The Chemicals (Hazard Information and Packaging for Supply) Regulations 2009 (CHIP Regulations).
9.	Regulation (EC) No 1907/2006	European Commission - Registration, Evaluation, Authorisation and restriction of Chemicals. (REACH), as amended.

10.	HSE Guidance Note GS4	Safety in pressure testing. 1998.
11.	BS 476	Fire tests on building materials and structures.
12.	BS EN 60079	Explosive atmospheres.
13.	BS EN 62305	Protection against lightning.
14.	EIGA IGC Document 6 / 02	Safety in storage, handling and distribution of liquid hydrogen.
15.	EIGA IGC Document 15 / 06	Gaseous hydrogen stations.
16.	BCGA Code of Practice 4	Industrial gas cylinder manifolds and distribution pipework (excluding acetylene).
17.	BCGA Code of Practice 39	In-service requirements of pressure equipment installed at user premises.
18.	NFPA 55	Compressed gases and cryogenic fluids code

Further information can be obtained from:

Health and Safety Executive	www.hse.gov.uk
HSE Books	www.hsebooks.co.uk
HMSO	www.hmso.gov.uk
BSi	www.bsigroup.co.uk
EIGA	www.eiga.eu
BCGA	www.bcga.co.uk
USA - National Fire Protection Association	www.nfpa.org

TABLE 1 - MINIMUM RECOMMENDED HORIZONTAL DISTANCES



If a firewall is used, a minimum separation distance of 3 m should be maintained between the wall and any part of the trailer or fixed installation that could provide a likely ignition point. The distances shown above are horizontal distances. Where specified hazards exist vertically above the installation special considerations apply. A formal risk analysis will be needed to assess the requirements.

EXAMPLE SAFETY DATA SHEET

HYDROGEN

1 IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY

MSDS Nr
067A
Product name
Hydrogen
Chemical formula
H_2
Company identification
see footer
Emergency 'phone numbers
see footer

2 COMPOSITION/INFORMATION ON INGREDIENTS

Substance/Preparation
Substance
Components/impurities
Contains no other components or impurities which will influence the classification of the product
CAS Nr
01333-74-0
EEC Nr (from EINECS)
2156057

3 HAZARDS INDENTIFICATION

Hazards identification
Compressed gas
Extremely flammable

4 FIRST AID MEASURES

Inhalation
In high concentrations may cause asphyxiation. Symptoms may include loss of mobility/consciousness. Victim may not be aware of asphyxiation.
Remove victim to uncontaminated area wearing self-contained breathing apparatus.
Keep victim warm and rested. Call a doctor.
Apply artificial respiration if breathing stopped.
Ingestion
Ingestion is not considered a potential route of exposure.

5 FIRE FIGHTING MEASURES

Specific Hazards
Exposure to fire may cause containers to rupture/explode
Burns with a colourless, invisible flame
Hazardous combustion products
None
Suitable extinguishing media
All known extinguishants can be used
Specific methods
If possible, stop flow of product. Move container away or cool with water from a protected position
Do not extinguish a leaking gas flame unless absolutely necessary. Spontaneous/explosive re-ignition may occur.
Extinguish any other fire.
Special protective equipment for fire-fighters
In confined space use self-contained breathing apparatus

6 ACCIDENTAL RELEASE MEASURES

Personal precautions
A flammable gas detector should be used before entering an area.
Evacuate area. Ensure adequate air ventilation.
Eliminate ignition sources.
Environmental precautions
Try to stop release.
Clean-up methods
Ventilate area

7 HANDLING AND STORAGE

Ensure equipment is adequately earthed.
Suck-back of water into the container must be prevented.
Purge air from system before introducing gas.
Do not allow back-feed into the container.
Use only properly specified equipment which is suitable for this product, its supply pressure and temperature. Contact your gas supplier if in doubt.
Keep away from ignition sources, including static discharge.
Segregate from oxidant gases and other oxidants in store.
Refer to supplier's container handling instructions.
Keep container below 50 ^{o}C in a well-ventilate place.

8 EXPOSURE CONTROLS/PERSONAL PROTECTION

Personal protection
Ensure adequate ventilation.
Do not smoke while handling product

9 PHYSICAL AND CHEMICAL PROPERTIES

Molecular weight
2
Melting point
-259 ^{o}C
Critical temperature
-240 ^{o}C
Relative density, gas
0.07 (air =1)
Relative density, liquid
0.07 (water =1)
Vapour pressure 20 ^{o}C
Not applicable
Solubility mg/l water
1.6 mg/l
Appearance/Colour
Colourless gas
Odour
None
Auto-ignition temperature
560 ^{o}C
Flammability range
4-75 vol % in air
Other data
Burns with a colourless, invisible flame

10 STABILITY AND REACTIVITY

Stability and reactivity
Can form explosive mixture with air.
May React violently with oxidants.

11 TOXICOLOGICAL INFORMATION

General
No known toxicological effects from this product.

12 ECOLOGICAL INFORMATION

General
No known ecological damage caused by this product.

13 DISPOSAL CONSIDERATIONS

General
Do not discharge into areas where there is a risk of forming an explosive mixture with air.
Waste gas should be flared through a suitable burner with flash-back arrestor.
Do not discharge into any place where its accumulation could be dangerous.
Contact supplier if guidance is required.

14 TRANSPORT INFORMATION

UN Nr
1049
Class/Div
2.1
ADR/RID Item No
ADR RID Item No
2, 1 ºF
ADR RID Hazard Nr
230
Labelling ADR
Label 3: flammable gas

Other transport information

Avoid transport on vehicles where the load space is not separated from the driver's compartment.
Ensure vehicle's driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.
Before transporting product containers, ensure that they are firmly secured and:

- cylinder valve is closed and not leaking
- valve outlet cap nut or plug (where provided) is correctly fitted
- valve protection device (where provided) is correctly fitted
- there is adequate ventilation
- compliance with applicable regulations.

15 REGULATORY INFORMATION

Number in Annex 1 of Dir 67/548
001-001-00-9
EC Classification
F+;R12
Symbols
F+: Extremely flammable
R Phrases 12
S Phrases 9-16-33
Labelling of cylinders
Symbols Label 3: flammable gases
Risk phrases R12 Extremely flammable
Safety phrases S9/16/33 Keep container in well-ventilated place, away from ignition sources, including static discharge.

16 OTHER INFORMATION

Ensure all national / local regulations are observed.
Ensure operators understand the flammability hazard.
The hazard of asphyxiation is often overlooked and must be stressed during operator training.
Before using this product in any new process or experiment, a thorough material compatibility and safety study should be carried out.
Details given in this document are believed to be correct at the time of going to press
Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use can be accepted.

EXAMPLES OF SAFETY CHECKS AND WRITTEN SCHEMES FOR HYDROGEN INSTALLATIONS

1 Installations consisting of cylinder or trailer storage with pressure / flow control cabinet.

Safety Checks

Every year, carry out the following safety checks, which form part of normal, regular maintenance of the installation:

a) Where practicable, full leak check of system using approved leak detection fluid. If leaks are found the system shall be depressurised before repairs are carried out. Any hot work will involve purging out of hydrogen with inert gas and a re-test with nitrogen or water before re-introducing hydrogen.

b) Pressure gauges will be checked for correct operation.

c) Relief valves will be checked externally for correct seal in place, clear outlet and security of installation.

d) Physical inspection of whole system for any external damage

e) Inspect high pressure transfer hose for condition and replace if necessary.

Written scheme of examination

Every 5 years:

f) Replace high pressure transfer hose.

g) Replace relief valv*es with new or* refurbished unit.

Every 10 years:

h) Remove and replace cylinder manifolds with new or refurbished units.

i) Where necessary, purge cylinders with nitrogen, remove them and transport for re-testing.

2 Installations incorporating one or more medium pressure vessels with pressure / flow control cabinet.

Safety Checks

Every year, carry out the following safety checks, which form part of normal, regular maintenance of the installation:

a) Where practicable, full leak check of system using approved leak detection fluid. If leaks are found the system shall be depressurised before repairs are carried out. Any hot work will involve purging out of hydrogen with inert gas and a re-test with nitrogen or water before re-introducing hydrogen.

b) Pressure gauges will be checked for correct operation.

c) Relief valves will be checked externally for correct seal in place, clear outlet and security of installation.

d) Physical inspection of whole system for any external damage

e) Inspect high pressure transfer hose for condition and replace if necessary.

Written scheme of examination

5 years after putting into service and every 5 years thereafter:

f) Replace relief valves with new or refurbished unit.

g) The external examination of the medium pressure vessel(s) specified above at 2 years is to be repeated.

h) Either: Where practicable external ultrasonic flaw detection of all main seam welds, with the capability of detecting cracks 3 mm in length.

or,

internal inspection of the inside surface of the vessel(s), with magnetic particle inspection of the welds. The requirements of the Confined Spaces Regulations (3) must be complied with.

i) Replace high pressure transfer hose.

NOTE: The pressure cycling data on medium pressure vessels collected (see Section 6) shall be reviewed by the Competent Person to assess the necessary frequency of the vessel examination.

INSTALLATION IN BUILDINGS

Storage

Cylinders or bundles of hydrogen may be stored together with other common flammable gases, excluding LPG, inside a building used only for the storage of cylinders provided that the following requirements are met:

a) The building shall be of non-combustible material in accordance with BS 476 Part 4 (11).

b) The hydrogen cylinders shall be separated from other cylinders of flammable gas by not less than 1 metre.

c) The building shall have good high and low level natural ventilation to the open air. Outlet openings shall be located at the highest point of the room in exterior walls or roof. Vent openings shall have a minimum total area of not less than 2.5 % of the combined area of the walls and roof of the building.

d) Adequate explosion relief shall be provided in exterior walls or roof of the building. The total relieving area shall not be less than either the area of the roof or the area of one of the longest sides.

This explosion relief should be designed so that if an explosion occurs the pressure would be relieved and yet the explosion relief materials would not be likely to become dangerous missiles. Any combination of the following would be suitable:

(i) Walls of light non-combustible material, preferably single thickness.

(ii) Lightly fastened hatch covers.

(iii) Lightly fastened doors in exterior walls opening outwards.

(iv) Walls or roof of light design and lightly fastened.

e) Heating, if provided, shall preferably be by hot water or warm air. Where recirculatory systems are used consideration shall be given to the possibility of hydrogen contamination and adequate precautions shall be taken. The heat sources should be located remote from the building and comply with the distances set out in Table 1. Where an electrical source for heating is located in a hazardous area it shall comply with the requirements for electrical equipment outlined in Section 3.1.7.

Installation

Hydrogen systems of less than 200 cubic metres capacity may be located in buildings used for other purposes provided that the installation meets the following requirements:

a) It shall be in a well ventilated area with good high and low level natural ventilation.

b) It shall be protected against damage due to falling objects or work activity in the area.

c) It shall not be close to or below lines containing other flammable gases or liquids.

d) It shall not be located below electric lines or equipment.

e) It shall comply with the distances in Table 1.

f) It shall be defined by means of conspicuous markings and not be used for storing other materials.

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