MINISTRY OF DEFENCE

JOINT SERVICE SAFETY REGULATIONS FOR THE STORAGE, HANDLING AND USE OF GASES

(3rd EDITION)

Sponsored for use in the
United Kingdom Ministry of Defence
and Armed Forces
by
Director Joint Support Chain

If there are any further enquiries in to publication please contact the Author for further details

de&S
JOINT SUPPORT CHAIN

FOREWORD TO JSP 319 THIRD EDITION

The task of discharging the personal responsibilities of the Secretary of State for Defence (SofS) for all gas related matters, including Gases Safety, is delegated through the 2nd Permanent Secretary (PUS) to the Chairman of the Defence Fuels and Gases Environmental Safety Board (DFG ESB). The Head of Defence Fuels Group (DFG) is responsible to the Chair in supporting the DFG ESB to provide policy, advise on legislative implications and set environmental and safety standards.

The 3rd Edition varies from previous versions as a large proportion of the new policy is based on national and European legislation and approved industry Codes of Practice, Guidance Notes etc. Hence some chapters have received more fundamental changes. For instance, the synergy between maintainers and operators has been improved as the design and maintenance aspects of gases infrastructure feature in much greater detail and the document now includes storage, handling and use information on the range of gases in-use in the MOD.

Units should destroy previous editions of this publication.

ACKNOWLEDGEMENTS

Diagrams reproduced from UKLPG Trade Association publications, with kind permission of the UKLPG. For more information visit: www.UKLPG.org

Diagrams reproduced from the British Compressed Gas Association (BCGA) publications, with kind permission of the BCGA. For more information visit: www.bcga.co.uk.

AMENDMENT SHEET

Amendment		Incorporated By		
No	**Date**	**Name**	**Signature**	**Date**
1	Dec 07			Dec 07
2	Jan 09	WO1 (SSM) Graunt		Jan 09
3	Jan 10	WO1 (SSM) Garner		Jan 10
4	Jan 11	WO1 (SSM) Garner		Jan 11

CONTENTS

GLOSSARY

Chapter Sponsor - FSAT – SAFETY 3

SECTION 1 – GENERAL

Scope. This chapter provides the standard definitions and abbreviations for specialist terminology used in connection with the storage, handling and use of the range of gases used within the MOD.

Source. Definitions used in this publication are mainly derived directly from legislation, Codes of Practice and Guidance Notes. In addition, NATO terminology has been introduced where appropriate. The relevant source is quoted wherever possible.

Primacy. In deriving the definitions used in this publication, several meanings have been found to exist for the same expression. Accordingly, the following table of accession has been adopted:

a. UK legislation.

b. International Standards Organisation (ISO).

c. Economic Commission for Europe (ADR).

d. European Standards (CEN).

e. British Standards Institute (BSI).

f. Trade Associations, including BCGA, UKLPG and EIGA.

g. NATO Terminology (APP-1).

h. MOD (e.g. APs, JAPs, JSPs, SRPs, etc).

Availability. JSP 319 is available electronically from the Defence Intranet at:

http://defenceintranet.diiweb.r.mil.uk/DefenceIntranet/Library/CivilianAndJointService/BrowseDocumentCategories/SafEnvFire/Safety/HazardousSubstancesSafety/Jsp319SafetyRegulationsForTheStorageHandlingAndUseOfGases.htm

A controlled version is available on the World Wide Web (Internet) at:

http://www.mod.uk/DefenceInternet/MicroSite/DES/OurPublications/HealthandSafety/Jsp319JointServiceSafetyRegulationsForTheStorageHandlingAndUseOfGases.htm

Units that require JSP 319 in CD-ROM format are expected to 'burn' off copies as required at a local level. Units that either have no access to the Intranet or the facility to 'burn' CD-ROM's should staff their requirement through the chain of command. Exceptionally CD-ROM copies of JSP 319 can be obtained from the JSP 319 Technical Author.

SECTION 2 – GLOSSARY OF TERMS

The terms defined in this publication are contained in Table 1.

In this publication the following terms have the definitions assigned to them irrespective of any other meanings that may be given elsewhere. The source publication has been identified where applicable.

To minimise confusion, wherever practical the terminology used by civilian industry or incorporated into legislation and standards is used.

Table 1: Definitions

Term	Definition	Source
Access Apron	An area between the tank and a tanker where the process operating controls on both tank and tanker are accessible to the operator during filling/discharging. This area will normally have provision for containing or diverting a liquid spillage.	BCGA CP 36
Accident (Incident)	Any event which causes, or has the potential to cause injury, loss or damage to people, plant or premises.	JSP 375
ADR	European Agreement Concerning the International Carriage of Dangerous Goods by Road	ADR
Aerosol or Aerosol dispenser	Any non-refillable receptacle made of metal, glass or plastics and containing a gas, compressed, liquefied or dissolved, with or without a liquid, paste or powder, and fitted with a relief device allowing the contents to be ejected as solid or liquid particles in suspension in a gas, as a foam, paste or powder or in a liquid state or a gaseous state.	ADR
Air Separation Unit (ASU)	Air separation units produce nitrogen, oxygen and argon using air and electrical power as raw materials. While there are variations in the process details, reflecting desired product mix and other factors, all air separation units belong to one of two general process categories: • Cryogenic plants - Produce gas and liquid products using very low temperature distillation to separate air components and achieve the desired product purities. • Non-cryogenic plants - Produce gaseous products with near-ambient temperature separation processes that utilize differences in properties such as molecular structure, size or mass to generate oxygen or nitrogen.	
Air compressor	A machine that draws in air at atmospheric pressure, compresses it and delivers it at a higher pressure.	
Anaesthetic gas	Gas with narcotic characteristics, for medical use. EXAMPLE: Cyclopropane.	ISO 10286
Analgesic gas	Gas with pain-relieving characteristics, for medical use. EXAMPLE: Nitrous oxide.	ISO 10286
Asphyxiant gas	Gas which can cause suffocation when inhaled by man or animals. Note: Although most gases, with the exception of air, oxygen and a few others, are asphyxiant, the term is mainly used for gases not connected with other hazards, flammability, toxicity, etc.	ISO 10286
Authorised Person - Petroleum	A person employed by, or commissioned by the Works Services Manager or MOD, and appointed for the purpose of implementing the MOD Safety Rules and Procedures by the Commanding Officer/Head of Establishment/Officer in Charge.	SRP 03
Authorising Engineer - Petroleum	A suitably experienced chartered mechanical engineer experienced in petroleum handling systems, employed or commissioned by the Works Services Manager or MOD, and appointed by the Commanding Officer, Head of Establishment or Officer in Charge to ensure safety of petroleum work for the base.	SRP 03
Batch	A quantity of cylinders that are filled from the same charge from the same source.	
Breathing Apparatus	Apparatus designed to enable the wearer to work and breathe without harmful effects in a non life supporting atmosphere by supplying breathable quality air via an airline or pressurised cylinder.	DB 1754
Breathing gas	Gas used in a breathing apparatus to aid breathing. EXAMPLES: Air, nitrogen/oxygen mixtures	
BLEVE	Boiling Liquid Expanding Vapour Explosion - the explosive release	BCGA GN15

Term	Definition	Source
	of expanding vapour and boiling liquid following the catastrophic failure of a pressure vessel (cylinder) holding a pressurised liquefied gas such as LPG. On contact with a source of ignition this then causes an unconfined vapour cloud explosion.	
Bundle (of cylinders)	An assembly of cylinders that are fastened together and which are interconnected by a manifold and carried as a unit. The total water capacity shall not exceed 3000 litres except that bundles intended for the carriage of toxic gases of Class 2 shall be limited to 1000 litres.	ADR
Burst pressure	Highest pressure reached in a cylinder during a burst test	ISO 10286
Cartridge	LPG: A non-refillable container of less than 1.4 litre water capacity. Often fitted with a pierceable diaphragm or a self-sealing valve. Gas: See Gas Cartridge.	
CE Mark(ing)	A EC Declaration of Conformity, by means of adding a CE Mark to a PPE product	EC Legislation
Combustible Gas Indicator (Explosimeter)	An instrument used to measure the concentration of flammable gas.	
Compressed air	Compressed air produced by an air compressor. Normally produced to a low specification (suitable for tool use) and is not suitable for breathing purposes.	Def Stan 68-284
Competent Person	A person with sufficient technical knowledge or experience to prevent danger or, where appropriate, injury, during his or her work.	SRP-CER
	A competent individual person (other than an employee) or a competent body of persons corporate or unincorporated. Responsible for preparing or certifying the suitability of a written scheme of examination and for carrying out an examination in accordance with the written scheme of examination.	PSSR
Compressed gas	Gas, which, when packaged under pressure for transport, is entirely gaseous at all temperatures above –50ºC. Note: This category includes all gases with a critical temperature less than -50ºC	ISO 10286 (BS) EN 1920
Container	A cylinder or cartridge.	HSE CS 4
	A storage tank, replenishment trolley or flask used for the storage and transportation of liquid oxygen or liquid nitrogen.	
	A portable container, including small cans and bottles, drums, portable tanks and tank containers of any size not connected to a process.	HS(G)51
Corrosive Gas	A corrosive gas is one which, on direct contact, may harm human tissue. Many corrosive gases may also react with certain materials of construction causing material damage and possible failure. Corrosive gases only react with a material in the presence of water or moisture from the atmosphere or other sources.	
	UN Definition - Gases which: (a). Are known to be so toxic or corrosive to humans as to pose a hazard to health; or (b). Are presumed to be toxic or corrosive to humans because they have a LC50 value for acute toxicity equal to or less than 5 000 mL/m³ (ppm).	ADR

Term	Definition	Source
	Gases or gas mixtures meeting the criteria for toxicity completely owing to their corrosivity are to be classified as toxic with a subsidiary corrosivity risk. Class 2, Division 2.3.	
Critical pressure	The minimum pressure required to liquefy a gas at its critical temperature.	
Critical temperature	The temperature above which the substance cannot exist in the liquid state. Note: For gas mixtures the corresponding term is pseudo-critical temperature.	ISO 10286 ADR
Cryogenic liquid	Gas which liquefies at 1.013 bar at a temperature below –30°C. Note: Cryogenic fluids can be stored or transported only in thermally insulated containers. These gases are also known as liquefied gases or liquefied refrigerant gases, as appropriate.	
Cylinder	A transportable pressure receptacle of a water capacity not exceeding 150 litres.	ADR
Dangerous Area	An area in which there exists, or may exist, a dangerous atmosphere which in turn is defined as an atmosphere containing: a. Any flammable gases or vapour in a concentration capable of ignition. b. A concentration of toxic gas above prescribed limits. c. An atmosphere containing insufficient oxygen for normal respiration.	BR 1754
Dangerous Occurrence	A specific, unplanned, uncontrolled event which has the potential to cause injury or damage and is listed in Schedule 2 of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995.	JSP 375
Decant	The filling or transfilling from one gas cylinder to another	
Decant cylinder	Cylinder, normally for refrigeration gases, cleaned to a high standard, suitable for the temporary storage of a gas from a system.	
Decomposition	Chemical reaction whereby a substance breaks down into its constituent elements. In the case of acetylene this means carbon and hydrogen. This reaction gives out a great deal of heat.	BCGA GN15
Design pressure	Pressure used in the formula for the calculation of the minimum wall thickness of a cylinder. Note: In most cylinder design regulations it is the test pressure	ISO 10286
Developed pressure at T_{max}	Pressure developed by the gas contents in a cylinder at a uniform temperature of T_{max} Note: T_{max} is the expected maximum uniform temperature in normal service as specified in international or national cylinder filling regulations.	ISO 10286
Dewar flask	A thermally insulated container. It consists of two flasks, one placed inside the other, with a vacuum between. The vacuum prevents the conduction of heat from one flask to the other. For greater efficiency the flasks are silvered to reflect heat. The substance to be kept hot or cold, e.g. a cryogenic liquid, is contained in the inner flask.	
Dew point	The temperature at which dew, or condensation, forms on cooling a gas. It is a measurement taken at normal atmospheric pressure (1.013 bar). Note: For temperatures below 0ºC the term 'Frost point' should strictly be used, but the term Dew point is often used to include Frost points.	Def Stan 68-284
Dissolved Acetylene	Acetylene dissolved in acetone or dimethylformamide.	(BS) EN 1800
Dissolved gas	Gas which when packaged under pressure for transport is dissolved in a liquid phase solvent	ISO 10286

Term	Definition	Source
Downstream User	Someone who uses substances in the course of his industrial or professional activities. Note 1: A Downstream User is, by definition, not a Manufacturer, or an Importer (into the EU) of chemicals. Note 2: Some of the duties of a Downstream User may apply to Distributors, Retailers and Storage.	REACH Regulations
Dunnage	Loose wood, matting or similar material used to keep cargo in position, typically in a ships hold.	
Earthing Boss	A brass bolt or lug brazed to a vessel to which the earthing system is attached.	
Entonox™	A trade name used by BOC Gases to identify a medical gas mixture of 50 % Nitrous Oxide and 50 % Oxygen.	
Expendable Container	An LPG container that cannot be refilled (see also Cartridge).	
Explosives area	An area used for the storage, handling and processing of explosives that is usually enclosed by a security fence.	JSP 482
F Gas	A Flourinated Greenhouse gas controlled under the Kyoto Protocol.	
Filler	Person or persons responsible for inspection prior to, during and immediately after filling and who has received an appropriate level of training for the work involved, and has access to all necessary data for the cylinder, valve and all other fittings used.	(BS) EN 1919 (BS) EN 1920
Filling pressure	Pressure to which a cylinder is filled at the time of filling. Note: It varies according to the gas temperature in the cylinder, which is dependent on the charging parameters and the ambient conditions.	ISO 10286 (BS) EN 1920
Filling ratio	Ratio of the mass of gas to the mass of water at 15°C that is filled in a gas cylinder ready for use. Note: Synonyms are filling factor and filling degree, often expressed in kg/l or similar.	ISO 10286 ADR (BS) EN 1919
Fire wall	A wall, screen or partition erected in the open air to help protect containers of flammable liquid (LPG) from heat radiating from a nearby fire, and/or to ensure adequate dispersion distance from buildings, boundaries, sources of ignition etc for flammable liquid or vapour leaking from any container. A fire wall in this context does not include a wall intended only to protect buildings and other features in the vicinity from a fire at a container storage area.	HS(G) 51
Flameproof	Apparatus that will withstand an internal explosion of the flammable gas or vapour which may enter it, without suffering damage and will prevent the transmission of flame to the external flammable gas or vapour for which it is designed, through any joints or structural openings in the enclosure.	
Flame Arrestor	A device which arrests a flame front (caused by flashback or decomposition) and which is suitable for the most severe type of flame which may occur.	
Flammable gas	Gases which burn readily in the presence of oxygen or air and in certain admixtures are explosive.	
Flashback	Occurs when flame from a torch burns back into the tip, the torch or the hose. It is often accompanied by a hissing or squealing sound with a smoky or sharp-pointed flame.	BCGA GN15
Frost point	See 'Dew point'.	Def Stan 68-284
F & L	Fuels & Lubricants	
Full gas cylinder	A gas cylinder charged to its working pressure or, in the case of a liquefiable gas, a cylinder filled to its tare weight.	
Gas	Any substance that is completely gaseous at 1.013 bar and 20 ºC or	ISO 10286

Term	Definition	Source
	has a vapour pressure exceeding 3 bar at 50ºC. Note: The word substance encompasses pure substances as well as mixtures.	
Gas cartridge	Any non-refillable receptacle containing, under pressure, a gas or a mixture of gases. It may be fitted with a valve.	ISO 10286 ADR
Gas free	A vessel or similar confined space is considered to be gas free if the concentration of combustible vapours present is below one per cent of the lower explosive limit as measured by an accurate and recently calibrated indicator, combustible gas. Note: Gas free does not mean non-toxic.	
Hazardous Area	An area in which explosive gas - air mixtures are, or may be expected to be, present in quantities as to require special precautions to instituted to prevent their ignition. Such areas are to be Designated and appropriately signed.	SRP 02 SRP 03
Hazard Division (HD)	A division of the United Nations Dangerous Goods Class definition indicating the main type of hazard to be expected in the event of an accident.	JAP100A-01
Heliox	A gas comprising a specified mixture of oxygen and helium, capable of supporting human life under appropriate diving or hyperbaric conditions.	BS 8478
High-pressure liquefied gas	Liquefied gas, which has a critical temperature between -50°C and +65ºC	ISO 10286
Incident (Accident)	Any event which causes, or has the potential to cause injury, loss or damage to people, plant or premises.	JSP 375
Industrial gas	Gas which is used in a technical process in industrial production or similar activity	ISO 10286
Inert gas	Gas which does not readily react chemically with other substances	ISO 10286
Inhabited Building	A building or structure occupied in whole or in part by people.	
Inside Quantity Distance	See definition of 'Quantity Distance'.	JSP 482
Intrinsically Safe	An intrinsically safe circuit is one in which any electrical sparking that may occur in the normal working, under the conditions specified by the certifying authority and with the prescribed components, is incapable of causing an ignition of the prescribed flammable gas or vapour. An intrinsically safe apparatus is that which is so constructed that, when installed and operated in the conditions specified by the certifying authority, any electrical sparking that may occur in the normal working, either in the apparatus or in the circuit associated therewith, is incapable of causing an ignition of the prescribed flammable gas or vapour. Notes: 1. The use of the term intrinsically safe in normal working is intended to cover sparking that may in normal use be produced by breaking line current or a short circuit across the lines in the circuit that is required to be intrinsically safe. It is also intended to cover sparking that may be produced under any conditions of fault, which in the opinion of the certifying authority might arise in practice. 2. The certifying authority referred to in the above is the Department of Trade and Industry.	(BS) EN 50020
Liquid Transfer Area	An area adjacent to the tank, which surrounds the tanker, when the latter is in the filling/discharge position, and which includes the access apron.	BCGA CP 36

Term	Definition	Source
Liquefied Gases	Gas, which, when packaged for transport, is partially liquid (or solid) at some temperature above –50ºC	ISO 10286
LPG	LPG is the abbreviation used to describe 'Liquefied Petroleum Gas'. The name describes a group of hydrocarbon gases which exist as vapour under ambient conditions of temperature and pressure, but which can be liquefied by the application of moderate pressure and/or refrigeration. Note: LPG is normally marketed as commercial butane (C_4H_{10}) or commercial propane (C_3H_8).	
LPG Authority	An authority, normally the DEO(W) or appointed person by them, having specialist knowledge concerning the storage and handling of LPG.	
Lower Explosive Limit (LEL)	This is synonymous with 'lower flammable limit'. It is the minimum concentration of vapour in air or oxygen below that which propagation of flame does not occur with a source of ignition.	
Low-pressure liquefied gas	Liquefied gas, which has a critical temperature equal to or above +65 ºC	ISO 10286
Maximum Liquid Level Device	A bleed valve connected to a dip tube terminating at the maximum permitted filling level in a vessel to indicate its maximum permitted level when being filled.	
Maximum permissible filling weight	Product of the water capacity of the cylinder and the filling ratio of the gas.	(BS) EN 1919
Maximum permissible operating pressure	Highest pressure permitted to be developed during service.	ISO 10286
Medical gas	Gas intended to be administered to patients for therapeutic, diagnostic or prophylactic purposes, or to be used for surgical tool applications.	ISO 10286
Minimum Pressure	The pressure below which a cylinder is not to be discharged in normal use.	
Multiple Element Gas Container	Multi-Element Gas Container (MEGC) is a unit containing elements which are linked to each other by a manifold and mounted on a frame. The following elements are considered to be elements of a MEGC: cylinders, tubes, pressure drums and bundles of cylinders as well as tanks for the carriage of Class 2 having a capacity of more than 450 litres.	ADR
Naked Lights	The term naked lights is to include all exposed flames, incandescent materials, lamps (e.g. torches, electric lights, hurricane lamps) of an unapproved pattern, gas and electric welding and portable hand or power operated equipment of an unapproved pattern.	
Nitrox	A gas comprising a specified mixture of oxygen and nitrogen, capable of supporting human life under appropriate diving or hyperbaric conditions. Note: This includes manufactured gas mixtures made up from combinations of pure oxygen and pure nitrogen, with or without compressed air.	BS 8478
Nominally empty container	A container from which most if not all liquid has been discharged but which will still contain LPG vapour.	HSE CS 4
Nominal pressure	In accordance with common international understanding, the working pressure.	ISO 10286
Numerical coding	A system of identifying by a 4-digit numerical code the properties of a gas/gas mixture with respect to fire potential, toxicity, physical state and corrosiveness.	
Operating pressure	Varying pressure which is developed in a cylinder during service	ISO 10286

Term	Definition	Source
Outside Quantity Distance	See definition of 'Quantity Distance'.	JSP 482
Oxidising gases	Gases which in the presence of combustible materials can be ignited and which promote or are essential for maintenance of combustion.	
Pallet	Device for handling several cylinders at the same time.	(BS) EN 1920
Partition	A fire-proof dividing wall, minimum 300 mm, carried from floor to roof without a gap.	
Permanent gases	Gases which cannot be liquefied by the application of pressure at temperatures above 10 °C.	
Personal Protective Equipment (PPE)	Personal Protective Equipment refers to all equipment and products designed to be worn or held by a person at work to protect them against one or more risks to their health and safety.	
Pi Mark	A special Logo used on Transportable Pressure Equipment. A mandatory European compliance mark, signifying compliance with the, EC, Pressure Equipment Directive and ADR.	
Pigtail	A connecting pipe, usually flexible, between the cylinder valve and the fixed gas piping or installation.	
Portable Container	A gas or LPG cylinder not exceeding 150 litre water capacity.	
Preparation	A mixture or a solution of two or more substances.	CHIP Regulation, REACH Regulation
Pressure	Pressures used in this document are gauge pressures, except where otherwise stated.	
Pressure receptacle	A collective term that includes gas cylinders, tubes, pressure drums, closed cryogenic receptacles and bundles of cylinders.	ADR
Pressure Regulator	A pressure regulator is fitted to the outlet of the gas cylinder valve and reduces the pressure of the gas from the cylinder pressure to the lower pressure required for the operation of the process equipment.	
Pressure relief device	A device which is fitted to the cylinder or its valve and designed to open to prevent a rise of pressure in excess of a specified value because of excess temperature and/or pressure.	(BS) EN 1919
Pressure Relief Valve	A valve of specified performance designed to relieve pressure within a pressure container above the design pressure.	
Pressure Stage	An area of the installation defined by the upstream and downstream equipment. High: That part between the valve of the cylinder/vessel and the inlet of the 1st stage regulator. Intermediate: That part between the 1st and 2nd stage regulators. Low: That part between the 1st stage (or 2nd stage if an intermediate stage is used) and the inlet of the appliance.	
Pressure System	A system comprising one or more pressure vessels of rigid construction, including any associated pipework and protective devices, which contains, or is intended to contain, a relevant fluid. The pipework along with its protective devices, to which a gas container is, or is intended, to be connected; and is used, or is intended to be used, to contain a relevant fluid.	JSP 375
Pressure Vessel	A closed vessel consisting of one or more independent chambers, any of which may be subject to an internal pressure greater than 0.5 bar and is used, or is intended to be used, to contain a relevant fluid.	JSP 375
Propellant gas	Gas under pressure used in a machine or apparatus to create a mechanical force.	ISO 10286

Term	Definition	Source
Purge	Definition 1: Vent momentarily, a process which allows the contained gas to blow away any contamination/debris from the gas outlet. Definition 2: Vent, a process using a gas source to clean and flush out contaminants from inside a container.	BCGA
Quantity Distance	There are two types, Inside and Outside: **Inside Quantity Distance:** • **Inter-Magazine Distance**. The distance between a building or stack containing explosives to other such buildings or stacks which will prevent the direct propagation of explosives or fire from one to the other by missile, flame or blast. • **Process Building Distance**. The distance from a building or stack containing explosives to a Process Building, or from a Process Building to another Process Building, which will provide a reasonable degree of immunity for the operatives within the Process Building(s), and a high degree of protection against immediate or subsequent propagation of explosions. **Outside Quantity Distance:** • **Inhabited Building Distance**. The minimum permissible distance between a Potential Explosion Site and inhabited buildings, caravan sites, places of assembly, etc, which is such that the ignition or explosion of explosives at a Potential Explosion Site will not cause severe structural damage to those buildings or unduly hazard their occupants, be they Service or civilian. • **Public Traffic Route Distance**. The minimum permissible distance between a Potential Explosion Site and public traffic routes which is such that the ignition or explosion of explosives at the Potential Explosion Site will not cause intolerable danger to the occupants of vehicles at an Exposed Site.	JSP 482
Rare gas	Gas which “never” reacts chemically with other substances. EXAMPLES: Argon, helium, neon, krypton.	ISO 10286
Recovery cylinder	Cylinder provided to recover 'contaminated' product for return, normally disposal.	
Refrigerant gas	Gas which liquefies at 1.013 bar at a temperature below –30°C. Note: In their liquid form these gases include Liquid Oxygen (LOx) and Liquid Nitrogen (LiN). These gases are also known as cryogenic liquids.	ISO 10286
Refrigerated liquefied gas	Gas which when packaged for transport is partially liquid because of its low temperature	ISO 10286
Relative Humidity (RH)	The ratio of the actual vapour pressure to the saturation vapour pressure over a plane liquid water surface at the same temperature, expressed as a percentage.	
Restricted Area	A temporarily defined area, which may or may not be in an existing hazardous area, in which there is increased risk of fire, explosion, asphyxiation, poisoning from fumes or gas, due to spillage, defects in installation, or type of maintenance operation to be carried out.	SRP 03
Respiratory Protective Device (RPD)	This refers to Personal Protective Equipment designed to protect the wearer’s respiratory tracts against the inhalation of atmospheres that would normally cause adverse health effects.	BS EN 132
Safe Area	Any area, no part of which lies within a specified dangerous, restricted or hazardous area.	

Term	Definition	Source
Safety Area	The area which is covered by the safety distance.	
Safety Distance	The distance to be observed with regards to gas and LPG stocks to ensure the minimum practical risk to life and property should an explosion occur.	
Safety distance external	The minimum distance between any gas cylinder storage area or bulk cryogenic liquid installation to the nearest main road, private building etc. so as to provide reasonable assurance of safety to life and property.	
Safety distance internal	The minimum distance required between storage sub-divisions of flammable, oxidising and inert gas cylinder stacks.	HSE CS 4
Scientific gas	A gas which is used for analysis, calibration and other similar purposes in scientific laboratories	ISO 10286
Separation distance	The horizontal distance between the nearest container in the storage area and the reference feature.	HSE CS 4
Settled pressure	Pressure of the contents of a gas cylinder in chemical, thermal and diffusive equilibrium	ISO 10286 ADR
Source of Ignition	All naked lights or a spark or flame produced by any other means.	
Stack	One or more cylinders located together, all containing the same type of gas.	HSE CS 4
Stampmarking	Permanent markings, applied to the cylinders by hard metal stamping, engraving, casting or other similar methods. In the case of composite cylinders, some permanent markings may be achieved by the use of a printed label, placed in the resin.	BS EN ISO 13769:2006
Stencilling	Marking of the item using inks and/or paints.	BS EN ISO 13769:2006
Storage Area (or store)	An area set-aside for the storage of Industrial Gases and LPG containers where there is no intention of using the products.	HSE CS 4
Storage sub-division.	One or more adjacent stacks of cylinders; each stack being composed only of cylinders containing gases of the same principal hazard classification, i.e. flammable, oxidising or inert.	
Substance	A chemical element and its compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.	CHIP Regulation, REACH Regulation
Tare weight	The tare weight is the sum of the empty weight plus the mass of any coating (e.g. paint) used in service, the mass of the valve including dip tube where fitted, any fixed valve guard and the mass of all other parts that are permanently attached (e.g. by clamping or bolted fixing) to the cylinder.	BS EN ISO 13769:2006
Temperate climate	A climate in which the maximum shade temperature does not exceed 35 °C; and thus the contents of a container stored in the shade is not likely to exceed 35 °C.	
Test life expired	A cylinder which has not been pressure tested within the periods laid down.	
Test pressure	Required pressure applied during a pressure test for qualification or re-qualification.	ISO 10286
Total weight	Tare weight of the cylinder plus the maximum permissible filling weight.	(BS) EN 1919
Toxic gases	Gases which have a toxic effect when breathed; this includes corrosive gases. Gases classified as UN Class 2, Hazard Division 2.3	ADR
Transit devices	This term embraces all protective items e.g. rubber grommets, coir	

Term	Definition	Source
	covers, cradles required by transport authorities as a condition of acceptance of compressed gas cylinders for transportation.	
Trimix	A gas comprising a specified mixture of oxygen, helium and nitrogen, capable of supporting human life under appropriate diving or hyperbaric conditions. Note: This includes manufactured gas mixtures made up from combinations of pure oxygen, pure helium and pure nitrogen, with or without compressed air.	BS 8478
Tropical climate	A climate in which the maximum shade temperature exceeds 35 °C; and thus the contents of a container stored in the shade is likely to exceed 35 °C.	
Water capacity	A 'value' declared by the manufacturer and permanently stamped on the cylinder shoulder. It is the capacity, in units of volume (litre), of the container when it is completely filled with water. It depends upon the dimensions of the container and not the liquid used to fill the container.	
Wet gas	A gas in which the water content of the gas is in excess of the gas specification.	
Wetting Test	Method used initially to establish if an acetylene cylinder is hot from an internal decomposition caused by a flashback or by exposure to fire. The wetting test may also be subsequently used to indicate if an ongoing decomposition is slowing down inside the cylinder and that the external shell has cooled indicating that a spontaneous explosion is unlikely, given ongoing cooling.	BCGA GN15
Working pressure	The Settled pressure of a compressed gas at a uniform reference temperature of 15 °C in a full gas cylinder	ISO 10286 (BS) EN 1920
Valve guard	A device protecting the valve during handling, transportation, storage. It need not be removed to provide access to the valve.	ISO 11117
Valve protection cap	A device securely fixed over the valve during handling, transportation, storage. It is removed for access to the valve.	ISO 11117
Vulnerable Population	People who cannot be evacuated easily and quickly from buildings because of age or infirmity. For example those in a nursery school, old people's home hospital or correction centre. It also includes buildings where people sleep.	HSE CS 4
Yield pressure	Pressure at which the actual yield strength of a cylinder is reached. Note: Exceeding the yield pressure will cause a permanent increase in the cylinder volume.	ISO 10286

SECTION 3 – ABBREVIATIONS

Description	Abbreviation	Source
A		
(European) Agreement Concerning the International Carriage of Dangerous Goods by Road	ADR	ADR
Air Commodities Project Team	AC PT	
Air Conditioning and Refrigeration Industry Board	ACRIB	
Air Separation Unit	ASU	
Air and Space Interoperability Council	ASIC	
Air Port of Embarkation	APOE	
Air Publication	AP	MOD
Airfield and Bulk Fuels Group	ABFG	
Allied Command Europe	ACE	
Allied Publication	AP	NATO
Allied Quality Assurance Publication	AQAP	NATO
American, British, Canadian, Australian	ABCA	
Amendment List	AL	MOD
As Low As Reasonably Practicable	ALARP	
Authorising Engineer	AE	
Authorised Person Petroleum	AP (Petroleum)	
Aviator's Breathing Oxygen	ABO	USA terminology
B		
Base Level Budget	BLB	
Boiling Liquid Expanding, Vapour Explosion	BLEVE	
Book of Reference	BR	RN
British Compressed Gases Association	BCGA	
British Oxygen Company	BOC	
British Standard	BS	
British Standards Institute	BSI	
C		
CE Mark(ing)	CE Mark	
Central Branch Commercial – Energy Procurement for Defence	CBC – EPD	
Central Health and Safety Project	CHASP	MOD
Chief Environmental Safety Officer	CESO	MOD
Chief of Defence Logistics	CDL	MOD
Chief of Fleet Support	CFS	
Clinical & Professional Support Division	CPSD	
European Committee for Standardization	CEN	
Compliance Monitoring Group Focal Point	CMP	
Compressed Natural Breathing Air	CNBA	Def Stan 68-284
Construction Industry Training Board	CITB	
Control of Major Accident Hazards	COMAH	HSE
Control of Substances Hazardous to Health	COSHH	HSE
Construction (Design & Management) Regulations	CDM	
Crown Fire Standards	CFS	
Customer Supplier Agreement	CSA	
Cryogenics and Gas Section	CGS	

Description	Abbreviation	Source
D		
Dangerous Substances and Explosive Atmospheres Regulations	DSEAR	
Defence Dangerous Goods and Hazardous Stores Group	DDGHSG	
Defence Equipment and Support	DE&S	
Defence Estates	DE	
Defence Fuels & Gases Environment Safety Board	DFGESB	
Defence Fuels Group	DFG	
Defence Fuels Operation Centre	DFOC	
Defence Standard	Def Stan	
Defence Supply Chain Operations and Movements	DSCOM	
Defence Support Group	DSG	
Defence Training Estate	DTE	
Defence Works Advisor	DWA	
Department for Transport (UK)	DfT	
Department of Transportation (USA)	DoT	
Deployable Support & Test Equipment PT	DS&TE PT	
Director Defence Health & Safety	D Def H&S	
Director Joint Support Chain	D JSC	
Director MOD Fire Services	D MOD FS	
Director Supply Chain Operations	Dir SC Ops	
E		
Environment Agency	EA	
Environment, Safety & Training Sub-committee	ES&TSC	DFG
Equipment Sub Committee	ESC	DFG
Equipment Support	ES	
Establishment Works Consultant	EWC	
Euro Atlantic Partnership Council	EAPC	MOD
European Agreement Concerning the International Carriage of Dangerous Goods by Road	ADR	ADR
European Chemical Agency	ECHA	
European Committee for Standardization	CEN	
European Community	EC	
European Standard (Norm)	EN	
European Union	EU	
Expeditionary Airfield Facilities	EAF	
Expeditionary Logistics Wing	ELW	
F		
First Aid Fire Appliances	FAFA	
Fleet Air Arm	FAA	
Fluorinated Gas	F Gas	
Focal Point	FP	MOD
Front Line Command	FLC	
Fuels & Lubricants	F&L	
Fuels Safety Assurance Assessment	FSAA	
Fuels Safety Assurance Team	FSAT	
Fuels Safety Working Group	FSWG	
G		

Description	Abbreviation	Source
Good Manufacturing Practice	GMP	
Government Pipeline and Storage System	GPSS	
Ground Support Equipment	GSE	
H		
Hazard Division	HD	ADR
Health & Safety at Work Act	H&SWA	
Health & Safety Executive	HSE	
Health & Safety Guidance Note	HS(G)	HSE
Higher Explosive Limit	HEL	
Higher Level Budget	HLB	
HQ Air Command	HQ Air	
HQ Land Forces	HQ LF	
HQ Land Forces Directorate of Infrastructure	HQ LF D Infra Sp	
HQ UK Support Command (Germany)	HQ UKSC(G)	
Hydrochlorofluorocarbon(s)	HCFC	
I		
Inside Quantity Distance	IQD	JSP 482
Institute of Petroleum (Now known as the Energy Institute (EI))	IP	
International Air Transport Association	IATA	
International Civil Aviation Authority	ICAO	
International Maritime Dangerous Goods Code	IMDG Code	
International Maritime Organisation	IMO	
International Standards Organization	ISO	
J		
Joint Air Publication	JAP	MOD
Joint Force Headquarters	JFHQ	
Joint Force Logistic Component	JF Log C	
Joint Helicopter Command	JHC	
Joint Service Publication	JSP	MOD
Joint Support Chain Services		
K		
-		
L		
Land Systems Fuels & Lubricants Sub-Committee	LSF&LPSC	
Liquid Oxygen	LOx	
Liquid Nitrogen	LiN	
Liquefied Petroleum Gas	LPG	
Logistic Support Inspections	LSI	
Logistic Support Services	Log Sp Svcs	
Logistic Support Technical Inspections	LSTI	
Logistic Support	Log Sp	
Long Term Costing	LTC	
Lower Explosive Limit	LEL	
M		
Major Accident Control Regulations	MACR	MOD
Manifolded Cylinder Pack	MCP	

Description	Abbreviation	Source
Maximum Explosive Limit	MEL	
Medicines and Healthcare products Regulatory Agency	MHRA	
Medical & General Supplies Team	M&GS Team	
Military Works Force	MWF	
Ministry of Defence	MOD or MoD	
MOD Defence Works Functional Standards Safety Rules & Procedures	SRP	MOD
MOD Demand Priority Code	SPC	
Montreal Protocol	MP	
Montreal Protocol Substances Bank	MPSB	
Montreal Protocol Task Force	MPTF	
Motor Transport Fuelling Installation	MTFI	
Multiple-Element Gas Container	MEGC	
N		
NATO Military Standards and Terminology	NMSt	MOD
NATO Standardisation Agreement	STANAG	NATO
NATO Stock Number	NSN	
Nitrogen Concentration Trolley	NCT	
Nuclear, Chemical and Biological	NBC	
New European Valve Outlet Connector	NEVOC	
North Atlantic Treaty Organisation	NATO	
Northern Ireland	NI	
O		
Oil Fuel Depots	OFD	
Oil Industry Emergency Committee	OIEC	
Operating Authority	OA	
Out of Area Operations	OOA Operations	
Outside Quantity Distance	OQD	JSP 482
Ozone Depleting Substances	ODS	JSP 418
P		
Permanent Joint Headquarters	PJHQ	
Personal Protective Equipment	PPE	
Personal Role Radio	PRR	
Petrol, Oils & Lubricants (Obsolete – Use ‘F&L’)	POL	JSP 317
Pressure Relief Valve	PRV	
Pressure Systems Safety Regulations	PSSR	HSE
Products Sub Committee	PSC	DFG
Project Team	PT	
Property Manager	PROM	
Q		
Quality Assurance	QA	
Quality Control	QC	
Quality Surveillance	QS	
R		
Rail Tank Cars	RTC	
Reichs-Ausschus fur Lieferbedingungen Number	RAL No.	
Registration, Evaluation, Authorisation and Restriction of Chemicals	REACH	

Description	Abbreviation	Source
Regulations concerning the International Carriage of Dangerous Goods by Road	RID	
Reporting of Injuries, Diseases and Dangerous Occurrences Regulations	RIDDOR	HSE
Respiratory Protective Device	RPD	
Role Office	RO	
Royal Air Force	RAF	
Royal Engineers	RE	
Royal Fleet Auxiliary	RFA	
Royal Logistic Corps	RLC	
Royal Navy	RN	
Royal School of Mechanical Engineering	RSME	
S		
Safety, Health, Environment & Fire Management Board	SHEFB	MOD
Safety Data Sheet	SDS	
Sea Port of Embarkation	SPOE	
Secretary of State	S of S	
Service Focal Points	SFP	
Siting Board	SB	
Specialist Petroleum Inspections	SPI	
Spillage Report	SPILLREP	
Standard Operating Procedure	SOP	
Standardisation Agreement (ABCA)	QSTAG	
Statement of Requirement	SOR	
Statement of User Requirement	SUR	
Status of Forces Agreement	SOFA	
Statutory Instrument	SI	
T		
Top Level Budget	TLB	
Training Group Development Agency	TGDA	
Transition to War	TTW	
U		
Unit Identity Number	UIN	
United Kingdom	UK	
United Kingdom Accreditation Service	UKAS	
United Kingdom Liquified Petroleum Gas Association	UKLPG	
United Nations	UN	
V		
Vice Chief Defence Staff	VCDS	
W		
Wet Stock Management	WSM	
Working Party	WP	
Works Service Manager	WSM	

INTRODUCTION TO JSP 319

Chapter Sponsor - FSAT Safety 3

SECTION 1 – GENERAL

Scope. This manual lays down the standards of practice to be observed within the MOD for the storage and handling of all gases including Liquefied Petroleum Gas.

Sources. The regulations contained in Joint Service Publication (JSP) 319 are derived from international and national legislation; international, NATO and national standards; industry Codes of Practice and Guidance Notes.

Authority. JSP 319 is produced and maintained by the Defence Fuels Group under the authority of the Defence Fuels and Gases Environment Safety Board as defined in JSP 815.

Maintenance. JSP 319 will be maintained on the Defence intranet and will be revised on an as-required basis. All hard copies of JSP 319 are uncontrolled. To check the latest amendment status reference should be made to the Defence Intranet or FSAT.

Equality and Diversity Impact Assessing Statement. This policy has been Equality and Diversity impact assessed in accordance with the department's equality and diversity impact assessment tool against:

"Part 1 Assessment only - no diversity impact found"

This policy is due for review on 1st June 2012.

SECTION 2 – APPLICABILITY

The Secretary of State for Defence issues a policy statement on safety, health, environmental protection and sustainable development in the MOD which sets out the strategic principles, duties and governance to be applied throughout the MOD. This policy statement is published in JSP 815. Compliance with JSP 815 ensures consistent implementation of the Secretary of State's policy.

JSP 319 is a level 3 publication which acts in support of the MOD Environment and Safety Management system detailed within JSP 815.

JSP 319 regulations shall be applied to the storage & handling of all LPG and gas products by the three Services, Defence Equipment and Support (DE&S), Central TLB, and Defence Agencies. The regulations shall also apply to contractors, and their personnel, operating on the MOD estate and to non-public activities/encroachments (such as flying clubs).

Transportation. All gases and pressure receptacles, including gas cylinders, aerosols, tanks and MEGC's are classified as dangerous goods. *JSP 800 – Defence Movement and Transport Regulations* are always to be consulted when transporting dangerous goods detailed within this publication (see Part 2, Chapter 8).

Exceptions. These regulations do not cover the internal use of Gas Products aboard ships or vessels, or in aircraft operated by the Services or specialist contractors or agencies, or the repair of MOD vehicles or aircraft for which special regulations apply. Such special regulations shall be based on this publication. Similarly, where the Services need to operate at locations which require specific standards higher than those contained in this manual, then the higher standard shall be applied. Where applicable these specialist regulations/publications are referenced within JSP 319.

Outside UK. In countries outside of the UK, the standards specified in this manual shall be applied unless the host nation requires a higher standard in which case that standard must be applied. In Germany, where the Status of Forces Agreement (SOFA) has precedence, all facilities must be constructed to German Standards with disgregard to the regulations specified in this manual.

Specific Procedures. The main sections of the JSP 319 will detail the generic procedures to be used within the services and associated users. However, where procedures are not common across the services at this stage, they will be detailed in annexes or references covering the Land, Marine and Aviation environments. Where single-Service issues require the production of clarifying or complementary statements, policies or orders, these shall be based on the detail of this publication, but should not repeat its contents. The JSP 319 shall have primacy over any such clarifying or complementary statements, policies or orders.

Operational Conditions. Some relaxation of the procedures detailed in the JSP 319 may be necessary under operational circumstances. However, as many of the regulations and procedures contained within the JSP are derived directly from legislation, exemption from the regulations would require the approval of the Secretary of State for Defence.

SECTION 3 – FORMAT

Parts. The JSP 319 consists of three main parts.

Chapters. Each part is divided into a number of chapters covering specific aspects of gas storage,handling and use, and where possible, will be based on prime source documents which will be sign-posted.

Sections. Each chapter is, in turn, divided into several sections, the first section will cover the scope of the chapter and where necessary provide any exceptions. Within Part 1 and 2, where it is necessary, a bibliography will list the prime sources of information at the end of each chapter. Within Part 3 there is a single bibliography located at the end.

Paragraphs. To ease identification and cross-referencing of paragraphs, each paragraph is numbered so as to indicate its precise relation in the publication, e.g. paragraph 1.2.3.45 is in Part 1, Chapter 2, Section 3, as the fourty fifth paragraph.

Figures and Tables. Figures and tables are identified with their position in this publication, e.g. Table 1.4.3 is in Part 1 Chap 4 as the third table.

SECTION 4 – EDITORIAL

JSP 319 is published under the management control of DFG as the MOD Regulations for storage, handling and use of gases. The chairman of the JSP 319 Working Group is responsible for the editionial content of this publication.

Editorial Working Group. An editorial Working Group is responsible for reviewing the content of JSP 319: see Table 1.

Table 1: Composition of JSP 319 Editorial Working Group.

Department	Technical Authority – Gases
Fuels Safety Assurance Team	Safety 3 – Chairman JSP 319 WG
	Safety Assurance – Secretary and Editor of JSP 319
	PST
Defence Fuels Group (DFG)	SCM SC Mgr
	SCM Inv Mgr 2
	Technical Team Manager
Defence Equipment & Support (DE&S)	M&GS Team – Medical Gases Techniccal Officer
	AC PT, GSE1d
	AC PT, GS1d1
	DSCOM, DMTPD, DGHSG
Royal Navy	DES SHIPS FEW MET RA 2b
Army	HQ LF - SO2 Cbt Fuels - Log Sp
	HQ LF – D Infra Sp Utilities Accounts Manager
Royal Air Force	HQ Air - SO2 A4 Ops Sp 1(Fuels)
Defence Estates	Construction Support Team - Senior Mechanical Engineering Adviser
	Fire Safety Officer
Defence Support Group	DSG Stafford – CGS Manager

Amendments. Amendments will be issued whenever required to reflect changes in legislation or other source documents. Proposed amendments to JSP 319 should be submitted through existing staff channels to the Editor of JSP 319. A proforma requesting an amendment change to JSP 319 is in the Prelim Section.

SECTION 5 – REPORTING AMENDMENTS IN JSP 319

Purpose

The purpose of this information is to provide users at all levels with a means of reporting unsatisfactory features in the JSP 319 and proposing an amendment. Reports are to be submitted using the MOD Form 765 as per Annex A.

Originator of report

Originators of reports are to raise one copy of the report. Once satisfied that the report contains all relevant detail, it is to be forwarded to the JSP 319 Editior Table 1. There is no requirement to provide a covering letter or additional correspondence with the report, unless the originator believes amplification of the report is necessary to assist the JSP 319 WG.

Action by JSP 319 WG

On receipt of the report, the JSP 319 WG is to investigate the content of the report and, if necessary, initiate amendment action through the Chapter Sponsors and the Editor of JSP 319. On completion the Editor is to return the original to the originator.

SECTION 6 – LEGISLATION

The Secretary of State for Defence requires that all employees, as far as reasonably practicable, comply with Legislation and Accepted Code of Practice concerning the health, safety and welfare of themselves and others, regardless of any exemption which may apply to the Ministry of Defence. This statement is produced in *Volume 1, Annex 2A to JSP 375 MOD Health and Safety Handbook Edition 3*.

The design, construction, maintenance, and operation of gas installations are governed by several pieces of important legislation. Of particular relevance are Regulations enforced under the primary legislation (Acts) for health, safety, and the environment. Further information can be obtained from the legislation below:

a. **Environmental Protection Act 1990**. Produced in 2 parts (Part I and II), and outlines the principles underlying the UK approach to pollution control across all environmental media.

b. **Health and Safety at Work, etc, Act 1974**. Places duties (e.g. duty of care) on defined individuals to ensure minimum health and safety standards at work; and general duties on all staff to take reasonable care of their own health and safety, not to intentionally or recklessly interfere with safety equipment and to cooperate with their employer to enable the employer to comply with his duties of care.

c. **Health and Safety At Work, etc, Act 1974 (Application to Environmentally Hazardous Substances) Regulations 2002, *(SI 2002 No 282).*** Provides a legislative link between health, safety and environmental issues concerning hazardous substances.

d. **Chemical (Hazard Information and Packing for Supply) Regulations 2002**, ***(SI 2002 No 1689& Amdt SI 2005 No 2571).*** Known as CHIP III and aims to ensure that purchasers, handlers and users of hazardous chemicals are provided with sufficient hazard information to protect their health and safety.

e. **Confined Spaces Regulations 1997, *(SI 1997 No 1713)***. Defines confined spaces and imposes controls on access.

f. **Construction (Design and Management) Regulations 1994, *(SI 1994 No 3140)***. Known as CDM, it imposes health and safety controls on construction projects that fall within the scope of the Regulations.

g. **Control of Major Accident Hazards Regulations 1999, *(SI 1999 No 743)***. Known as COMAH, it is implemented within the MOD through the Major Accident Control Regulations (MACR).

h. **Control of Substances Hazardous to Health Regulations 2002, *(SI 2002 No 2667*;** and the **Health and Safety - Control of Substances Hazardous to Health (Amendment) Regulations 2004, *(SI 2004 No 3386).*** Collectively, known as "COSHH" and covers exposure to most hazardous substances.

i. **Dangerous Substances (Notification and Marking of Sites) Regulations 1990, *(SI 1990 No 304).*** These Regulations apply to sites holding certain quantities of listed substances. Its main aim is to ensure site access for fire fighting services.

j. **Dangerous Substances and Explosives Atmospheres Regulations 2002, *(SI 2002 No. 2776*).** Known as DSEAR, it imposes requirements of eliminating or reducing risk from fire, explosion or other events arising at work from the hazardous properties of a dangerous substance. It supersedes previous regulations specifically concerned with highly flammable liquids and LPG.

k. **Environmental Protection (Controls on Substances that Deplete the Ozone Layer) Regulations 1996, *(SI 1996 No 506)*.** Produced in accordance with the international agreement known as the Montreal Protocol.

l. **Environmental Protection (Prescribed Processes and Substances) Regulations 1991*(SI 1991 No 472)*.** Identifies and restricts the use of named substances.

m. **Gas Safety (Installation and Use) Regulations 1998, *(SI 1998 No 2451) (corrections October 1998 and February 1999)*.** These Regulations cover the installation, maintenance and use of gas systems.

n. **Management of Health and Safety at Work Regulations 1999**, ***(SI 1999 No 3242 &Amdt SI 2002 No 2979).***

o. **Manual Handling Operations Regulations 1992 *(SI 1992 No 2793)*.**

p. **Notification of Installations Handling Hazardous Substances Regulations 1982, *(SI 1982 No 1357)*.** Under these Regulations the HSE must be notified of premises wherever substances listed in the Regulations may be present in the quantities stated.

q. **Personal Protective Equipment at Work Regulations 1992, (as amended) *(SI 1992 No 2966).***

r. **Planning (Control of Major Accident Hazards Regulations) 1999, *(SI 1999 No 981)*** and the **Health and Safety – The Control of Major Accident Hazards (Amendment) Regulations 2005, *(SI 2005/1088)*.** Although legally exempt from these Regulations, the MOD complies through its Major Accident Control Regulations (MACR).

s. **Pressure Systems Safety Regulations 2000, *(SI 2000 No 128)*.** Fixed installations require a suitable written scheme of examination. In addition, those responsible for the management and use of all installations need to be able to demonstrate that they know the operating pressures of the installations and that they are safe to operate at those pressures.

t. **Provision and Use of Work Equipment Regulations 1998, *(SI 1995 No 3163)*.** Known as PUWER, it provides requirements for the provision of safe work equipment and its safe use, irrespective of age or place of origin.

u. **Regulation (EC) No 1907/2006 OF The European parliament and of The Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)**, establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC. This imposes obligations on Manufacturers, Importers (into the EU), Downstream Users (and Distributors, Retailers and Storage Providers) of certain substances. These requirements are being phased in over the period 1 June 2007 to 31 May 2018.

v. **Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995, *(SI 1995 No 3163)*.** Known as RIDDOR, it provides a mechanism by which certain categories of work related injuries, diseases, and dangerous occurrences are reported to the Health and Safety Executive.

w. **The Carriage of Dangerous Goods and use of Transportable Pressure Equipment Regulations 2009, (*SI 2009 No 1348*).** This requires compliance with the UN regulations for the carriage of dangerous goods.

BIBLIOGRAPHY

1. ISO 10286 - *Gas Cylinders, Terminology*.

2. BS EN ISO 13769:2006 - *Gas Cylinders. Stamp marking*.

3. HSE Guidance Note CS 4 - *The Keeping of LPG in Cylinders and Similar Containers*.

4. *Pressure Systems Safety Regulations*, 2002.

5. ISO 11117 - *Gas cylinders - Valve Protection Caps and Valve Guards for Industrial and Medical Gas Cylinders - Design, Construction and Tests*.

6. *European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)*.

7. BS EN 1800 - *Transportable Gas Cylinders. Acetylene Cylinders. Basic requirements and Definitions*.

8. BS EN 1919 - *Transportable Gas Cylinders – Cylinders for Liquefied Gases (excluding acetylene and LPG) - Inspection at Time of Filling*,

9. BS EN 1920 - *Transportable Gas Cylinders – Cylinders for Compressed Gases (excluding acetylene) - Inspection at Time of Filling*.

10. BS EN 50020 - *Electrical Apparatus for Potentially Explosive Atmospheres. Intrinsic Safety 'i'*.

11. BS 8478 - *Respiratory Protective Devices – Breathing Gases for Diving and Hyperbaric Applications*.

12. HSE HS(G)51 - *The Storage of Flammable Liquids in Containers*.

13. BCGA Guidance Note GN 2 - *Guidance for the Storage of Gas Cylinders in the Workplace*.

14. BCGA Guidance Note GN 15 - *Managing Gas Cylinders Involved in a Fire*.

15. BCGA Code of Practice CP 36 - *Bulk Cryogenic Liquid Storage at User's Premises*.

16. Defence Works Safety Rules and Procedures - *SRP-CER - MOD Safety Rules and Procedures Common Elements & Requirements*.

17. Defence Works Safety Rules and Procedures - *Petroleum. SRP 03 - MOD Safety Rules and Procedures for Work on Petroleum Installations*.

18. MOD JAP 100A-01 - *Military Aviation Engineering Policy, Regulation and Documentation*.

19. MOD JSP 375 - *Health & Safety Handbook*.

20. MOD JSP 815 – *Defence, Environment & Safety Management*

21. DBR 1754 - *Safety Regulations for Storing and Handling Petroleum Oils, Lubricants and Certain Other Hazardous Stores in HM Ships*.

22. Defence Standard 68-284 - *Compressed Breathing Gases for Aircraft, Diving and Marine Life-Support Applications*.

ANNEX A

MOD Form 765 (Rev Jul 02)

Unsatisfactory Feature Report

Originating Unit

Title / Address

Date (dd/mm/yyyy)

Reference

Unit Point of Contact & Ext

Publication Reference: JSP 319

Amendment/Revision/Issue State: 3rd Edition, AL4

Title: Joint Service Safety Regulations for the Storage, Handling and Use of Gases.

Element

Part 1 – Originators Report

Unsatisfactory feature(s):

Recommend Change (include continuation sheet(s) if necessary):

☐ I know of no other publications that may be affected by this recommendation.

☐ Other publications affected/further effects* have been reported at:

Originator's Signature	Rank/Grade and Name	Tel No	Appointment	Date

Part 2 – Specialist Officer, User Authenticator or Authorised Individual's Report*

Passed to TD Sponsor: Info copy(s) to:

Signature	Rank/Grade and Name	Tel No	Appointment	Date

✓ Tick box as required * Delete as appropriate

Part 3 – Technical Document Sponsor (FAST Safety 3

- ☐ Information copy to other Service Co-users.
- ☐ Report has maintenance implications.
- ☐ Report agreed, passed to PA for action as recommended.
- ☐ Report not agreed, returned to Originator for the reasons given below.
- ☐ I know of no other publications that may be affected by this recommendation.
- ☐ Other publications affected/further effects*have been reported at: ______

Comments: (Include continuation sheet(s) as necessary):

Date Unit Feedback dispatched ______ Passed to Publication Authority on ______

Signature	Rank and Name	Tel No	Appointment	Date

Part 4 – Publication Authority (Editor)

- ☐ Interim report issued, Ref ______ Dated ______
- ☐ Temporary amendment issued, formal amendment will follow.
- ☐ Recommendations will be actioned in Amdt/Issue/Rev* ______ to be issued ______
- ☐ Recommendations NOT / PARTLY* agreed, see remarks below.
- ☐ I know of no other publications that may be affected by this recommendation.
- ☐ Other publications affected have been reported at: (MOD F765 Ref)

Remarks:

Copy returned to TD Sponsor, Info copies to ______ (Originator), ______ (FLC) & ______

Signature	Rank/Grade and Name	Tel No	Appointment	Date

✓ Tick box as required * Delete as appropriate.

Part 1

Chapter 1 (Sponsor - FSAT Safety 3)

MOD FUELS & GASES ORGANISATION

SECTION 1 – SCOPE

1.1.1.01 This chapter provides information on the MOD Fuels and Gases organisation, the Head of Defence Fuels Group responsibilities and the Defence Fuels Group Management Board.

SECTION 2 – GENERAL

1.1.2.01 **The Defence Fuels and Gases Environmental Safety Board (DFG ESB)**. The DFG ESB exists as a safety board established under the authority of 2 PUS in accordance with the Secretary of State for Defence Policy statement and JSP 815, Defence Environment and Safety Management. The DFG FSB takes direction and reports to the Defence Environment and Safety Board (DESB) chaired bi-annually by 2nd PUS. The DFG FSB provides pan-departmental direction on fuels, gases and lubricants safety and environmental policy and ensures the continual effectiveness of the MOD Safety Management System. It provides assurance to the Secretary of State that procedures and processes for the safety and environmental management of fuels, gases and lubricants are defined and are effective across MOD and TLB interfaces (especially the relationship with Front Line Commands (FLC) and the Permanent Joint Headquarters (PJHQ)). In particular the tasks of the DFG ESB include:

a. Sponsorship and setting of gases safety policy, standards and procedures as described in JSP 319.

b. Assisting the Defence Estates Competent Authority and the Competent Authority for Major Accident Control with the interpretation of gases related risk management and safety policy direction.

c. Monitoring the FLC's and PJHQ's compliance with JSP 319, Air Safety Publications and other safety legislation applicable to fuels, gases and lubricants.

1.1.2.02 **Management of Fuels, Gases and Lubricants within the MOD**. Management of Fuels, Gases and Lubricants within the MOD is exercised by the Defence Fuels Group (DFG), which is a fully vested business grouping within Defence Equipment & Support (DE&S). The DFG is commanded by a military officer of 1* rank and reports through the 2* Director Joint Support Chain (D JSC), the 3* Chiefs of Materiel (CofM) – Fleet, Land and Strike to the 4* Chief of Defence Materiel (CDM). The DFG is the tri-service focus for all matters involved with the management of Fuels, Lubricants and Gases.

1.1.2.03 **DFG**. The Head of DFG has delegated responsibility for policy regarding the storage and handling of gaseous products, to meet the MOD requirements in peace and war. The Head of DFG is the tri-Service manager of aviation petroleum products, ground fuels, oils, lubricants and gases. Additionally, the Head of DFG is directly responsible to Vice Chief Defence Staff (VCDS) for petroleum policy in the unified overseas commands (Cyprus, Falkland Islands and Gibraltar). Particular responsibilities include:

a. Tri-Service provision of aviation and ground fuels, aviation, ground and marine lubricants and gases.

b. UK Government Pipelines and Storage System (GPSS).

c. QA authority for aviation F&L and compressed gases.

d. General and technical policy on the storage, handling and distribution of fuel and gas products in peace and war, including the implementation of the Montreal Protocol.

e. Detailed policy on fuel and gas accounting, training and pollution control aspects of fuel and gas products.

f. Assist in planning the distribution of fuel and gas to support tri-Service units in peace and war, including advice to operational commanders on field petroleum organisations.

g. Operational requirements for fuel and gas handling equipment and fuel vehicles.

h. The exchange of requirements and data with NATO, EAPC (Euro Atlantic Partnership Council) and ABCA (American British Canadian Australian) countries, the Energy Institute and the petroleum industry.

i. Co-ordination and liaison with other Government departments and MOD TLBs on all fuel and gas matters.

1.1.2.04 DFG Liaison With Other Agencies. The DFG has representation on many international, national, industrial, NATO and inter-governmental committees and working groups associated with all aspects of F&L business. This ensures that the needs of the MOD are considered when international and national policy changes, legislation and regulation is being defined and also ensures that the MOD is kept abreast of any changes which will affect our F&L operations.

1.1.2.05 **MOD Focal Points**. The MOD and 3 Services have specialist staffs to represent the needs of their Organisation to the DFG, to disseminate policy and to act as the general focus for their units. The focal points for gas matters within each Organisation is as follows:

a. RN – N4 LOGS CAP E SO2
FLEET AV ESS SO2
FLEET N4 E RFA ME SO3

b. Army – HQ LF– SO2 Cbt Fuels – Log Sp (for IG)
HQ LF D Infra Utilities – Utilities Accounts Manager (for LPG)
HQ JHC – J4 Spt Log Sp SO3

c. RAF – HQ Air – A4 Ops Spt Fuels SO2

1.1.2.06 **Fuels & Gases Support for Operations**. Whilst each Service is primarily responsible for planning the support of its own forces, for joint operations there are well defined divisions of responsibility between the 3 Services which reflect their particular attributes and capabilities.

1.1.2.07 **Crisis or War**. In crisis or war, the fuels staffs of the DFG, together with personnel from the Oil Industry Emergency Committee (OIEC) and the US Air Force, man the Defence Fuels Operations Centre (DFOC). DFOC is based within the HQ DFG and, depending on the nature of the crisis, representatives from DFOC may deploy to the MOD JOC Defence Logistics Cell.

1.1.2.08 **The Defence Fuels Group Management Board**.The DFG Management Board is the primary authority for the conduct of Defence fuels and gases business encompassing fuels handling equipment, fuels, lubricants and compressed gases. It is sponsored by DE&S and empowered by the Defence Council through CDM. CDM has delegated responsibility for the Defence Fuels Logistic Process to Head of DFG and with this, the authority to chair the DFG Management Board. It takes place 6-monthly. The DFG Management Board has the following tasks:

a. To set policy and provide the expert technical focus for fuels, lubricants and gaseous matters in Defence.

b. To monitor the performance of the support chain in meeting the needs of the front line commands.

c. To foster the performance of best practice throughout the Defence fuels business, and ensure that the policies and procedures converge between the three Services. Where tri-Service convergence is technically or operationally impractical, the DFG Management Board is to note and authorise peculiar or divergent procedures.

d. To ensure that the Department conducts its fuels business in accordance with such national, EU and international laws, obligations and agreements as apply over time.

e. To ensure the integration of all elements of Deployable Bulk Fuel Installations (DBFI) and to ensure compatibility with the fixed fuels infrastructure and with current and future fuels.

f. To act as the regulatory authority for the operation of MOD owned/controlled fuels facilities and the use of equipment and distribution systems.

g. To be the technical authority for products to enable customers to meet their Defence Missions using the following sponsors for product specifications:

(1) The DFG for joint service, air and land products.

(2) CofM (Fleet) for the certain specific marine products.

h. To sponsor studies, projects and links with industry in order to obtain best value in the delivery of Defence Capability, and to facilitate innovation.

i. To set and monitor progress against the programmes of work of its subordinate committees and Working Groups details of which are in paragraphs 1.1.2.08 and 1.1.2.09.

j. To provide advice to the Department, through DE&S, on any matter within its area of responsibility.

k. Develop, maintain and publish MOD regulations for *Petroleum Storage and Handling - JSP 317*, and *Gas Storage, Handling and Use - JSP 319*.

1.1.2.09 **DFG Management Board Sub-Committees**. Much of the DFG Management Board work is committee based and it has 3 standing sub-committees. These sub-committees manage discreet areas of the MOD's fuels and gases business and are: the Environment, Safety & Training Sub-committee (ES&TSC), the Equipment Sub-Committee (ESC), and the Products Sub-Committee (PSC).

1.1.2.10 **DFG Management Board Working Groups/Parties**. Certain aspects of evolving policy or specific topics require in-depth staffing through the single-Service focal points under the direction of the DFG Management Board. Where this is necessary, a working group or party is formed from members of the DFG Management Board or its Sub-Committees and co-opted staffs. An example of this is the JSP 317 Editorial Working Group of the ES&TSC.

1.1.2.11 **Support Solutions Envelope**. A Support Solution is the plan that a project team develops during the acquisition of an equipment or capability that details how the support and maintenance of that equipment or capability will be sustained, wherever it is deployed, throughout the life of the equipment, right up to disposal. The Support Solutions Envelope (SSE) identifies the support policies that are deemed so critical to defence that a project team must consider them when developing a support solution for an equipment or capability. The appropriate use of gases is essential if military capability is to be generated and sustained. Policy, information and guidance on the Support Solution aspects of UK MOD Defence Acquisition is available on the Defence Intranet at: http://www.aof.dii.r.mil.uk/aofcontent/tactical/sse/index.htm.

The policy relating to gases is detailed in:

a. Key Stage Area 3 – Supply Chain Management.

b. Governing Policy 3.6 – Fuel Lubricants and Industrial Gases.

Part 1

Chapter 2 (Sponsor - DFG SCM INV Mgr 2)

SINGLE SERVICE GAS ORGANISATIONS

SECTION 1 – SCOPE

1.2.1.01 This chapter provides information on the individual services gas organisation and details their responsibilities.

SECTION 2 – ROYAL NAVY GAS ORGANISATION

1.2.2.01 DFG is responsible for developing, publishing and implementing policy for contractual supply of gas products to FLEET units.

1.2.2.02 **Units**. Customer Liaison sections at each of the three Naval Bases (Portsmouth, Devonport and Clyde) are responsible for processing demands from RN and RFA units for liquid and compressed gases via the DFG sponsored contract. The Naval Base logistics organisations are responsible for the receipt, issue and returns processing of compressed gas cylinders and monitoring of liquefied gases deliveries from the contractor. Appropriately trained technical personnel are responsible for the operation and maintenance of gas production, concentration and dispensing equipment.

SECTION 3 – ARMY GAS ORGANISATION

1.2.3.01 **Front Line Command**. DFG has responsibility for the implementation of policy pertaining to liquefied and compressed gases within the Army including units of the Adjutant General, GOC Northern Ireland, Army units of the JHC, units of the Field Army and the Defence Training Estate (DTE). This is carried out by Log Sp Division for IG and HQ LF D Infra Sp Utilities Account Manager for LPG. Both these branches have responsibility in conjunction with DFG for the provision of advice on the supply of gases. The HQ LF D Infra Sp is responsible for co-ordinating and planning the supply of LPG to operational theatres. LAND Log CSS Ops is responsible for the co-ordination and planning the supply of IG to operational theatres. Log Sp Division is responsible for undertaking Logistic Support Inspections, which includes operating and maintenance procedures within the Army. LAND Petroleum Inspectorates are responsible for undertaking Logistic Support Inspections (LSI), and Logistic Support Technical Inspections (LSTI), Specialist Petroleum Inspections (SPI) and regime inspections. These cover the storage, handling, operating and maintenance procedures within LAND and contribute to generating firepower.

1.2.3.02 **Units**. Unit Quartermasters are responsible for ordering of gases, in both liquid and compressed forms, either from the DFG sponsored gas contract or the HQ LF D Infra Sp sponsored LPG contracts. They are also responsible for the receipt, issue and return of compressed gas cylinders and monitoring of liquefied gas deliveries from the current DFG contractor or the departments LPG contractors. The Army rules for accounting for LPG are contained in the Army Infrastructure Manual Leaflet available on the LF D Infra Web site . Accommodation Services Units are responsible for the receipt, validation and payment of all LPG both bulk and cylinders. They are also responsible for the management of Calor Cards for the procurement of LPG cylinders except in NI where the responsibility lies with CSS.

Note: The provision and accounting of Utilities including LPG has been removed from JSP 886 pending the issue of a new Infrastructure JSP covering the subject. Presently therefore the single service regulations that were replicated in JSP 886 are extant until such time that LF D Infra Sp drafts the new JSP.

SECTION 4 – ROYAL AIR FORCE GAS ORGANISATION

1.2.4.01 **Front Line Command**. DFG has responsibility for implementing policy pertaining to liquefied and compressed gases within the RAF, including units of Air Command, Joint Helicopter Command (JHC) and other Directly Administered Units. The HQ Air Support Engineering Role Office (RO) has responsibility for the fleet management of, and provision of operation and engineering advice on, in-service gas production and gaseous equipment in conjunction with the Aircraft Commodities Project Team (AC PT), the Support Authority for such equipment. The DFG has responsibility for the provision of advice on the supply of gases. The HQ Air Logistics Support Centre (LSC) is responsible for co-ordinating and planning the supply of gases to operational theatres.

1.2.4.02 **Units**. Unit Supply staffs are responsible for the ordering of gases, in both liquid and compressed forms, from the DFG sponsored gas contract. They are also responsible for the receipt, issue and return of compressed gas cylinders and the monitoring of liquefied gas deliveries from the current DFG contractor. Competent engineering tradesmen are responsible for the operation and maintenance of gas production, concentration and dispensing equipment.

1.2.4.03 **Deployable Gas Cylinders - Options**.

a) Movement of cylinders between the UK and overseas locations. Units are to demand cylinders via the current contractor using normal demand procedures. Where appropriate units may request cylinders be delivered direct to the designated APOE/SPOE for despatch to theatre. Demanding units/LFPs are responsible for liaison with the Supply Sqn at the receiving APOE/SPOE for the provision of receipt checks, supply accounting procedures and raising applicable movements documentation. Movement of consignments is to be in accordance with extant movements bidding procedures.

b) There is a possibility that the contractor can enter into a partnership contract with a local supplier to provide gas to the relevant standards. FLC staffs/Units (as applicable) that may require this service are to contact the DFG to discuss their requirements and to determine if a local supplier is a suitable option.

c) In certain circumstances the Air Separation Unit (ASU) may be deployed in accordance with paragraph 1.2.4.04. In this instance the DFG contractor is able to provide cylinders that can be re-filled using the ASU. The permission of the owner of the cylinders, as well as DFG, has to be obtained before refilling can take place. All DFG supplied cylinders which are refilled from the ASU are to be managed and controlled in accordance with the procedures detailed within Part 2, Chapter 5.

Note: Where units are aware in advance of a requirement to provide gas for an exercise or deployment they are to inform the DFG at the earliest opportunity to ensure supplies can be made available.

1.2.4.04 **Deployable Gas Production**. The RAF maintains a capability to provide gases to aircraft deployed on operations. The Air Separation Unit (ASU) is an air transportable liquefied gas production unit maintained at operational readiness by Cryogenics & Gas Section (CGS), DSG Stafford. Engineering support is provided by CGS to any ASU deployed in a non-hostile environment with training for Service personnel conducted by the Cryogenic and Gas Maintenance School, (CGMS) DSG Stafford. 5001 (Expeditionary Airfield Facilities (EAF)) Squadron is responsible for the deployment and installation of the ASU, and if necessary its supporting generator working in close conjunction with 170 (Infra Sp) Engr Gp who design and construct the base. The operation and maintenance of deployed ASU assets is undertaken by trained personnel of the deployed Unit once it has been installed by 5001 Squadron. Tasking of 5001 Sqn is undertaken by the HQ Air Support Engineering RO in liaison with HQ Air LSC, PJHQ and AC PT staffs, as appropriate. Only personnel who have successfully completed the ASU training courses and whose qualification remains current are allowed to operate and maintain this equipment. Relevant qualifications are Q-GE-PCI(OP), Q-GE-PCI(I) and Q-GE-PCI(QA).

Part 1

Chapter 3 (Sponsor - DFG SCM INV 2)

PROCUREMENT OF GENERAL GASES

SECTION 1 – SCOPE

1.3.1.01 This chapter details the procedures to be followed when ordering or returning gases, gas cylinders, liquefied and cryogenic gases and their associated containers controlled by the DFG. It does not include medical gases (see Part 1, Chapter 4) or LPG (see Part 1, Chapter 5).

SECTION 2 – GENERAL

1.3.2.01 The Gases Organisation within the DFG provides supply, technical and scientific support for the management of General Gases. The structure of this organisation can be found in Annex A.

1.3.2.02 Contractor supplied cylinders. Whilst the DFG is responsible for ensuring the supply of gas cylinders through the current MOD contract, Units are solely responsible for the accounting of all cylinders from point of delivery until return to contractor. Delivered cylinders are allocated to individual Unit accounts by the DFG contractor and rental charges are made to these accounts on a monthly basis. If, for any reason, cylinders are transferred to another user it is the Unit's responsibility to ensure that this issue is undertaken through the stores system and that the DFG contractor is informed. The cost of replacing cylinders subsequently identified as 'lost' will fall to the holding Unit's budget.

1.3.2.03 Instructions for the accounting, ordering and disposal of Industrial Gases can be found in *JSP 886, Vol 2, Part 5 - The Defence Logistics Support Chain Manual*.

1.3.2.04 All the gases (including liquefied and cryogenic gases e.g. liquid oxygen) and their respective containers, provided through the direct supply contracts, have been managed to ensure their conformance with the appropriate technical standards, compliance with legislation and their compatibility with in-service equipment. Provision of these commodities from a central contract ensures commonality of the product wherever MOD units are operating and provides best value for money for the MOD as a whole. Without exception, all MOD units are to obtain all gases and associated containers from the DFG contract. Where this may not be practical, units are to agree alternative arrangements with the DFG. Further detailed policy is available in the Support Solutions Envelope. Part 1, Chapter 1, Section 2 refers.

1.3.2.05 The DFG has a direct supply contract for the supply of gases and associated containers. Details of the contractor and contact details are at Annex A.

Notes:
1. Medical gas cylinders are listed separately at Part 1, Chapter 4, Annex B.
2. LPG cylinders are listed separately at Part 1, Chapter 5, Annex B.

1.3.2.06 The DFG and the Gas Supply Contractor have set up a joint website that displays current product information, Safety Data Sheets and other relevant safety information.

Details of this website can be found at Annex A.

1.3.2.07 **Safety Data Sheets**. The supplier of a dangerous substance or dangerous preparation is required to provide a Safety Data Sheet. All gases require a Safety Data Sheet. All Units holding gas cylinders are to ensure that they have a copy of the current Safety Data Sheet for the gas within and that it is made available to all personnel handling or using the gas cylinder. Safety Data Sheets are available for all dangerous substances or dangerous preparations, including gases, within JSP 515. DFG will ensure that there is a Safety Data Sheet for all gases which are available via its supply contracts within JSP 515. For gases that are not procured via the DFG, the procurement organisation / user is responsible for providing a current Safety Data Sheet and for populating JSP 515.

Notes:
1. JSP 515 is controlled by DSCOM DMTPD.
2. JSP 515 is available on the Defence Movements & Transport policy division website via the Defence Intranet at http://www.transportsafety.dii.r.mil.uk.

1.3.2.08 **Support to Exercises and Routine Deployments**. Units requiring any gases from the direct supply contract in support of exercises or routine deployments are required to notify the DFG within the time scales set out below:

a. General gas – a minimum of one months' notice is required for Squadron and Regiment level exercises/deployments within the UK. A minimum of three month's notice is required for Brigade and larger formation exercises/deployments and for all exercises/deployments outside the UK.

b. Bulk liquid gas – a minimum of three months' notice is required for all exercises/deployments requiring provision of bulk liquid gas.
Notification of requirements is to be made using the form on the JSP 319 website.

1.3.2.09 **Support Solutions Envelope**. When developing, and to sustain, a support solution for a particular project or item of equipment the appropriate use of gases is essential. All project teams are to follow the policy, information and guidance within the defence acquisition support solutions envelope. Refer to 1.1.2.11.

SECTION 3 – STANDARD ORDERING PROCEDURES

1.3.3.01 **United Kingdom Ordering Procedure**. For all MOD United Kingdom requirements, units are to place demands by telephoning the DFG Contractor detailed in Annex A.

1.3.3.02 **HM Ships and Royal Fleet Auxiliary**. For the Royal Navy and Royal Fleet Auxiliary, demands are to be placed through the appropriate Naval Base Customer Liaison section dependent upon the ship location at the time the requirement arises. This should, therefore, be via:

a. The Naval Base at which they are berthed.

b. The Naval Base nearest to the ships location i.e. when berthed at commercial facilities, or anchored at sea.

c. If transiting to another UK location, the nearest Naval Base to that location.

Note: Cylinders will be delivered within contracted timescales to the demanding Naval Base and it is their responsibility to arrange onward transportation to the vessel where needed.

Contact telephone numbers for the Naval Base Customer Liaison sections are:

a. Portsmouth (including Marchwood) GPTN: 9380 23481, BT: 023 92 723481.

b. Devonport (including Portland) GPTN: 9375 65552, BT: 01752 555552.

c. Clyde: 93255 6262, BT: 01436 676262.

1.3.3.03 All Refrigerants and Halons are demanded using the Montreal Protocol Substances procedures detailed in paragraph 1.3.5.05.

1.3.3.04 The DFG Contractor will attempt to satisfy demands for gases to UK destinations within 48 hours from the day of request. Pipeline times for specialist, calibration and diving gas will be longer. A list of gases available on this contract can be found at MOD/Contractor website detailed at Annex A.

1.3.3.05 When placing an order, units are to quote the following:

a. Ministry of Defence Requirement.

b. Direct Supply Contract Number.

c. Unit Identity Number (UIN).

d. Customer Account Number. All Unit Account Numbers previously held with the DFG contractor will remain the same. New customers will be allocated with a Customer Account Number when the first demand is placed.

e. SPC.

f. Required Delivery Date.

g. Delivery location and a contact telephone number.

1.3.3.06 **Supply of cryogenic liquids**. Units are responsible for monitoring cryogenic storage tank contents and informing the DFG Contractor when replenishment is necessary. Where Units have Contractor owned cryogenic storage tanks installed which incorporate remote monitoring devices, routine replenishment of the tank is the responsibility of the contractor. However, whilst this system should maintain tank levels under normal usage, the unit will remain responsible for placing demands with the DFG Contractor to cover *ad hoc* surge demands. All deliveries are to be accounted for via the Unit supply / F&L section. For detailed information on cryogenic liquids and their associated storage tanks refer to Part 2, Chapter 10.

1.3.3.07 **Overseas Ordering Procedure (Excluding Operations and Bases in**

Germany). All overseas commands are to demand directly from the DFG contractor, detailed in Annex A. HM Ships and RFAs are to follow the procedure as detailed for UK. Upon placing demands commands will be required to clearly state the following:

a. Ministry of Defence Requirement.

b. Direct Supply Contract Number.

c. Customer Account Number.

d. Full Overseas Postal Address.

e. Unit Identity Number (UIN).

f. MOD Demand Priority (SPC) and Required Delivery Date.

1.3.3.08 Any overseas commands that have not previously ordered gas via the DFG contract are to contact the DFG for advice and authorisation. Contact details are at Annex A.

1.3.3.09 All overseas issues will be made via the Hazardous Airfreight Section, Joint Support Chain Services (JSCS), Bicester. Overseas units should, routinely, hold only enough stock to cover the delivery period from Bicester to unit, ensuring that a small buffer stock is maintained to allow for extended pipeline times.

1.3.3.10 **Demand Procedure for Operations.** Demands in support of Operations are to be placed through the DFG SCM INF Mgr 2 desk. Demands should be submitted by fax or e-mail. All demands are to be confirmed by telephone within 48 hours. Issues will be made via Bicester, as detailed in Paragraph 1.3.3.08 and returns should be made as detailed in Paragraph 1.3.4.01b. All queries regarding support to Operations should be made through the SCM INF Mgr 2 desk, or alternatively via the DFG SO2 Fuels Operations (Mil: 94379 4357; Civil: 01202 654357). Contact details for the DFG are at Annex A.

1.3.3.11 **Demand Procedure for Bases in Germany** 1-3-4 **.** Provision has been made for MOD units based in Germany to be supplied with General Gases direct. Demands should be placed direct upon 1UKXX, who will act as central POC, and deliveries will be made direct from Linde to users. Queries regarding this procedure should be made through 1UKXX-LogSp-CSups-FLMgr on Civ: 0049 (0)5221 995 3402 Mil: 94883 3402 or DFG, Annex A refers.

Note: It should be noted that these products are for use within Germany only.

1.3.3.12 **HM Ships and Royal Fleet Auxiliary**. For HM Ships, demands are to be placed through the home-port Naval Base Customer Liaison section as detailed in paragraph 1.3.3.02 For RFA ships, supply staff on board should select the demand input point, and where demand history is held, submit demands through the Naval Base Customer Liaison section supplying on previous occasions.

Note: Demands for transportation by sea freight container should be placed through HMNB Portsmouth.

1.3.3.13 **Tropical fill**. Due to the potential high temperatures in some overseas locations there is a danger that the internal pressure of a cylinder will rise, with increasing ambient temperature. To ensure that the cylinder internal pressure stays within the prescribed limits for that cylinder, the cylinder will be supplied with a 'Tropical Fill' which may be less than the normal 'full' condition supplied in the UK. A range of cylinders can be provided that are filled to this Tropical Fill standard. Mainly this affects only liquefied gases (e.g. CO_2, N_2O). Information detailing the fill standard of a cylinder is available on the cylinder spreadsheet (see MOD Contractor Website) or advice can be obtained from the contractor or DFG.

1.3.3.14 Any person demanding a gas cylinder for an overseas location is to ensure that it is to a Tropical Fill standard.

1.3.3.15 **Receipt and Issue checks**. Following all deliveries, and prior to all issues, checks are to be carried out to ensure all products are in a serviceable condition and the appropriate documentation is completed. Refer to Part 2, Chapter 9, Section 6.

SECTION 4 – STANDARD RETURNS PROCEDURES

1.3.4.01 **Return of Empty and Surplus Cylinders**. All DFG Contractor owned cylinders are subject to demurrage or rental charges, the costs of which fall to the consuming unit. These charges remain in force until cylinders are returned to the DFG contractor. It is, therefore, the demanding unit's responsibility to ensure that all empty / surplus cylinders are returned to the DFG contractor. However, cylinders obtained from locally arranged contracts in operational theatres are not to be sent back to UK, but are to be returned to local contractors. Units are to comply with current Hazardous Waste Regulations and all applicable Transportation of Dangerous Goods Regulations (see Part 2, Chapter 8)

a. **United Kingdom Units**. The DFG contractor will collect empty cylinders as part of their normal delivery service. Units are to inform the DFG contractor when ordering gas that they have cylinders for return. If there are no deliveries planned, then units are to contact the DFG contractor and arrange a separate collection.

Note: The DFG Contractor will only collect cylinders for return where the unit has previously notified the contractor that there are cylinders to be collected. This allows the contractor to meet their legal responsibilities for the carriage of dangerous goods and ensures that the return of cylinders is correctly documented and recorded. Units are not to make ad hoq arrangements to return cylinders with the driver of the collection vehicle.

b. **Overseas Units**. Overseas units are to return empty and surplus cylinders via the JSCS Bicester, at the earliest opportunity. Units are required to ensure that cylinders are palletised for return and are to advise Bicester, upon shipment, of returns being made by faxing the form at Annex D to GPTN: 94240 8422 BT: 0044 1869 258422. UIN and account number are to be identified on all forms.

c. **HM Ships and Royal Fleet Auxillary**. Wherever possible, HM ships and RFA ships are to return all empty and surplus cylinders to one of the three main UK Dockyards. In the event of unavoidable off-loading of empty or surplus cylinders in any other ports HM ships and RFA ships are instructed to inform their homeport of the location, product codes and quantities of the cylinders concerned.

d. **Unserviceable cylinders**. Cylinders that are being returned as unserviceable, (i.e. cylinders being returned for reasons other than they are empty, part-full, life-expired or no longer required by a unit) are to be returned in accordance with the procedures detailed in Part 1, Chapter 6.

1.3.4.02 Units with arisings of empty LPG cylinders are to note that the point of contact for instructions is the HQ LF D Infra Sp Utilities Accounts Manager. For contact details see Part 1, Chapter 5.

1.3.4.03 **Disposal of Cylinders**. There are two routes for the disposal of cylinders.

a. All contractor owned cylinders, MOD owned cylinders containing refrigerant / MPS / controlled gases and cylinders falling under the 'stranger' cylinder policy are to be disposed by the DFG contractor. Further information can be obtained from DFG SCM.

b. All other MOD owned cylinders containing gases that are fit for transport are to be sent to DSG Stafford (CGS), ST18 0AZ using the form found on the JSP 319 website.

1.3.4.04 **Disposal of platforms and / or equipment containing gas cylinders**. When military platforms or equipment that contain gas cylinders are no longer required for use then all gas cylinders on that platform/equipment are to be accounted for and appropriate (safe) disposal action is to be taken.

1.3.4.05 All gas cylinders which are provided from a gas supply company under a rental agreement are to be returned to that gas supply company. The Support Authority responsible for the gas cylinder supply contract is to be informed. If the platform / equipment is to be sold as a going concern then it is the responsibility of the new owner to obtain suitable gas cylinders under their own contract arrangements.

1.3.4.06 Where MOD owned gas cylinders are in use on the platform / equipment, then the Support Authority responsible for the gas cylinders is to be identified and informed (for DFG owned cylinders see Annex A). Unless prior agreement is obtained from the Support Authority responsible for the gas cylinders to transfer ownership of the gas cylinders, all gas cylinders are to be removed from the platform / equipment and returned to stores.

1.3.4.07 **Stranger Cylinder Policy**. Under standard returns procedures the DFG Contractor will only collect gas cylinders for which they are the owner. Part 2, Chapter 3 provides information on identifying gas cylinders. Where the owner of a gas cylinder is not the DFG Contractor then the Unit is to contact the owner and arrange collection. Where the owner of a gas cylinder cannot be identified then the following procedure is to be adopted:

a. Segregate all unidentified cylinders from other stock. Inform DFG (See Annex A).

b. DFG will arrange for its contractor to provide an expert in cylinder identification who will make a site visit.

c. The DFG contractor will, as required, make the cylinder(s) safe, provide appropriate paperwork and arrange for collection/disposal.

WARNING: Cylinders which are in poor condition and/or are potentially unsafe are to be dealt with promptly. The Unit is responsible for ensuring that only safe cylinders remain on-site

Notes:
1. This process may incur a cost (to the user), depending on location and the amount of work involved.

2. Contact details for the major gas supply companies in the UK are detailed in Part 1, Chapter 9, Section 5.

SECTION 5 – ORDERING AND RETURNING CONTROLLED GASES

1.3.5.01 **Sulphur Hexafluoride (SF_6)**. Following recent and proposed changes to regulations, including the movements of hazardous substances, the DFG has put into place a new procedure to control the issue and return of SF_6.

1.3.5.02 **Ordering Procedure for SF_6**. Demands for all SF_6 products shall be made using the order/returns form (found at the JSP 319 website). Once completed the form must be faxed to DFG contractor, detailed in Annex A. The DFG contractor is contracted to meet routine and normal demands within 5 working days of receipt of order. A normal demand is defined as up to 16 cylinders that can be despatched as part of the standard delivery service provided by the DFG contractor. Demands for excessive quantities may attract a delivery charge which is payable by the demanding authority. Telephone demands for SF_6 products will not be accepted.

1.3.5.03 **Return of SF_6**. Units are instructed not to request ad hoc collection of SF_6 cylinders, including empties. Due to the nature of recovered substances all authorised SF_6 returns are to be dealt with in accordance with the current Hazardous Waste Regulations. All SF_6 products are to be recovered during maintenance procedures or when decommissioning or converting systems. They are to be decanted into the appropriate recovery cylinder, which can be demanded on the order form. All cylinders are to carry an Equipment Conditioning Label (e.g. MOD Form 731) identifying whether full or empty and the substance/quantity contained. Returns are to be annotated in the appropriate columns of the orders/returns form (found at the JSP 319 website). If part full/opened or recovery cylinders are being returned Units are also requested to complete the Cylinder Detail form found at the JSP 319 website. For product returns (reclaimed and virgin) Units are to ensure completion of the Premises Code in the Product Returns information box; this Code is unique to an individual Unit and can be obtained from the Unit Environmental Protection Officer, SHEF Advisor or CESO. Collection will be arranged by the DFG contractor after consultation with the Unit concerned. Any Units holding SF_6 products not identified on the order form (including old MOD cylinders) are instructed to inform DFG immediately so that collection can be arranged.

1.3.5.04 **Montreal Protocol Substances Bank (MPSB)**. The DFG has a contract with its contractor to manage the Montreal Protocol Substances Bank. The facility is authorised to hold specific quantities of Halon 1211 and Halon 1301, along with other controlled products (R236fa and R245fa). These products held by the MPSB are owned by nominated Service Focal Points (SFP). The purpose of the MPSB is to collect, reclaim/recycle, store and issue the products listed above for essential uses when authorised by the appropriate SFP. A list of SFP's can be found at Annex B. Other refrigerant gases are available on the gas supply contract, which are not controlled by the SFPs and which may also be stored at the MPSB. Additional information on the MPSB is located in *JSP 418, MOD Sustainable Development and Environment Manual*. Where only limited quantities of certain products are held in the MPSB, DFG, working with the SFPs, will control the issue of these products which will only be provided to MOD users who have declared an interest to DFG and then will only be issued on a priority basis

1.3.5.05 **Ordering Procedure for Montreal Protocol Substances and Refrigerants**. Demands for any products held by the MPSB must be faxed or emailed to the DFG (detailed in Annex A)using the order forms found within the JSP 319 website. Due to the nature of these substances the DFG contractor will meet routine and normal demands within 5 days of receipt of order. A normal demand is defined as up to 16 cylinders or less that can be despatched as part of the standard delivery service provided by the DFG contractor. Demands for excessive quantities and/or larger containers will be met within 8 days and requests for urgent delivery within 5 days, both will attract a delivery charge which is payable by the demanding authority. Telephone demands will not be accepted.

1.3.5.06 **Return of Montreal Protocol Substances and Refrigerants**. Units are instructed not to request ad hoc collection of MPS or other refrigerant cylinders, including empties. Due to the nature of the recovered substances all authorised returns are to be dealt with in accordance with the current Hazardous Waste Regulations. All product that is recovered during maintenance procedures, or from decommissioned or converted systems is to be offered to the DFG. Any product being recovered and returned is to be decanted into the appropriate recovery cylinder/drum which can be demanded on the order forms at found at JSP 319 website. All cylinders are to carry an Equipment Conditioning Label (e.g. MOD Form 731) identifying whether full or empty and the substance contained. If part full/opened or recovery cylinders are being returned Units are also requested to complete the Cylinder Detail form (found at the JSP 319 website). Returns of product should be submitted on the forms found within the JSP 319 website. Units are to ensure completion of the Premises Code in the Product Returns information box; this Code is unique to an individual Unit and can be obtained from the Unit Environmental Protection Officer, SHEF Advisor or CESO. Collection will be arranged by the DFG contractor after consultation with the Unit concerned.

1.3.5.07 **Ordering and Return of Controlled Gases by HM Ships and Royal Fleet Auxiliary.** For the Royal Navy and Royal Fleet Auxiliary, all demands and returns of controlled gases are to be made through the appropriate Naval Base Customer Liaison section (demands) / direct to the appropriate local gas store detailed in paragraph 1.3.3.02.

Note: Cylinders will be delivered within 5 working days to the demanding Naval Base and it is their responsibility to arrange delivery within their distribution area, or, where the demanding vessel is deployed, to arrange onward transportation to the vessel where required.

1.3.5.08 In all cases any product that is offered and not accepted for return to the MPSB will require environmentally safe disposal. The user must in all cases ensure that the surplus substances are disposed of in an approved manner by an authorised contractor with due regard for their Duty of Care. The full cost of disposal will fall to the user. Advice regarding this matter can be sought from DFG.

SECTION 6 – LOCAL PROCUREMENT

1.3.6.01 **Procuring gas and gas cylinders via local arrangements**. Whenever practical all gas (including liquefied and cryogenic gases e.g. liquid oxygen) and their respective gas containers are to be provided from the DFG Gas Supply Contract. DFG SCM INV Mgr 2(Annex A) is always to be contacted in the first instance to establish the requirement and to establish if it is possible for supply from the UK. The DFG has worked with its prime contractor to standardise the range of products it supplies. Local procurement can add a new range of gas cylinders and fittings that may not be compatible with the existing contract items or to the equipment to which the gas cylinders are supposed to fit. The quality of the gas may also be different to that expected. This can confuse personnel operating the equipment. Gas cylinders are highly dangerous if handled/used incorrectly, and the 'can do' attitude of making equipment work with locally manufactured attachments or procedures, which is not unusual in theatre, is to be avoided. Where units find it necessary to obtain their gas and/or gas cylinders from a local supplier then the following procedures are to be followed.

1.3.6.02 Reference is to be made to The MOD contractor website to determine the required specification of a gas. Further information is available in Part 2, Chapter 6, or contact DFG for advice (Annex A). These standards are to be conformed to. Certificates of Conformity to the required standard will be required. Specialist gases may require more comprehensive documentation, i.e. Certificate of Analysis. Copies of all certificates shall be sent to DFG Technical Team (Annex A).

1.3.6.03 The supply of specialist gases, e.g. medical, aviation, calibration, can only be authorised by DFG, and has to be supported by the Support Authority responsible for the parent equipment/plant/platform.

1.3.6.04 **Refrigerant and halon gases**. These gases are generally supplied under the regulations imposed from a variety of environmental legislation to which the UK is a signatory, and which is mandated for UK forces in *JSP 418, MOD Sustainable Development and Environment Manual*. Comprehensive control measures are to be followed for the use/disposal of these products.

1.3.6.05 All gas cylinders are to have their contents, and associated hazards, clearly identified by the use of Precautionary Labels. Identification of gas containers is detailed within Part 2, Chapter 3.

1.3.6.06 The use of all gases is to be subject to a Risk Assessment. All supplied gases are to have a Safety Data Sheet. Reference is to be made to the Safety Data Sheet when compiling the Risk Assessment. The supplier shall be able to provide appropriate technical/scientific advice for the gas and its container.

1.3.6.07 The method and manufacturing source of the gas is to be determined. For the supply of cryogenic gases documented evidence will be required to ensure the gas is produced to and meets the required standards. This may require a sample from the plant.

1.3.6.08 If DFG supplied cylinders are to be refilled by a local supplier, then the permission of the owner of the cylinders, as well as DFG, has to be obtained before refilling can take place. The owner of the cylinders, via DFG Technical Team(see Part 1 Chapter 3 Annex

A), will require evidence that:

a) The gas is to the correct standard.

b) That they have the correct connections etc. to provide safe filling practices.

c) That they use approved safe filling procedures.

d) The correct documentation procedures are followed.

Note: All DFG supplied cylinders which are refilled by a local supplier are to be managed and controlled in accordance with the procedures detailed within Part 2, Chapter 5.

1.3.6.09 All mechanical components have to be compatible, e.g. valve outlets, cylinder dimensions. This provides a positive connection into the parent equipment, maintains safety and ensures that interchangeability is not affected. All DFG supplied items are provided to standard UK, European (CEN), or ISO specifications.

Note: There are a variety of different standards across the world, not all are direct substitutes.

1.3.6.10 **Transportation**. If the cylinders are required to be transported by military vehicles then all cylinders, and their fittings are to be manufactured to recognised standards which allow them to be transported (e.g. compliant with JSP 800 Vol 4b & ADR). They are to be tested and inspected at appropriate intervals, and are to be suitable for the gases that they contain.

1.3.6.11 **Quality**. The contractor will be required to manufacture and supply the required products within a Quality Management Regime. A Quality Plan will therefore be required to cover supply chain management including the delivery of the product, the standard of the container its fixtures and fittings, systems to check product quality before and after delivery, as well as procedures to deal with any non-conforming product. To meet MOD standards NATO AQAP 2000 series (minimum AQAP 2120) will be the contractual quality management requirement. The Contractor shall provide appropriate evidence of accreditation if required.

1.3.6.12 The MOD will retain the right to carry out independent testing of any product with which it is supplied

1.3.6.13 **Environment**. The MOD is committed to the protection of the environment and to avoid harm or nuisance by minimising the impact its activities have on the environment. To support this MOD initiative, all contractors are to be able to demonstrate their concern for the environment through the use of an Environmental Management System based on ISO 14000 or a suitable equivalent.

1.3.6.14 **Safety Management System**. The contractor will be required to have a Safety Management System in place to ensure the safety of design, support and operation of equipment, and to manage equipment safety in a co-ordinated and effective manner.

BIBLIOGRAPHY

1. *The Hazardous Waste (England and Wales) Amendment Regulations, 2009*. No. 507.

2. The Special Waste Amendment (Scotland) Regulations, 2004. No. 112.

3. MOD Form 731 - *Equipment Conditioning Label.*

4. JSP 418 – *MOD Sustainable Development and Environment Manual.*

5. JSP 515 - *MOD Hazardous Stores Information System.*

6. JSP 800 – *Defence Movement and Transport Regulations.*

7. JSP 886 – *The Defence Logistics Support Chain Manual.*

8. NATO AQAP 2000 series - NATO policy on an integrated systems approach to quality through the life cycle.

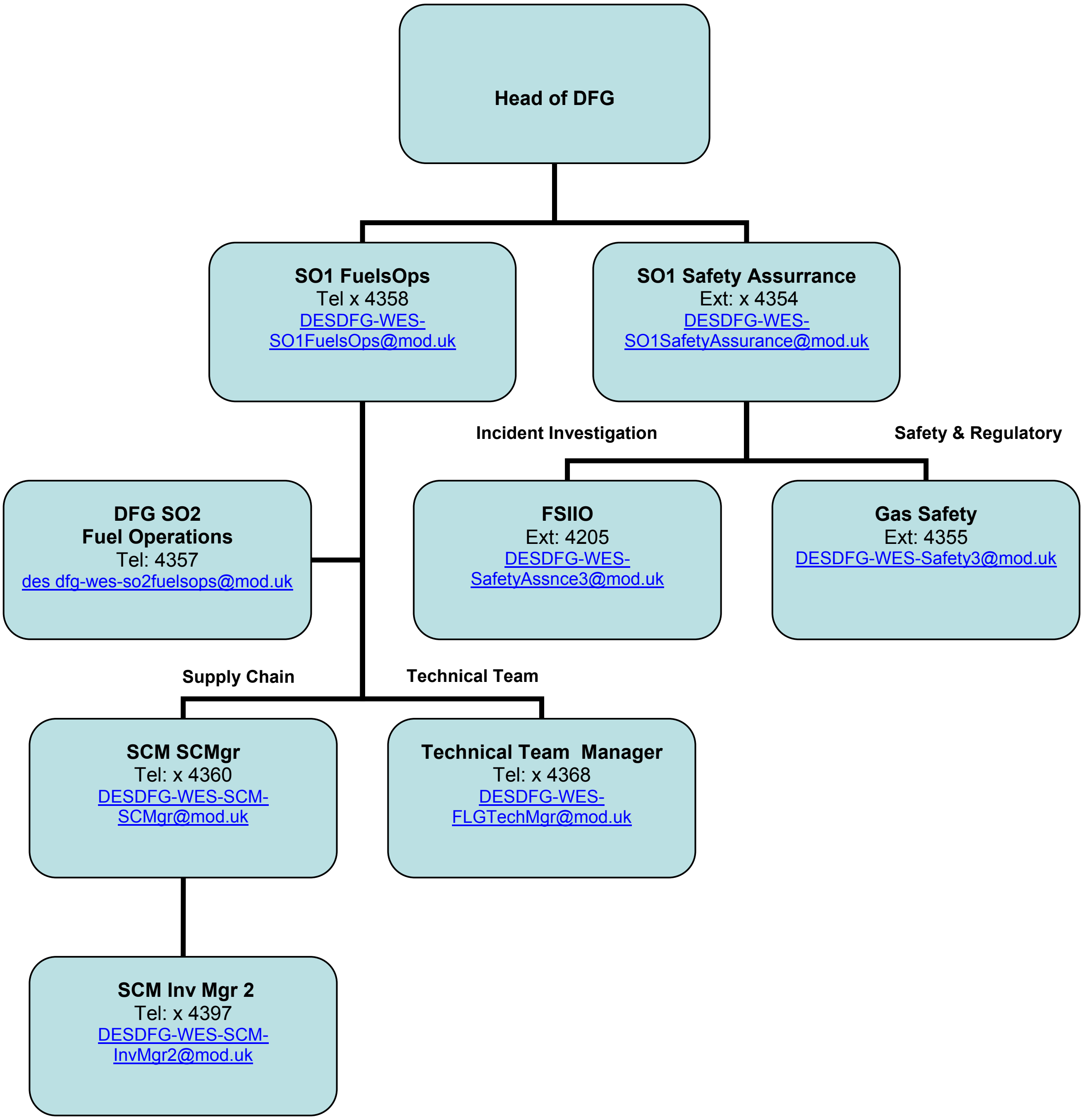
9. ISO 14000 - *Environmental Management.*

10. ADR, *European Agreement Concerning the International Carriage of Dangerous Goods by Road.*

ANNEX A1

(introduced at paragraph 1.3.2.01)

DFG Gases Organisation
Defence Fuels Group
West Moors
Wimborne
Dorset, UK
BH21 6QS
Military Code: (9)4379
Civil Code: +44 (0)1202 65. ext



ANNEX A2

MOD GAS SUPPLY CONTRACTOR

MOD Gas Supply Contractor:	BOC A Member of The Linde Group
MOD Gas Supply Contract Nos:	**Contact JSP 319 Author for further details**

UK based units only	General gas demands	BOC Customer Service Centre Freephone	0800 111 333
	Specialist, Calibration and Diving Gases	BOC Special Gases	0800 02 0800 or fax 01925 523 052
	Controlled Gases	Follow instructions from demand form	n/a

Overseas (Excluding operations and bases in Germany)	General gas demands	BOC Customer Service Centre	+44 (0) 1619 306486 or 306565
	Specialist, Calibration and Diving Gases	BOC Special Gases	fax +44(0)1925 523052
	Controlled Gases	Follow instructions on form	n/a

All MOD units Website access	**Contact JSP 319 Author for further details**

Note: In the event of an incident , or where specific advice is required, in the first instance contact: 080011133

ANNEX B

<table>
<tr><td>Account</td><td colspan="4">MPSB Product</td></tr>
<tr><td></td><td>R12</td><td>R114</td><td>Halon 1211</td><td>Halon 1301</td></tr>
<tr><td>Sea Systems</td><td colspan="2">No Product</td><td colspan="2">Service Focal Point: MES UFS FF
Address:Birch 3a #3321, MOD Abbeywood, Bristol, BS34 8JH
Tel: 03067939604 (9352 39604)
E-mail: DES ShipsFWE-MES-UFS-FF
Essential Use: Surface Ships/ Support Vessel/ Submarine Only</td></tr>
<tr><td>Land Systems</td><td colspan="2">No Product</td><td colspan="2">Service Focal Point: LSSO1
Address: DG S&E DLS-LSS01, DE&S,
Bldg 400/G/001 IDL 401, Monxton Road,
Andover, Hants, SP11 8HT
Tel: 01264 381338 (94391 7338)
Fax: 01264 381888 (94391 7888)
E-mail: DES SE Land-LSSO-RDP
Essential Use: Armoured Fighting Vehicles Only</td></tr>
<tr><td>Air Systems</td><td colspan="4">Service Focal Point: AC GS1
Address: Air Commodities Team, Rm V130
Palmer Pavilion, RAF Wyton, Huntingdon, Cambs, PE28 2EA
Tel: 01480 452451 x 4867 (95371 4867)
Fax: 01480 446971/446831 (95371 4620/4952)
E-mail: DES AC-GS1@mod.uk
Essential Use: Fixed and Rotary Wing Aircraft Only</td></tr>
</table>

Part 1

Chapter 4 (Sponsor – M&GS Team Medical Gases Technical Officer)

PROCUREMENT OF MEDICAL GAS

SECTION 1 – SCOPE

1.4.1.01 This chapter details the procedures to be followed when ordering or returning medical gas cylinders controlled by the Medical & General Supplies Team. It does not include general gases (see Part 1, Chapter 3) or LPG (see Part 1, Chapter 5).

SECTION 2 – GENERAL

1.4.2.01 The Medical & General Supplies Team (M&GS Team) calls off the DFG contract to supply Medical Gases to authorised tri-Service users. Details of the current DFG Contractor are located within Part 1, Chapter 3, Section 2. Regulatory Information on Medical products can be obtained by contacting the M&GS Team on GPTN: 9355 83896 BT: 01225 883896.

Projects Equipment
Medical & General Supplies Team
Spur 11
Block F
Foxhill
Bath
BA1 5AB

Table 1.4.1: M&GS Team Customer Care Teams

Type 1 Customers (supplied via JSCS, includes overseas customers	Type 2 Customers (supplied direct from contractor)	Medical Gases Commercial Officer	Special Projects Manager-P2P Queries (Medical Gases Accounts)
M&GS Team Inv1A1 Spur 12, Block F DE&S Foxhill Bath BA1 5AB mailto:desmedgs_Inv1A1@mod.uk Civ Tel No: 01225 883988 Military: 9355 83988 Civ Fax No:01225 883033 Military Fax: 9355 83033	M&GS Team Inv2A1 Spur 12, Block F DE&S Foxhill Bath BA1 5AB DESMedGS-Inv2A1@mod.uk Civ Tel No: 01225 883965 Military: 9355 83965 Civ Fax No: 01225 883033 Military Fax: 9355 83033	M&GS Team AccMan2A Annexe A6, Block F DE&S Foxhill Bath BA1 5AB DESCommodities-M&GS-Comrcl-3B@mod.uk Civ Tel No 01225 885469 Military 9355 85469	M&GS Team Block D, Spur 3, Room 29. DE&S Foxhill Bath BA1 5AB DESMedGS-BDevinvSys2@mod.uk Civ Tel No: 01225 883469 Military: 9355 83469 Civ Fax No: 01225 883754 Military Fax: 9355 83754

1.4.2.02 Detailed instructions for the accounting, ordering and disposal of medical gases can be found in JSP 886 – The Defence Logistics Support Chain Manual. JSP 340 details the Joint Service policy for the provision, supply, management, servicing and repair of medical, dental and veterinary materiel. JSP 437 details the Joint Service Regulations for the engineering support of medical, dental and veterinary equipment.

1.4.2.03 Further information on medical gases and associated equipment is provided in Part 2, Chapter 13.

1.4.2.04 Examples of typical labels used on medical gas cylinders are located at Part 2, Chapter 3, Annex D.

1.4.2.05 Modern lightweight composite gas cylinders are the preferred cylinder design for use by military medical personnel. These cylinders have been cleared for use in the Forward Edge Battle Area subject to specific limitations. See Part 2, Chapter 13, Section 6.

SECTION 3 – STANDARD ORDERING AND RETURN PROCEDURES

1.4.3.01 **Medical Centres. UK**. Medical Centres are to demand medical gases using the Purchase-to-Payment system (P2P) or from the M&GS Team using an FMED 573. Medical Centres should ensure that a full list of cylinders that require collection is annotated to the order as only cylinders identified at time of order will be collected. Goods will be delivered directly to Medical Centres and if previously notified, empty cylinders for return will be collected. Units must confirm receipt of the goods on the P2P System.

1.4.3.02 **Medical Centres. Germany, Gibraltar and Cyprus**. Medical Centres are to demand and return medical gases via the local MDP using an FMED 573. The Medical Distribution Point (MDP) will order medical gases from UK using P2P. Cylinders are to be returned to Bicester using the procedure described in Section 4. The MDP must confirm receipt of cylinders on P2P.

1.4.3.03 **Medical Centres. Northern Ireland**. Medical Centres are to demand and return medical gases via the local MDP using an FMED 573. The MDP Northern Ireland is to order Medical Gases using P2P. Cylinders will be delivered from and returned to, the DFG contractor Northern Ireland.

1.4.3.04 **Medical Centres. Falkland Islands**. All requirements for medical gases in the Falklands are to be managed by the Medical Centre, Mount Pleasant Airport, who will demand medical gases using the Defence Supply System. Cylinders for return to the DFG contractor are to be sent to Bicester using the procedure detailed in Section 4.

1.4.3.05 **Medical Centres. Brunei**. All requirements for medical gases in Brunei are to be managed by the MDP, Sierra who will demand medical gases using the Defence Supply System. Cylinders for return to the DFG contractor are to be sent to Bicester using the procedure detailed in Section 4.

1.4.3.06 **Dental Centres**. All Dental Centres are to demand medical gases using P2P. In the UK, Dental Centres should ensure that a list of cylinders that require collection is annotated to the order as only cylinders identified at time of order will be collected. Goods will be delivered directly to Dental Centres and if previously notified, empty cylinders for return will be collected. Units must confirm receipt of the goods on the P2P System.

1.4.3.07 Overseas Dental Centres will receive cylinders via the Defence Supply System. Cylinders for return are to be sent to Bicester using the procedure detailed in Section 4. Units must confirm receipt of goods on P2P.

1.4.3.08 **Veterinary Units**. Veterinary units in the UK may order medical gases direct from the M&GS Team using an FMED 573. The M&GS Team will place an order with the DFG contractor using the P2P system. Goods will be delivered direct to unit and cylinders for return will be collected. Units should ensure that a full list of cylinders for collection is annotated to the order as only cylinders identified at time of order will be collected. Units must forward confirmation of receipt to the M&GS Team.

1.4.3.09 Overseas Veterinary units should order medical gases using the Defence Supply System. Cylinders for return are to be sent to Bicester using the procedure detailed in Section 4. If available to Units on Operation, the local Medical Supply Section should be used for demand and return of gases.

1.4.3.10 UK Based Search and Rescue Units. Search and Rescue units in the UK may order medical gases direct from the M&GS Team who will place an order with the DFG contractor using the P2P system. Goods will be delivered direct to unit and cylinders for return will be collected. Units should ensure that a full list of cylinders for collection is annotated to the order as only cylinders identified at time of order will be collected.

1.4.3.11 Units must forward confirmation of receipt to the M&GS Team.

1.4.3.12 **Naval Submiss/Subsunk Stores**. The RN Submarine Rescue stores in the UK may order medical gases direct from the M&GS Team who will place an order with the DFG contractor using the P2P system. The Unit should ensure that a full list of cylinders that require collection is annotated to the order as only cylinders identified at time of order will be collected. Goods will be delivered directly to the Unit and if previously notified, empty cylinders for return will be collected.

1.4.3.13 The Unit must forward confirmation of receipt to the M&GS Team.

1.4.3.14 **Institute of Naval Medicine (INM)**. The INM may order routine medical gases direct from the M&GS Team who will place an order with the DFG contractor using the P2P system. The Unit should ensure that a full list of cylinders that require collection is annotated to the order as only cylinders identified at time of order will be collected. Goods will be delivered directly to the Unit and if previously notified, empty cylinders for return will be collected.

1.4.3.15 Special Mixture Medical Gases may be ordered direct from the DFG contractor. The Unit should ensure that a full list of cylinders that require collection is annotated to the order as only cylinders identified at time of order will be collected. Goods will be delivered directly to the Unit and if previously notified, empty cylinders for return will be collected.

1.4.3.16 Units must forward confirmation of receipt to the M&GS Team.

1.4.3.17 **Centre of Aviation Medicine (CAM)**. CAM may order routine medical gases direct from the M&GS Team who will place an order with the DFG contractor using the P2P system. Goods will be delivered direct to unit and cylinders for return will be collected. Units should ensure that a full list of cylinders for collection is annotated to the order as only cylinders identified at time of order will be collected.

1.4.3.18 Special Mixture Medical Gases may be ordered direct from the DFG contractor. The DFG contractor will deliver direct to units and collect cylinders for return. Invoices should be sent to the M&GS Team. Units must forward confirmation of receipt to the M&GS Team.

1.4.3.19 **All Other Units**. All other units not already mentioned above are to demand medical gases using the standard Defence Supply Systems and return cylinders to Bicester using the procedure detailed in Section 4.

1.4.3.20 **HM Ships Ordering Procedure**. When outside the range of UK ports, and when the exchange of medical gas cylinders at local UK medical facilities overseas is not possible, HM Ships (including RFA and RM units) are to submit demands for medical gases using Oasis or by e-mail or signal to JSCS Ops. Ships within range of UK ports are to submit demands directly to the M&GS Team by e-mail, signal, fax or P2P. In addition to the demand details, the full postal address for delivery, the name and telephone number of the POC on board and the required delivery dates are to be provided. The M&GS Team will arrange for the DFG contractor to deliver the full cylinders required and collect any empty or surplus cylinders. Ships are to ensure that the M&GS Team is notified of the numbers and types of empty/surplus cylinders for collection on the order if delivery of replacement and collection of empty/surplus cylinders is required at the same time.

1.4.3.21 **Tropical fill**. Due to the potential high temperatures in some overseas locations there is a danger that the internal pressure of a cylinder will rise, with increasing ambient temperature. To ensure that the cylinder internal pressure stays within the prescribed limits for that cylinder then the cylinder will be supplied with a 'Tropical Fill' which may be less than the normal 'full' condition supplied in the UK. A range of cylinders are provided that are filled to this Tropical Fill standard. Mainly this affects only liquefied gases (e.g. CO2, N2O). Information detailing the fill standard of a cylinder is available on the cylinder spreadsheet (see Annex A) or advice +can be obtained from the contractor or DFG. Under no circumstances are the DFG contractor rental cylinders to be refilled under local arrangements.

SECTION 4 – STANDARD RETURNS POLICY

1.4.4.01 **Return of Empty and Surplus Cylinders**. Overseas units are to return empty and surplus cylinders in accordance with JSP 886 via the Overseas Transhipment Section, JSCS(S) Bicester, who will then arrange collection by the DFG contractor.

1.4.4.02 Units are to advise Bicester immediately upon shipment of returns by completing and faxing the form found on the JSP 319 website, where the contact details are found. Cylinders obtained from locally arranged contracts in operational theatres are NOT to be sent back to UK but are to be returned to local contractors. All legacy MOD owned Medical Gas cylinders are to be disposed of in accordance with paragraph 1.3.4.03.

1.4.4.03 **Returns from HM Ships**. If empty cylinders can not be kept on board until return to a UK port they should be returned to the UK as for overseas units using the form found at the JSP 319 website.

1.4.4.04 **Returning Unserviceable Contractor Owned Medical Cylinders**. Cylinders identified as unserviceable must be segregated from serviceable stock and clearly labelled to that effect, including details of the identified fault.

1.4.4.05 The procedures detailed in Part 1 Chapter 6 Annex A should be used to obtain a 'Telequery Number' from the current contractor. This number must be included on the serviceability label prior to return to the contractor. Customers that have their cylinders collected by the contractor are to ensure that the driver is made aware that cylinder(s) are being returned under the Telequery system.

1.4.4.06 Customers that return cylinders via JSCS(S) Bicester are to ensure that their returns are detailed on the medical gases return form (found at the JSP 319 website). All U/S cylinder(s) and relevant Telequery Number must be annotated on the form.

1.4.4.07 All customers are reminded of health, safety and handling procedures introduced in Part 1, Chapter 6.

1.4.4.08 Contaminated medical cylinders. Any medical cylinders which may have been contaminated are to be returned using the procedure detailed in Part 2, Chapter 13, Section 5.

BIBLIOGRAPHY

1. JSP 324 - *Catalogue of Medical Material.*

2. JSP 340 - *Joint Service Regulations for the Management of Medical, Dental and Veterinary Material and Equipment*.

3. JSP 437 - *Joint Service Regulations for the Engineering Support of Medical, Dental and Veterinary Equipment.*

4. JSP 886 - *The Defence Logistics Support Chain Manual*.

5. FMED 573 - Eternal Demand, Issue and Receipt Voucher Medical and Dental Material.

ANNEX A

(introduced at paragraph 1.4.3.02)

Complete versions of these spreadsheets are available for viewing on the MOD / DFG Contractor website, details in Part 1, Chapter 3. Alternatively contact DFG (See Pt1, Ch3, Annex A) for advice.

Table 1 Medical gases

Product Description	NATO Stock Number (NSN)	Product Code	Gas Standard	Water Cap. (litre)	Nom. Fill Pressure (bar)	Gross Weight (kg)	Approx Dimensions (mm)	Valve Outlets	Suitable For Tropical Climates
Oxygen	6505-99-5791670	101-CD	European Pharmacopoeia Specifications 2000	2	230	3.35	100 x 520	Integral valve	YES
Oxygen	6505-99-2110849	101-D	European Pharmacopoeia Specifications 2000	2.32	137	3.86	102 x 535	Pin index	YES
Oxygen		109-PD	European Pharmacopoeia Specifications 2000	2	137	4.8	100 x 455	Bull nose 5/8"BSP	YES
Oxygen	6505-99-7090578	101-SD	European Pharmacopoeia Specifications 2000	2	137	3.1	100 x 430	Pin index	YES
Oxygen	6505-99-2110850	101-E	European Pharmacopoeia Specifications 2000	4.68	137	6.32	102 x 865	Pin index	YES
Oxygen	6505-99-9423298	101-F	European Pharmacopoeia Specifications 2000	9.43	137	16.34	140 x 930	Bull nose 5/8"BSP	YES
Oxygen	6505-99-2128750	101-HX	European Pharmacopoeia Specifications 2000	10	230	17.4	140 x 940	Integral valve	YES
Oxygen	6505-99-9423299	101-G	European Pharmacopoeia Specifications 2000	23.6	137	39.1	178 x 1320	Bull nose 5/8"BSP	YES
Oxygen	6505-99-8500814	101-ZX	European Pharmacopoeia Specifications 2000	10	300	14.1	143 x 940	Integral valve	YES

Table 1 Medical gases

Product Description	NATO Stock Number (NSN)	Product Code	Gas Standard	Water Cap. (litre)	Nom. Fill Pressure (bar)	Gross Weight (kg)	Approx Dimensions (mm)	Valve Outlets	Suitable For Tropical Climates
Oxygen	6505-99-8989538	101-J	European Pharmacopoeia Specifications 2000	47.2	137	78.1	229 x 1520	Pin index (side spindle)	YES
Oxygen	6505-99-5082506	109-DD	European Pharmacopoeia Specifications 2000	2	230	3.25	100 x 520	Integral valve regulator	YES
95% Oxygen / Carbon Dioxide		131-F	Components conform to European Pharmacopoeia Specifications 2000	9.43	137	39.2	140 x 930	Bull nose 5/8" BSP	YES
95% Oxygen / Carbon Dioxide	6505-99-6172802	131-G	Components conform to European Pharmacopoeia Specifications 2000	23.6	137	39.2	178 x 1320	Bull nose 5/8" BSP	YES
Nitrous Oxide	6505-99-2110855	141-D	European Pharmacopoeia Specifications 2000	2.32	44	3.4	102 x 535	Pin index	NO
Nitrous Oxide	6505-99-2110856	141-E	European Pharmacopoeia Specifications 2000	4.68	44	8.77	102 x 865	Pin index	NO
Nitrous Oxide		141-F	European Pharmacopoeia Specifications 2000	9.43	44	14.5	140 x 930	Handwheel 11/16" x 20 tpi (m)	NO
Nitrous Oxide	6505-99-2110857	141-G	European Pharmacopoeia Specifications 2000	23.6	44	51.8	178 x 1320	Handwheel 11/16" x 20 tpi (m)	NO
Air Medical	6505-nc-1007586	191-E	European Pharmacopoeia Specifications 2000	4.68	137	6.19	102 x 865	Pin index	YES
Air Medical	6505-99-8985160	191-F	European Pharmacopoeia Specifications 2000	9.43	137	16.07	140 x 930	Bull nose 5/8" BSP	YES

Table 1 Medical gases

Product Description	NATO Stock Number (NSN)	Product Code	Gas Standard	Water Cap. (litre)	Nom. Fill Pressure (bar)	Gross Weight (kg)	Approx Dimensions (mm)	Valve Outlets	Suitable For Tropical Climates
Air Medical	6505-99-1014509	191-G	European Pharmacopoeia Specifications 2000	23.6	137	38.74	178 x 1320	Bull nose 5/8"BSP	YES
Air Medical	6505-99-1476368	191-T4	European Pharmacopoeia Specifications 2000	20	230	32.5	203 x 925	Star valve schrader	YES
Air Medical		191-T7	European Pharmacopoeia Specifications 2000	20	230	32.5	203 x 925	Star valve schrader	YES
Air Medical	6505-99-0612177	191-J	European Pharmacopoeia Specifications 2000	47.2	137	76.74	229 x 1520	Pin index (side spindle)	YES
Carbon Dioxide	6505-99-2110852	201-C	European Pharmacopoeia Specifications 2000	1.2	50	2.85	89 x 430	Pin index	NO
Carbon Dioxide		201-E	European Pharmacopoeia Specifications 2000	4.68	50	5.4	102 x 865	Pin index	NO
Carbon Dioxide		201-LF	European Pharmacopoeia Specifications 2001	9.43	50	21	140 x 930	Hand wheel 0.860" x 14 tpi (m)	NO
Carbon Dioxide	6505-99-8986235	201-VF	European Pharmacopoeia Specifications 2000	9.43	50	21	140 x 930	Hand wheel 0.860" x 14 tpi (m)	NO
Entonox - 50% Nitrous Oxide / Oxygen	6505-99-2115045	211-D	Components conform to European Pharmacopoeia Specifications 2000	2.32	137	4.22	102 x 535	Pin index	YES
Entonox - 50% Nitrous Oxide / Oxygen	6505-99-9859230	211-CD	Components conform to European Pharmacopoeia Specifications 2000	2	137	3.3	100 x 520	Integral valve regulator	YES

Table 1 Medical gases

Product Description	NATO Stock Number (NSN)	Product Code	Gas Standard	Water Cap. (litre)	Nom. Fill Pressure (bar)	Gross Weight (kg)	Approx Dimensions (mm)	Valve Outlets	Suitable For Tropical Climates
Entonox - 50% Nitrous Oxide / Oxygen	6505-99-2111708	211-F	Components conform to European Pharmacopoeia Specifications 2000	9.43	137	17.76	140 x 930	Pin index	YES
Entonox - 50% Nitrous Oxide / Oxygen		211-G	Components conform to European Pharmacopoeia Specifications 2000	23.6	137	34.5	178 x 1320	Pin index	YES
Entonox - 50% Nitrous Oxide / Oxygen	6505-99-3917074	211-HX	Components conform to European Pharmacopoeia Specifications 2000	10	230	17.4	140 x 940	Integral valve regulator	YES
Helium	6505-nc-1001239	163-F	British Pharmacopoeia Specifications 1988	9.43	137	14.5	140 x 930	Bull nose 5/8"BSP	YES

Part 1

Chapter 5 (Sponsor - HQ LF, D Infra Sp - Utilities Accounts Manager)

PROCUREMENT OF LPG

SECTION 1 – SCOPE

1.5.1.01 This chapter details the procedures to be followed when ordering or returning Liquefied Petroleum Gas in bulk or in cylinders controlled by the HQ LF Directorate of Infrastructure Support. It does not include general gases (see Part 1, Chapter 3) or medical gases (see Part 1, Chapter 4).

SECTION 2 – GENERAL

1.5.2.01 **LPG supply in the UK**. The MOD places central contracts for the supply of both LPG in Bulk and associated storage tanks, and LPG cylinders. The commercial branch responsible is Central Top Level Budget (Commercial) - Energy Procurement for Defence - CTLBC/EPD. This branch is the only licensed authority to let LPG contracts. The contracts result from a competitive tendering exercise informed by site and consumption details supplied to CBC – EPD by the appropriate single service sponsor. This is in accordance with the EC Public Procurement Directive. LPG is only to be procured through these centrally let contracts.

1.5.2.02 Although the LPG product may be the same from different suppliers, the tanks and connections to MOD infrastructure may not be interchangeable. The MOD LPG contractor is also responsible for supplying and pressure testing tanks. Any planner or contractors installing LPG systems on MOD sites are to ensure that the MOD LPG contractor supplies and installs the tank(s) under the EPD contracts. New requirements for LPG should also be notified to the service sponsors, so that contract amendment action can be taken. This action will ensure that MOD is not in breach of extant supply contracts.

Note: All LPG Installations are to be compliant with Part 3 and JSP 375.

1.5.2.03 The point of contact for information on demands / returns / disposal instructions for LPG is the HQ LF D Infra Utilities Accounts Manager:

GPTN: (9)6770 1259
BT: 03067701259
Mobile: 07717 424158

1.5.2.04 Information on the storage and handling of bulk LPG is detailed in Part 3.

1.5.2.05 Information on LPG cylinders is detailed in Part 2, Chapter 16.

SECTION 3 – STANDARD ORDERING PROCEDURES BULK LPG

Supply and Delivery of Bulk Liquid Petroleum Gas (LPG) to MOD Establishments - Contract Numbers CTLBC/EPDa/212 and CTLBC/EPDa/213

1.5.3.01 **United Kingdom Ordering Procedure for Bulk LPG**. For all MOD United Kingdom requirements, units are to place demands by telephoning the appropriate number relating to the regional area as shown below:

Contact JSP 319 Author for further details .A1.

Contact JSP 319 Author for further details 2.
240.

1.5.3.02 The Demanding Officer will need to be in possession of the following information to place an order:

a. Demanding officer's account/delivery point number and the Unit Identification Number (UIN).

b. Quantity of fuel required.

c. Date and time for delivery.

d. Address of delivery point.

SECTION 4 – STANDARD ORDERING PROCEDURES LPG CYLINDERS

Supply and Delivery of Liquid Petroleum Gas (LPG) Cylinders Contract Number CTLBC/EPDa/214

1.5.4.01 **United Kingdom Ordering Procedure for LPG Cylinders**. For all MOD United Kingdom requirements, units are to place demands by telephoning the local supplier shown in the list in Annex A (Table 1.5.A3). A list of permitted cylinder sizes is shown in Annex B.

1.5.4.02 LPG cylinders may be obtained either by use of a Calor Card or supplied direct from a Calor Depot. For each method the procedure is the same (with the exception of item (e) below) for Calor Card supplies. New demanders should set up a Calor Delivery Point Code No prior to ordering any gas. Any request to set up a new delivery point should be sent initially to:

Contact JSP 319 Author for further details

1.5.4.3 The demander when requesting set up of a delivery point must provide a UIN. A list of Calor depots and filling stations are shown in Annex A, Table 1.5.A3.

a. Demanding officer's account/delivery point number and the Unit Identification Number (UIN).

b. The size and type of cylinder required.

c. Quantity of cylinders required.

d. Date and time for delivery.

e. Address of delivery point.

1.5.4.04 When placing a telephone order, a delivery point reference will be given by Calor. If units wish to pick up cylinders from Calor depots on the list attached, they must telephone first to obtain the delivery point reference number which should be quoted when picking the cylinders up.

1.5.4.05 **Return of Empty and Surplus Cylinders**. To avoid unnecessary rental charges, costs of which are attributed to the Unit concerned, empty and surplus cylinders are to be returned to Calor without delay. Calor will collect empty cylinders as part of the delivery service. If there are no deliveries planned, then units are to contact Calor and arrange a separate collection.

1.5.4.06 Operational Units are requested to return LPG bottles direct to the correct consignee address, which is:

Contact JSP 319 Author for further details

1.5.4.06 **Lost or Damaged Cylinders**. Will be charged for at the appropriate rate contained in the contracts listed above. Details can be obtained from local Accommodation Service Units or Divisional FM Branches.

SECTION 5 – PROCUREMENT OF LPG IN OVERSEAS THEATRES

1.5.5.01 LPG in overseas theatres is either procured through the D Infra for specific short term operations or to enable a longer deployment to begin functioning. Once an operational theatre is functioning on a more permanent basis the fuel is to be procured in theatre by the Log Sp section with financial authority of the operations budget staff. Where it is not possible to procure LPG cylinders in theatre either because of compatibility or for operational reasons then re-supply from the UK is to take place. Orders are to be passed through the D Infra S. Contact details at paragraph 1.5.2.03. Stock states and deployment to theatre is arranged through DSDA Bicester and called forward by DLOC Andover as and when advised by the D Infra. LPG cylinders for exercise should either be procured before the exercise starts and taken with the unit, procured at the exercise location in the UK using the system detailed above, or procured in the exercise theatre under local purchase arrangements.

ANNEX A

(introduced at paragraph 1.5.4.01)

Table 1.5.A1: BP LPG (UK) Ltd. - Bulk LPG Supply Contract Delivery Areas.

Area No	Delivery Area	Area No	Delivery Area
1	Argyllshire	26	Lanarkshire
2	Avon	30	London
4	Berkshire	31	Lothian
5	Buckinghamshire	35	North Ayrshire
6	Cambridgeshire	38	Northampton
7	Central	40	Northumberland
8	Cheshire	42	Oxfordshire
9	Cleveland	43	Perthshire
10	Cornwall	44	Rosshire
11	County Durham	46	Somerset
12	Cumbria	47	South Ayrshire
13	Derbyshire	48	South Wales
14	Devon	51	Suffolk
15	Dorset	53	West Sussex
17	East Sussex	54	Tayside
19	Essex	55	Tyne And Wear
20	Gloucestershire	56	Warwickshire
22	Hampshire	60	Wiltshire
24	Highland	61	Worcestershire
25	Kent		

Table 1.5.A2: Calor Gas Ltd. - Bulk LPG Delivery Areas.

Area No.	Delivery Area
3	Bedfordshire
16	Dumfries & Galloway
18	East Yorkshire
21	Grampian
23	Hertfordshire
27	Lancashire
28	Leicestershire
29	Lincolnshire
32	Merseyside
33	Middlesex
34	Norfolk
36	North Wales
37	North Yorkshire
39	Northern Ireland
41	Nottinghamshire
45	Shropshire
49	South Yorkshire
50	Staffordshire
52	Surrey
57	West Midlands
58	West Yorkshire
59	Western Isles (Skye Only)

Table 1.5.A3: Calor centres and filling plants for LPG cylinders

Area 1	Manager	Address	Phone
Aberdeen CC		56 Park Road, Aberdeen, AB24 5NY	01224 637575
Ayr CC		Boundary Road, Heathfield Industrial Estate, Ayr, KA8 9SW	01292 267893
Glasgow CC		61 Kilbirnie Street, Glasgow, G5 8JD	0141 420 6615
Grangemouth Direct		Abbotsinch Ind. Estate, Bo'ness Road, Grangemouth, FK3 9YL	01324 483583
Lanarkshire CC		196 Motherwell Road, Belshill, Lanarkshire, ML4 2JH	0169 874 5532
Area 2			
Barnsley CC		Shawfield Road, Carlton Industrial Estate, Carlton, Barnsley, S71 3HS	01226 201332
Carlisle CC		Mill Brook Road, Kingstown Industrial Estate, Carlisle, Cumbria, CA3 0EU	01228 522144
Durham CC		Rudland House, 24 Railway Street, Bishop Auckland, Co Durham, DL14 7LR	01388 603865
Elland Direct		Dewsbury Road, Elland, West Yorkshire, HX5 9JU	01422 376711
Humberside CC		Dairycoates Industrial Estate Wiltshire Road, Hull. HU4 6PA	01482 441111
Kendal CC		Mints Feet Road North, Kendal, Cumbria, LA9 6LZ	01539 741551
Liverpool CC		39 Derby Road, Liverpool, L20 8PF	0151 922 4541
Manchester CC		Daniel Adamson Road, Salford, Manchester, M50 1GU	0161 872 5576
Port Clarence Direct		Haverton Hill Road, Port Clarence, Middlesbrough, TS2 1SF	01642 546700
Preston CC		Factory Lane Trading Estate, Preston, PR1 9UT	01772 746622
Wirral CC		Unit 3, 117 Newchester Road, Birkenhead, Wirral, CH41 9BW	0151 6662177
Central Cylinder Business Area			
Anglesey CC		Pentreath Industrial Estate, Pentreath, Anglesey, LL75 8LJ	01248 450719
Bedford CC		Kenneth Way, Wilstead Industrial Park, Wilstead, Beds. MK45 3PD	01234 740255
Birmingham CC		Mornington Road, Smethwick, Birmingham, B66 2JE	0121 565 0703
Newark CC		Whitehouse Farm, Valley Lane, Long Bennington, Nr Newark, Notts, NG23 5EE	01400 282836
Nth Wales CC		Royal Welch Avenue, Bodelwyddan, Denbighshire, Ll18 5TQ	01492 546603
Oxford CC		Ferry Hinskey Road, Orsny Mead Industrial Estate, Oxford, OX2 0BY	01865 268120
Potteries CC		Sneyd hill, Smallthorn, Stoke on Trent, Staffordshire ST6 2DZ	01782 272566
Reading CC		Brunel House, Station Road, Mortimer, Reading, RG 7 2AB	0118 933 2363
Stoney Stanton Direct		Occupation Road, Stoney Stanton, LE9 4JJ	01455

			275204
Worcester CC		The Old Goods Yard, Sherrif Street, Worcester, WR4 9AB	01905 28839
South West Cylinder Business Area			
Aberaeron CC		Central Garage, Ffoss-y-ffin, Aberaeron, Cardiganshire, SA46 0HA	01545 570937
Bristol CC		Sussex Street, St Phillips, Bristol, BS2 ORA	01179 552595
Cardiff CC		2 Station Terrace, Ely Bridge, Cardiff, CF5 4AA	029 2056 2209
Central Devon and Somerset CC		Grace Road, Marsh Barton Estate, Exeter EX 2 8 QE	01392 203035
Neath Direct		Scapa Works, Aberdulais, Neath, Glamorgan, SA 10 8ER	01639 642694
Plymouth Direct		Central Avenue, Lee Mill Industrial Estate, Ivybridge, PL21 9ER	01752 263960
Poole CC		3 Willis Way, Fleet Industrial Estate, Poole, Dorset, BH15 3SS	01202 672280
Pwllheli CC		The Old Coal Yard, Glandon Industrial Estate, Pwllheli, Gwynedd LL53 5YT	01758 701957
Stalbridge CC		Gibbs Marsh Trading Estate, Stalbridge, Dorset, DT10 2RY	01963 362542
Swindon CC		Bridge End Road, Swindon, Wilts, SN3 4PD	01793 487580
Truro CC		Higher Newham Lane, Newham Industrial Estate, Truro, Cornwall, TR1 2ST	01872 270819
South East Cylinder Business Area			
Bow CC		Global Approach, Hancock Road, Bow, E3 3BW	0208 981 1234
Coryton Direct		Manor Way, Stanford Le Hope, Coryton, Essex, SS17 9LW	01375 645763
Cranbrook Direct		Old Station Yard, Cranbrook, Kent, TN17 2SR	01580 713935
Edmonton CC		29 Stacey Avenue, Edmonton, London, N18 3PE	020 8807 9281
Kings Lynn CC		Hamlin Way, Hardwick Narrows Industrial Estate, Kings Lynn, Norfolk, PE30 4NG	01553 774000
Norwich CC		The Livestock Market, Hall Road, Norwich, NR4 6EQ	01603 452692
Saxham Direct		New Market Road, Risby, Bury St Edmunds, IP28 6QY	01284 770601
Sittingbourne CC		The Old Pump House, West Lane Trading Estate, Sittingbourne, Kent, ME10 3SR	01795 477101
South East London Calor Centre		Burt's Wharf, Crabtree Manorway North, Belvedere, Kent, DA17 6LJ	020 831 23368
Uxbridge CC		47 Wallingford Road, Wallingford Industrial Estate, Uxbridge, UB8 2XS	01895 256882
Wandsworth CC		10 Delta Park, Smugglers Way, Wandsworth, SW18 1EG	020 8874 9693

ANNEX B

(introduced at paragraph 1.5.4.01)

GENERAL LPG CYLINDER INFORMATION

BUTANE CYLINDERS

Capacity	**4.5 kg**	**7 kg**	**15 kg**
Height	340 mm	495 mm	580 mm
Diameter	240 mm	256 mm	318 mm
Recommended Offtake	0.14 m^3/h 0.42 kg (5 kW)	0.20 m^3/h 0.5 kg (7 kW)	0.28 m^3/h 0.7 kg (9.9 kW)
Colour	Blue	Blue	Blue
Typical Tare	4.1 – 8.6 kg	7.2 – 10.8 kg	12.7 – 21.8 kg

PROPANE CYLINDERS

Capacity	**3.9 kg**	**13 kg**	**19 kg**	**47 kg**
Height	340 mm	580 mm	800 mm	1290 mm
Diameter	240 mm	315 mm	315 mm	375 mm
Recommended Offtake	0.28 m^3/h 0.53 kg (7.5 kW)	0.57 m^3/h 1.05 kg (15 kW)	0.71 m^3/h 1.32 kg (19 kW)	1.27 m^3/h 2.4 kg (34 kW)
Colour	Red	Red	Red	Red
Typical Tare	4.1 – 8.6 kg	12.7 – 21.8 kg	17.2 – 30.4 kg	33.1 – 57.8 kg

Note: This annex illustrates examples from Calor Gas UK.

Part 1

Chapter 6 (Sponsor – FSAT- SAFETY 3)

RETURNING UNSERVICEABLE CYLINDERS

SECTION 1 – SCOPE

1.6.1.01 This chapter details the requirements and procedures to be followed when returning unserviceable cylinders.

Note: Cylinders being returned which are empty, part-full, life-expired or no longer required by a unit, and which would otherwise be regarded as serviceable, are to be returned under the procedures detailed within Part 1, Chapter 3.

SECTION 2 – GENERAL

1.6.2.01 If a cylinder is unserviceable as a result of an incident, accident or dangerous occurrence ensure that the reporting procedures in Part 1, Chapter 7, are followed. As a minimum, where DFG is the Support Authority, complete and return the DFG Cylinder Incident / Accident Report (MOD Form 7777 is available on the JSP 319 website).

1.6.2.02 A cylinder that has been involved in a fire or has any heat damage is to be assessed in accordance with Part 1, Chapter 9, and declared unserviceable. This is to be clearly indicated on an Equipment Conditioning Label (U/S) (e.g. MOD Form 731).

1.6.2.03 When returning unserviceable cylinders ensure that they meet the requirements for transportation. See Part 2, Chapter 8.

1.6.2.04 Depending upon the particular gas involved and the cause of the unserviceability, this may preclude certain modes of transportation; for instance, leaking cylinders charged with gas cannot be transported by air and toxic gases cannot be transported in a closed vehicle unless designed for that purpose. This may impose additional logistic implications for overseas commands in returning unserviceable cylinders to UK.

1.6.2.05 Where DFG is the Support Authority, overseas commands' unserviceable cylinders should be returned in accordance with Annex A or Annex B, as appropriate; however cylinders should be returned via JSCS Bicester (see Part 1, Chapter 3) using the form given in Part 1, Chapter 3, Annex D.

SECTION 3 – PROCEDURES FOR RETURNING CYLINDERS

1.6.3.01 **MOD Owned Cylinders**. Identify MOD as the owner of the cylinder (see Part 2, Chapter 3).

1.6.3.02 Once identified as MOD owned, then determine who is the Support Authority with responsibility for the cylinder.

1.6.3.03 Return the cylinder under the direction of the Support Authority.

1.6.3.04 Where the DFG is identified as the Support Authority, unserviceable MOD cylinders which are maintained under DFG contracts, are to be returned in accordance with the flowchart at Annex B.

1.6.3.05 Where the DFG is identified as the Support Authority, all other MOD unserviceable cylinders are to be returned in accordance with the flowchart at Annex A.

1.6.3.06 **Contractor Owned Cylinders**. Identify the owner of the cylinder. The following marking (see Part 2, Chapter 3) should be on all contractor owned cylinders:

a. The company name stampmarked on the shoulder.

b. The company is identified as the owner on the identification label.

also,

c. Some companies may have distinctive colour schemes, or company identification marks, on the cylinder body.

1.6.3.07 Return the cylinder under the direction of the Support Authority responsible for the contract with the contractor.

1.6.3.08 All unserviceable contractor owned cylinders supplied under the DFG contracts, are to be returned in accordance with the flowchart at Annex B.

1.6.3.09 **Cylinders for which DFG is not the Support Authority**. See Part 1, Chapter 4, for details of the supply arrangements for Medical Gases.

1.6.3.10 See Part 1, Chapter 5, for details of the supply arrangements for LPG in the UK and for overseas theatres.

Note: LPG supplied to overseas theatres may be supplied on deployment from the UK, or from a local supplier, depending on the operational requirements of that theatre. Supply, re-supply and returns to/from overseas theatres is to be organised through the HQ LF D Infra Sp. It is particularly important, therefore, to correctly identify the cylinder owner (see Part 2, Chapter 3).

1.6.3.11 **Stranger Cylinder Policy**. If the owner of a cylinder cannot be identified follow the procedure detailed in 1.3.4.07.

BIBLIOGRAPHY

1. MOD Form 731 - *Equipment Conditioning Label*.

ANNEX A

(introduced at paragraph 1.6.2.05)

RETURNING UNSERVICEABLE MOD OWNED CYLINDERS

Support Authority: DFG

Fault on a MoD (DFG) supplied gas cylinder.

Identify the problem.
Remove from service.

Make cylinder safe.
If leaking, seal, recover or release gas in a safe manner.
Close all valves.
As appropriate, fit valve protection devices.

Technical advice available from:

Refer to DFG - Pt1, Ch 3, Annex A

Attach an Equipment Conditioning Label, (U/S) (e.g. MOD Form 731).
Include details of the fault.
Return to unit stores section (F&L).
Accident/Incident/Dangerous Occurrence, if appropriate, reported as per Part 1, Chapter 7.

U.K. unit stores section (F&L) return to DSG Stafford (Attention CGS).
Demand replacement cylinder as required.

DSG Stafford (CGS) to investigate fault.
Report to DFG.
Information to originating unit on request (to DFG).

ANNEX B

(introduced at paragraph 1.6.2.05)

RETURNING UNSERVICEABLE CYLINDERS TO THE CONTRACTOR WHERE DFG IS THE SUPPORT AUTHORITY

Contractor: BOC Gases

Fault on a BOC supplied gas cylinder, or a MoD owned cylinder maintained under DFG contract.

Identify the problem.
Remove from service.

Make cylinder safe.
If leaking, seal, recover or release gas in a safe manner.
Close all valves.

Technical advice available from:

Refer to BOC - Pt1, Ch 3, Annex A

Attach an Equipment Conditioning Label, (U/S) (e.g. MOD Form 731).
Include details of the fault.
Return to unit stores section (F&L).
Accident/Incident/Dangerous Occurrence, if appropriate, reported as per Part 1, Chapter 7.

U.K. unit stores section (F&L) to contact BOC (0800 111333) quoting unit BOC Account Number.
Inform BOC of the faulty cylinder(s).
Ask for a Telequery Number for each gas cylinder (identify by serial number).
Include Telequery Number on serviceability label.
Ask BOC for a replacement cylinder – if required.

BOC collect U/S cylinder(s) & provide replacement(s).
Ensure BOC driver is aware that cylinder(s) are being returned under the telequery system.

BOC will investigate & provide a fault report to the DFG Engineering Authority.
Copies available to units on request to DFG.

Part 1

Chapter 7 (Sponsor – FSAT, SAFETY3)

ACCIDENT/INCIDENT/DANGEROUS OCCURRENCE REPORTING

SECTION 1 – SCOPE

1.7.1.01 This chapter discusses the MOD policy and procedures for reporting accidents, incidents or dangerous occurrences associated with pressure systems and pressure vessels. It introduces a requirement to report any occurrences involving gas cylinders to DFG.

SECTION 2 – GENERAL

1.7.2.01 **Definitions**. *JSP 375* makes the following definitions:

1.7.2.02 **Accident / Incident**. Any event which causes, or has the potential to cause injury, loss or damage to people, plant or premises.

1.7.2.03 **Dangerous Occurrence**. A specific, unplanned, uncontrolled event which has the potential to cause injury or damage and is listed in Schedule 2 of the *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR).*

1.7.2.04 **Pressure System**. A system comprising one or more pressure vessels of rigid construction, including any associated pipework and protective devices, which contains, or is intended to contain, a relevant fluid.

1.7.2.05 The pipework along with its protective devices, to which a gas container is, or is intended, to be connected; and is used, or is intended to be used, to contain a relevant fluid.

1.7.2.06 **Pressure vessel**. A closed vessel consisting of one or more independent chambers, any of which may be subject to an internal pressure greater than 0.5 bar and is used, or is intended to be used, to contain a relevant fluid.

1.7.2.07 **Relevant Fluid**. Means in relation to a pressure system:

a. Steam.

b. Any fluid or mixture of fluids which is at a pressure greater than 0.5 bar above atmospheric pressure, and which fluid or mixture of fluids is:

(1) A gas. or

(2) A liquid which would have a vapour pressure greater than 0.5 bar above atmospheric pressure when in equilibrium with its vapour at either the actual temperature of the liquid or 17.5 degrees Celsius. or

c. A gas dissolved under pressure in a solvent contained in a porous substance at ambient temperature and which could be released from the solvent without the application of heat.

(Examples include any compressed or liquefied gas, including air).

SECTION 3 – SUMMARY OF MOD REPORTING POLICY

1.7.3.01 **Requirements**. All accidents, incidents and dangerous occurrences are to be reported through the MOD incident reporting chain. An Accident/Incident reporting flowchart is provided in Annex A.

1.7.3.02 MOD policy for accident reporting is detailed within *JSP 375, Volume 2, Leaflet 14.*

1.7.3.03 The procedure for the recording of all accidents and incidents that affect, or could have affected life, property or the environment are detailed in *JSP 442*; it also provides advice in determining the responsible line manager where this is unclear.

Note: JSP 442 has been superseded. Accidents and Incidents should be recorded on the Incident Recording Information System (IRIS).

1.7.3.04 Responsibility for ensuring accidents and incidents are recorded rests with the line manager in control of the location where the event occurred, or the line manager of the injured person if the injury occurred at a location not under MOD control.

1.7.3.05 The line manager is responsible for ensuring that all accidents, incidents and dangerous occurrences are reported to the MOD Support Authority which is responsible for the equipment involved.

1.7.3.06 The line manager is to ensure that the unit Health and Safety Officer is informed of any accidents, incidents and dangerous occurrences involving gas cylinders.

1.7.3.07 DFG / FSAT has a responsibility to the Defence Fuels and Gases Environment Safety Board for the safe use of gases and their cylinders. To ensure that lessons learnt through incidents and accidents are assimilated into safety and environmental arrangements, all incidents, accidents or dangerous occurrences involving gas cylinders are to be reported to DFG using the format detailed within Annex B. Copies of reports, involving incidents / accidents with gas cylinders, provided to other authorities are also to be copied to DFG.

1.7.3.08 If any persons are hurt as a result of MOD activities they are to record their incident in the local accident book. *MOD Form 510, Accident Reporting Form*. Comply with all local procedures for reporting incidents/accidents.

Note: Individual Commands may use their own accident/incident reporting forms, e.g. the RAF Form 7454, Accident/Incident Report.

1.7.3.09 **RIDDOR.** If in the UK, report to the Health and Safety Executive (HSE), under RIDDOR, if there is any incident which involves an explosion, collapse or bursting of any pressure equipment and associated system, regardless of whether or not there is personal injury. This is a defined dangerous occurrence under RIDDOR which needs to be reported to the HSE by the quickest practicable means, e.g. by telephone or by completing an on-line electronic *Form 2508* at: www.riddor.gov.uk.

Notes:

1. Refer to JSP 375, Volume 2, Leaflet 48, Reporting of MOD accidents and

incidents to the HSE.

2. Refer to JSP 815, Defence Environment and Safety Management.

1.7.3.10 **Fire**. Incidents involving fire can involve the loss of assets, the death or injury of personnel and, in the case of the MOD, could also have an adverse effect on its operational capability. It is essential therefore that the MOD has a system for recording fire incidents so that not only can statistical information be maintained for assessing future fire protection policies, but also timely action can be taken on any developing trends. See Part 1, Chapter 9 for further information regarding the immediate action to be taken in the case of gas cylinders and fires.

1.7.3.11 All fires and related incidents are required to be reported to the appropriate TLBHs and Chief Fire Officer MOD Fire Safety. *MOD Forms 1059, 1060* and *1061* have been introduced for this purpose. Additionally, all serious fires or any emergency incident which results in the death of, or injury to, any person, where arson is suspected or where chemicals are involved, are to be communicated to the appropriate Regional Defence Fire & Rescue Service Officer and Chief Fire Officer MOD Fire Safety within 24 hours of their occurrence. Where possible, initial notification is to be by telephone followed up by signal or facsimile, *JSP 426 - MOD Fire Safety Policy*, refers.

1.7.3.12 **Montreal Protocol Substances**. *JSP 418, MOD Sustainable Development and Environment Manual* (clause 7229) requires that any accidental discharges of Montreal Protocol substances, which result in a significant accidental loss of material, must be investigated and measures taken to prevent a recurrence. All single event accidental discharges of greater than 25 kg of any ozone depleting substance must be notified to the appropriate Montreal Protocol Task Force Member and to the DFG.

1.7.3.13 **Aircraft accidents or incidents, oxygen contamination and sampling**. Procedures for the reporting and investigation of accidents and incidents to UK military aircraft are contained in JSP 551. Post crash management procedures require that oxygen samples are taken from the dispensing equipment, bulk tanks or supply containers. Policy on, reports and the procedure to follow whenever contamination of breathing oxygen is suspected or confirmed in aircraft breathing oxygen systems, bay maintenance and test equipment, associated replenishment trolleys, bulk storage or production units is detailed in JAP 100A-01, Chapter 11.10.

Note: STANAG 3318 provides a guide on the minimum information to be recorded following an aircraft accident and/or an aeromedical incident, for example:

a. Type of oxygen system installed in the aircraft.

b. Type and size of oxygen mask worn.

c. Oxygen contents at time of incident.

1.7.3.14 **Transportation of dangerous goods by road, rail & sea**. Units and establishments are to report and investigate accident and incidents (including near misses) concerning loading, unloading and the carriage of dangerous goods. Copies of reports, irrespective of formats, are to be forwarded to Defence Dangerous Goods and Hazardous Stores Group (DDGHSG) and the appropriate Compliance Monitoring Group (CMP) Focal Point. This is to assist in pan-MOD performance measurement (part of the legally mandated compliance monitoring process) and to determine if a Dangerous Goods Safety Advisor will be required to assist in subsequent investigation.

1.7.3.15 Serious accident/incidents as defined by 1.8.5 of ADR/RID are to be reported immediately using the model report form shown at 1.8.5.4 of ADR/RID to the DDGHSG and the appropriate CMG member (and to FSAT see Annex B).

1.7.3.16 *JSP 800 Vol 4b – Dangerous Goods by Road, Rail and Sea* refers (Clause 1.8.5).

Note: On-line Dangerous Goods Non-Compliance reporting is available on the Defence Movements & Transport Policy division website via the Defence Intranet http://www.transportsafety.dii.r.mil.uk

1.7.3.17 **Transportation of dangerous goods by air**. If the dangerous goods are being transported by air then follow the procedures in *JSP 800 Vol 4a – Dangerous Goods by Air Regulations.*

1.7.3.18 Initial reports are to be made by signal within 12 hours of the accident or incident by the RAF air movements squadron/unit or by an aircraft captain when operating from an airfield where there is no RAF movements presence.

1.7.3.19 A full follow-up report, to be supplemented by photographs, may be requested by DSCOM and the appropriate parent command.

1.7.3.20 All accidents and incidents involving dangerous goods that occur on the ground prior to loading Air Transport aircraft or after off-loading are to be reported to Air Freight Policy DSCOM by using the *F/Mov 999 DG by Air – Ground Accident/Incident Report Form.* The form is to be completed and forwarded no later than 48 hours after the accident or incident has occurred. This form is also to be used for incidents involving the discovery of undeclared dangerous goods in freight, passenger's baggage or on a passenger's person.

1.7.3.21 **Cylinders containing contaminated gas**. All cylinders of gas which are suspected of not meeting the required specification are to be locally quarantined and not used. Advice is to be sought from the support authority responsible for provisioning the gas cylinders. Advice is also to be sought from the equipment support authority where it is believed contaminated gas may have been used to service that equipment. All gas cylinders which do contain contaminated gas are to be returned using the procedure for returning unserviceable cylinders detailed in Part 1, Chapter 6.

1.7.3.22 For contaminated aviation breathing oxygen refer to JSP 319, 1.7.3.13.

1.7.3.23 It is possible that the contaminated gas may be part of a poor quality production batch. As such it is may be necessary to ensure that the manufacturer and any other MOD units who may have been issued with this gas are informed so that appropriate action can be taken. In all cases the support authority responsible for provisioning the gas cylinders is to be informed. Additionally, where DFG is the support authority complete and return the Gas Container Incident Form (MOD 7777) found within the JSP 319 website. Refer to Annex B for further details.

1.7.3.24 Analysis of gases can be undertaken by DFG's nominated Test Laboratory (see Part 2, Chapter 6, Annex D) by prior arrangement with the Technical Team within DFG (see Part 1, Chapter 3, Annex A).

1.7.3.25 **External contamination of packages**. Externally contaminated packages, i.e. gas cylinders and their valves, guards, etc, shall not be presented for transportation. The contamination is to be removed, neutralised, or mitigated before transportation. However, for medical gas cylinders see Part 2, Chapter 13.

BIBLIOGRAPHY

1. JSP 375 - MOD Health and Safety Handbook.

2. JSP 418 - MOD Sustainable Development and Environment Manual.

3. JSP 426 - MOD Fire Safety Policy.

4. JSP 442 - Accident Reporting System. **Superseded.**

5. JSP 551 – Military Flight Safety Regulations.

6. JSP 800 - Defence Movement and Transport Regulations

7. JSP 815 - Defence Environment and Safety Management.

8. The Reporting of Injuries Diseases and Dangerous Occurrences Regulations 1995, as amended (RIDDOR).

9. JAP 100A-01 - Military Aviation Engineering Policy, Regulation and Documentation.

10. F/Mov 999 DG by Air - Ground Accident/Incident Report Form.

11. MOD Form 510 - Accident Reporting Form.

12. MOD Form 7777 – Gas Container Incident Reporting Form

13. STANAG 3318 – Aeromedical aspects of aircraft accident and/or aeromedical incident investigation

14. RAF Form 7454 – Accident/ Incident Report.

15. ADR - The European Agreement concerning the International Carriage of Dangerous Goods by Road.

ANNEX A

(introduced at paragraph 1.7.3.01)

ACCIDENT/INCIDENT REPORTING FLOWCHART

Incident – Accident – Dangerous Occurrence

Immediate Actions:

As appropriate:
1. Make system safe.
2. Initiate local emergency routine.
3. Inform Emergency Services.
4. Deal with casualties

Reporting
1. Inform line management.
2. Inform unit Health, Safety and Environment Officer.
3. Inform Support Authority responsible for the equipment.
4. Inform DFG/FSAT (see Part1, Chapter3, Annex A)

As appropriate:

4. Complete the MOD Form 7777 Gas Cylinder IncidentReport.
5. Complete MOD Form 510 – Accident Reporting Form.
6. Comply with the requirements of JSP 375. Initiate accident / incident investigation.
7. Carry out actions detailed in JSP 442 (Complete MOD Form 2000).
8. Inform HSE – RIDDOR reporting (HSE Form 2508)
9. Fire. Follow procedures in JSP 426. Inform Chief Fire Officer MOD Fire Safety and TLBHs.
10. Montreal Protocol substance - Inform MPTF member and DFG. (JSP 418).
11. Aviation breathing oxygen. Follow procedures in JAP 100A-01, Chapter 11.10.
12. Transporting dangerous goods. Follow procedures in JSP 800.

ANNEX B

(introduced at paragraph 1.7.3.07)

REPORTING OF GAS CYLINDER INCIDENTS ON MOD FORM 7777

1.7.B.01 **Aim/purpose of reporting to FSAT**. The purpose of this reporting system is to monitor incidents involving gas cylinders and to enable action to be taken to identify any weaknesses in procedures, training and equipment which may require corrective action. The system is not designed to enable staff to make comment on the performance of individuals, or to apportion blame.

1.7.B.02 The need for prompt and complete reporting of incidents / accidents cannot be overstated. Prompt notification of incidents will also make the task of arranging assistance, whether from MOD or commercial sources, much easier. Therefore, it is clearly in the interest of units to report incidents / accidents as promptly and completely as possible.

1.7.B.03 The incident / accident report form is available independently as an electronic download in a pdf format, it is found at the JSP 319 website.

1.7.B.04 **Responsible reporting officer**. The MOD Line Manager responsible for the area or activity in which the event occurred is responsible for ensuring that the report is raised.

1.7.B.05 **Reporting timescale**. The FSAT - Safety 3 is to be notified as soon as is practicable of an incident involving gas cylinders, where reports are to be made available within ten working days of the incident as far as is reasonably practical using the MOD Form 7777.

1.7.B.05 **Recommendations or Lessons Learnt**. Comment on recommendations or lessons learnt.

1.7.B.06 **Environmental Impact**. Describe any likely environmental impact from the release of gas.

1.7.B.07 **Media Involvement**. Describe any Media involvement, and list occurrences.

1.7.B.08 **Addressees**. Copies of the DFG cylinder incident / accident report are to be sent to FSAT Safety 3 and FSIIO.

See Part 1, Chapter 3, Annex A for contact details.

Part 1

Chapter 8 (Sponsor – FSAT- SAFETY 3)

TRAINING

SECTION 1 – SCOPE

1.8.1.01 This chapter details the requirement to provide training for all personnel involved with the handling or use of gas cylinders.

SECTION 2 – GENERAL

1.8.2.01 To meet the requirements of the Health and Safety at Work, etc, Act, 1974, (HSWA), it is the responsibility of the employer to ensure the provision of such information, instruction, training and supervision as is necessary to ensure so far as reasonably practicable the health and safety at work of his employees.

SECTION 3 – TRAINING REQUIREMENTS

1.8.3.01 Anyone who examines, refurbishes, fills or uses a gas cylinder must be competent to do so. All personnel involved in the supply, handling, transportation and disposal of gas containers shall be trained to a level appropriate to their involvement. All personnel are to be suitably trained and have the necessary skills to carry out their job safely. They are to understand the risks associated with gas cylinders and their contents. In particular:

a. New employees shall receive training and be supervised closely.

b. Users must be able to carry out an external visual inspection of the gas cylinder, and any attachments (e.g. valves, flashback arresters, regulators and hoses), to determine whether they are serviceable for use. Users shall be able to identify visual indicators of damage such as: dents, bulges, evidence of fire damage (scorch marks) and severe grinding marks etc.

c. All personnel handling gas cylinders are to have had appropriate manual handling training.

1.8.3.02 Training shall be planned, recorded and reviewed regularly. Training must be in accordance with documented operating and safety procedures. To maintain high skill levels, a schedule of regular continuation training shall be undertaken by all personnel. Trainees should be checked to ensure they have a thorough understanding of the topics on which they have been trained.

a. **Initial Training**. Personnel are to be given the appropriate instruction in the storage and handling of gases and their containers to enable the individual to carry out the work they may be expected to undertake. The instruction is to be provided by a qualified instructor for the subject matter being taught. The training will be conducted as a formal course, usually at a recognized training establishment. Following thorough testing, successful students are to be certified as competent.

b. **Continuation Training**. Continuation training is deemed as training given at the place of work or any training received in the normal course of duty from suitably qualified personnel. It is to be given to all personnel, military, civilian or contractor who are involved in the handling, storage and transportation of gas and gas containers. All checks and continuous training shall be recorded and authenticated by the signatures of both trainer and trainee. Training will be required:

(1) On appointment to any job related to the handling, storage and use of Gases.

(2) Whenever a new gas as procedure is introduced or when an existing procedure is modified.

(3) At the discretion of line management when concern is expressed as to an operator's standard of operation with respect to his/her duties.

(4) At least every 5 years. Line managers or personnel may decide that the time between specific appointments renders their specialist knowledge imperfect and they are therefore deemed to require either continuation or repeat initial training. Line managers are to exercise extreme caution when re-employing personnel without any form of refresher training.

SECTION 4 – TRAINING PROGRAMMES AND SYLLABUS

1.8.4.01 Training courses will vary according to the equipment, role, service and the specific duties of personnel. Training programmes will cover the following subject areas with the depth of information being tailored to prior knowledge held by personnel when regarding Hazardous Material (Hazmat) training:

a. The hazards regarding the safe transportation, storage, handling and use of gases.

b. Stock control and measurement requirements.

c. The operation of specific gas equipment.

d. Loading and unloading procedures of packed gases.

e. First Aid, Safety procedures, the use of Safety equipment (to include fire-fighting equipment) and Personal Protective Equipment (PPE).

f. Emergency procedures, including raising the alarm.

g. Knowledge of pertinent legislation.

h. Prevention of escaping gases and the reporting of incidents.

i. Types of gaes product in service.

1.8.4.02 **Health and Safety Awareness**. All personnel are to be made aware of their responsibilities when working with pressure equipment, whether transportable pressure vessels or fixed pressure systems. Line management will have ensured that they have implemented the requirements of the *Health and Safety at Work Act* and that they operate safe working procedures as defined within *JSP 375* and that where appropriate they have applied the *Defence Estates Safety Rules and Procedures*.

1.8.4.03 Site managers are to have a working knowledge of the *Health and Safety at Work, etc Act 1974*, the *Control of Substances Hazardous to Health Regulations, 2002* and the *Manual Handling Operations Regulations, 1999*. As a minimum standard, all personnel working with transportable gas containers are to have a thorough knowledge of:

a. Safety regulations detailed in this document and all policies, procedures and operation/work instructions for the sites on which they are authorised to work.

b. Safety Data Sheets for the gases they are likely to be involved with.

c. Safe handling of gas containers.

d. Identification and hazards of gas container contents.

e. Gas properties (physical, chemical, hazardous).

f. Potential hazards of high pressure containers.

g. Procedure for the supply and disposal of gases, and associated activities.

h. Personal protective equipment (selection, storage and use).

i. Emergency equipment (location and use).

j. Emergency procedures (gas leaks, fire, etc).

k. Gas container safety checks on receipt and before return to supplier.

l. Designated smoking and no-smoking areas.

1.8.4.04 JSP 375 Volume 3 contains detailed rules and procedures that are the MODs safe systems of work for the management and control of significant risk activities on the defence estate. For all personnel who are required to undertake the design, construction, operation and maintenance of facilities under the ownership, in the widest sense, of the MOD (e.g. boilers and pressure systems; natural gas and LPG systems; medical gas pipeline systems; dental air and vacuum systems) the implementation of JSP 375 Volume 3 is mandatory. Appropriate training is to be provided in the application of the rules and procedures within JSP 375 and to ensure that certain competent persons are in place.

1.8.4.05 **Environmental awareness**. All personnel are to be made aware of the environmental impact of gases. There are many different gases in-use across the military, some of which can have negative effects on our environment and which are therefore controlled (e.g. refrigerants). MOD policy for the protection of the environment is detailed in JSP 418, where environmental protection is a line management responsibility. Line management ensure compliance with the *Environmental Protection Act 1990*, the *Environment Act 1995* and other relevant statutory provisions and any additional requirements arising from international treaties and protocols to which the UK is a signatory. All units will have an Environmental Management System (EMS) in place in accordance with *JSP 418*. Personnel are to be made aware of their responsibilities for protecting the environment, their role within the unit EMS, and are to receive appropriate training in the safe handling of gases to prevent releases to atmosphere.

1.8.4.06 **Fire awareness**. As required within the Fire Safety Regulations, all personnel who handle or use gases and their containers are to have adequate fire training. The training is to take account of any significant findings from the fire risk assessment carried out at each site and is to be recorded in the Fire Safety Management Plan (Refer to JSP 426).

SECTION 5 – TRAINING WITHIN THE MOD

1.8.5.01 **Responsibilities**. Unit Commanders, Heads of Establishment and Heads of Department are responsible for ensuring that all Military, Civilian or Contractor personnel are correctly trained for the specific gas duties on which they are employed. Gas duties include the following:

a. The safe storage and handling, use and accounting of gas products.

b. Transportation and road movement of packed gas products.

c. Operation of in-service gas production & concentration equipment.

1.8.5.02 **Methods of Training**. Depending on the degree of skill and knowledge required by an employer of his employee, three methods of training exist:

a. Attendance on formal training courses.

b. Formal in unit training.

c. Informal in unit training.

1.8.5.03 **Formal External Courses**. These courses are for personnel who:

a. Will be in full time employment in gas duties.

b. Are to be employed as instructors within the unit.

1.8.5.04 Details of formal external courses and how to apply for places for both civilian and service personnel are published in DIN's and in single Service courses programmes.

1.8.5.05 **Army Formal / Informal in Unit Training**. Instructors who attend formal external all arms courses are qualified, on successful completion of the course, to conduct as directed by their CO/OC formal and informal in unit training courses. Units who do not have qualified instructors should request assistance from their Regimental Brigade HQ, G3 Training branch, quoting why they are unable to provide their own instructional staff. Informal training normally requires an instructor to assess an individual who has been carrying out a specific duty for a period of time and whose duty would not warrant attending a specific course.

1.8.5.06 **Department / Unit Documentation**. Heads of departments or units are required to ensure a record of personnel instruction and training is maintained. In addition a copy of all such records is to be made available to the individual concerned. Unit documentation and records may include a combination of all or any of the following:

a. Issue of certificates: to instructors and operators.

b. Publication of military or civilian orders.

c. Inclusion of details of specialist qualifications in the individual's personal records.

1.8.5.07 The HSE and the LAND Petroleum Inspectorate are empowered to request details of all unit records on any person within a unit who has LPG / Industrial Gas responsibilities.

1.8.5.08 **Responsibilities for Personnel not Employed by the MOD**. The HSWA requires every employer to conduct his activities in such a way that persons not in his employment but who nevertheless may be affected by those activities are, so far as is reasonably practicable, not exposed to any risk to their Health & Safety. The employer has a duty to ascertain, so far as reasonably practicable, if the operations of contractors on his premises are likely to give rise to any hazards which could affect his own employees, other persons on site, or members of the public at large. The engagement of contractors or agents to undertake work for the MOD does not relieve MOD of any of its responsibilities for Health & Safety. Contractor competency and skilled person appointment procedures should be followed in accordance with *Defence Estates Safety Rules and Procedure*s as detailed in *JSP 375*.

1.8.5.09 **Contractors**. The prime responsibility for Health & Safety rests with the employer. When a contractor is employed, the MOD still retains duties under HSWA towards its own employees. MOD also has some additional duties to the contractor or agent about potential hazards, which might arise from MOD activities. These are:

a. The safety of materials and plant equipment.

b. Services supplied to the contractor or agent.

c. The safety of any buildings they work in.

d. Any work systems they are required to follow.

1.8.5.10 In conjunction with the contractor or agent the MOD has a duty to ensure that the operations of contractors or agents on MOD premises do not give rise to hazards which could affect either MOD personnel or the public, and the contractor's or agent's employees.

1.8.5.11 **RAF Training**. RAF tradesmen are trained as appropriate in the relevant safety precautions associated with receipt, storage and handling of all full and empty gas cylinders. This does not include gas cylinders that are in use. A cylinder is deemed in use once a regulator has been attached to the outlet valve. An overview of the general requirements of storage is covered on the basic trade training course. Further training is given to personnel employed on full time LPG / Industrial Gas duties or as pre-deployment training as necessary. Personnel employed on duties where they will be required to act as safety man on receipts of LOx / LiN are also to receive further training. All personnel involved with the external transportation and shipment of LPG and Industrial Gas are to receive training in the transportation of dangerous goods. (Compressed gases are classified as dangerous goods and therefore only Q-Sup-GC qualified supply personnel are to oversee the supply aspects of these materials. (See paragraph 1.8.6.08.)

1.8.5.12 RAF tradesmen are trained, as appropriate, in the relevant safety precautions associated with, and operation of, gas cylinders and gas dispensing equipment as part of their basic trade training. Personnel employed on the production of gases, in Cyprus, Falkland Islands or at deployed locations, the control and issue of liquid oxygen or liquid nitrogen and the operation of nitrogen concentration equipment attend specialist pre-employment training courses. Course allocation is controlled by 22 (Training) Group and is based on qualification requirements approved and funded in Local Unit Establishments (LUE). Specialist training courses are detailed in Support Policy Statements promulgated in *AP 119L-0001-2(R)*.

SECTION 6 – SPECIALIST TRAINING REQUIREMENTS

1.8.6.01 **Personnel Working With Cryogenic Liquids**. It is a mandatory requirement that all personnel working within a Liquid Oxygen (LOx) or Liquid Nitrogen (LiN) aviation maintenance bay, or using LOx or LiN aviation Ground Support Equipment are appropriately trained and authorised. All Service and MOD personnel working in an aviation cryogenics workshop are to attend the Oxygen Bay Maintainers Course run from DSG Stafford. Personnel successfully completing the course are awarded the qualification QQ-A-Oxy-795/RAF. Contractors working in MOD aviation cryogenic workshops, or on MOD aviation cryogenic Ground Support Equipment, are also to attend the Oxygen Bay Maintainers course, or be able to prove an equivalent, or better, level of training/competence to work with cryogenic equipment.

1.8.6.02 **Personnel Working With Refrigerants**. The UK Government has introduced mandatory qualifications for handlers of Ozone Depleting Substances and other fluorinated gases (e.g. refrigerants, SF_6) within the scope of the ‘F’ Gas Regulations.

1.8.6.03 The minimum qualification is the City and Guilds Certificate No. 2079 in Handling Refrigerants or the CITB qualifications, J11 – J14, Safe handling of Refrigerants. If you currently hold one of the older qualifications such as City and Guilds 2078 or CITB J01 Refrigerant Handling then you may continue to work temporarily but must have achieved the new qualification by 4th July 2011.

1.8.6.04 Appropriate qualifications have been required since April 2007. Records are to be kept of all personnel qualifications and training.

1.8.6.05 Employers of personnel who handle these refrigerants but do not have these qualifications will be liable to prosecution including fines after this date.

Note: The Air Conditioning and Refrigeration Industry Board (ACRIB) currently manages a voluntary register of personnel qualified as Safe Refrigerant Handlers. Any individual who handles refrigerants must be able to do so safely and with due regard to the environment, and the scheme aims to provide a national register of all those individuals who have successfully completed an approved refrigerant handling competence assessment.

1.8.6.06 **Personnel working on Natural Gas and LPG**. Any individual working on Natural Gas and/or LPG must have successfully undertaken technical and practical training and assessment to enable them to be a member of a class of persons approved by HSE, their registration must be applicable to the type of work and responsibilities found on the particular establishment(s). They must hold a valid identity card as a member of a class of persons approved by HSE (registered with Gas Safe Register) with the relevant areas either endorsed on the rear of identity card or contained in a relevant certificate of competence from a Nationally Accredited Certification Body. Compliance is required with JSP 375, Volume 3.

Note: Gas Safe Register replaced CORGI as the gas registration body in the UK on 1st April 2009. CORGI gas registration is no longer recognized in law.

1.8.6.07 **Personnel working on Medical / Dental Gas Systems**. All personnel working on Medical Gas Pipeline Systems (MGPS) and Dental Gas Systems (DAVS) are to be trained and competent to do so. Personnel must be able to verify competence in appropriate techniques including supervision by qualified managers. Annual reviews of all staff training requirements are to be carried out. Skilled Persons must be able to demonstrate suitable experience and that they are fully familiar with:

a. The Department for Health, Health Technical Memorandum (HTM) series of documents (e.g. HTM 02-01 Medical Gas Pipeline Systems).

b. Their own pipeline systems.

Compliance is required with JSP 375, Volume 3.

1.8.6.08 **Logistics and Supply Personnel Working with Compressed Gases and Cryogenic Liquids**. The RAF Logistics and Supply Training Squadron at RAF Halton provides a supply specialist training course for all logistics and supply personnel who are employed on compressed gas and cryogenic liquid duties (Course No. 3252). Personnel successfully completing the course are awarded the trade qualification annotation Q-Sup-CG. This qualification is valid for a period of 5 years. Continued employment on compressed gas and cryogenic liquid duties requires further attendance on this formal training course.

BIBLIOGRAPHY

1. Health and Safety at Work, etc, Act, 1974.

2. Control of Substances Hazardous to Health Regulations, 2002.

3. Manual Handling Operations Regulations, 1999.

4. The Gas Safety (Installation and use) Regulations 1999.

5. AP 119L-0001—2(R) - *Gas (including Liquid Gas) Production, Storage and Test Equipment*.

6. JSP 375 - *MOD Health and Safety Handbook*.

7. JSP 418 – *Sustainable Development and Environment Manual*.

8. JSP 426 – *MOD Fire Safety Policy*.

Part 1

Chapter 9 (Sponsor – FSAT – SAFETY 3)

EMERGENCY SITUATIONS, PREPARATION & ACTIONS

SECTION 1 – SCOPE

1.9.1.01 This chapter details the MOD policy for the preparation for, and the subsequent actions to be taken in the event of, an emergency situation involving gas cylinders. It discusses the properties of the main gases and their associated containers and provides advice on dealing with gas cylinders involved in an emergency situation.

SECTION 2 – GENERAL

1.9.2.01 Any gas cylinder that is exposed to fire or extreme heat may rupture due to an increase of temperature and pressure. This is valid even for cylinders that have pressure relief devices as in extreme circumstances the device can not operate quickly enough. Acetylene cylinders have the additional problem where a decomposition reaction may develop. Gas cylinders may also rupture if they are hit, accidentally or deliberately, by high velocity bullets or armour piercing ammunition.

1.9.2.02 The hazards associated with cylinder rupture arise from pressure shock, flying cylinder pieces and from the release of the flammable, toxic, or corrosive content of the cylinder. A ruptured gas cylinder can fly a distance of 100 m or more; cylinder trolleys, shrapnel and sheared cylinder valves can travel much further, up to 200 m or more.

1.9.2.03 Compressed gas containers shall be afforded adequate protection from known risks.

1.9.2.04 All accidents / incidents involving gas cylinders are to be reported (see Part 1, Chapter 7).

1.9.2.05 When not-in-use or being transported, all gas cylinders are to be kept in an approved gas cylinder store which has been designed specifically for the storage of gas cylinders. The gas cylinder store is to be designed and managed in accordance with Part 2, Chapter 9.

SECTION 3 – MOD FIRE POLICY AND EMERGENCY ACTIONS

1.9.3.01 **Major Emergencies**. Major emergencies, those which have the potential to significantly disrupt the operation of a unit or establishment, shall be thoroughly considered when formulating an emergency plan. In particular, the risk to life, property, and serious disruption to the surrounding community, shall be mitigated by robust work instructions and well exercised emergency procedures. A major emergency will require the use of outside resources to recover the situation effectively. Natural phenomena such as severe electrical storm; accidents such as aircraft crashes; and deliberate acts such as arson and sabotage, may initiate major emergencies.

1.9.3.02 **Legislation**. Certain industrial gases are ‘Named Substances’ as defined by the *Major Accident Control Regulations (MACR)*, which is the MOD application of the

Control of Major Accident Hazards Regulations 1999 (COMAH). *JSP 498* provides the relevant information for MACR sites. Additionally, all managers shall be familiar with the requirements of the *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR)*.

1.9.3.03 Correct handling, storage and use of gas cylinders will contribute to minimising the risk of an accident involving them. All cylinder storage facilities shall have comprehensively written emergency procedures, which may be incorporated into other unit or site plans. The plan is to include the actions to be taken in the event of cylinder and/or tank leaks, fire and explosion, and all predictable local hazards such as hurricanes, earthquakes and volcanic eruptions. This will help to minimise the risks to personnel and property, and to restrict the escalation of the incident. A guide for producing emergency procedures for gas storage areas is in Annex B. Refer to Part 2, Chapter 9, Section 4.

1.9.3.04 **Exercises**. Emergency procedures are to be exercised annually. Such exercises may be office based and conducted in phases over the year. However, exercises shall involve all of the agencies in the plan. Those persons with specific practical involvement in dealing with gas storage emergencies (e.g. fire and rescue teams) are to undergo annual on-site training which may be conducted independently from the main exercise.

1.9.3.05 **First Aid Fire Appliances (FAFA)**. Advice on fire fighting equipment and fire precautions shall be sought, in the first instance, from the unit fire officer or local fire authorities as appropriate. The appropriate level of FAFA is to be determined by the unit fire officer, and shall be deployed as directed by him or his staff. As a minimum requirement, two fire extinguishers suitable for use on a Class C (gases or liquefiable gases) fire are to be readily available.

1.9.3.06 **Fire Precautions**. *JSP 426* sets out the central policy and standards for the effective management of fire safety in the MOD. Fire can injure or kill people, damage assets and thereby affect operational capabilities, cause financial losses and possibly harm the environment. Legal requirements as well as responsibilities under duty of care demand that all personnel at MOD establishments, both those working there and visitors, are appropriately protected from fire. It is also vital that assets, especially those which cannot be replaced swiftly and are vital to operational capabilities, are suitably protected from fire and that the potential for fire to harm the environment is minimised. The means of achieving these objectives are embraced by the term fire safety, which encompasses all the component precautions and activities which contribute towards the provision of the necessary protection.

1.9.3.07 Fires involving compressed gases can be extremely difficult to contain and control. Procedures shall be put in place to prevent gas leaks and escapes, and to prevent fires occurring in the vicinity of compressed gas stores.

1.9.3.08 The probability of fire and explosion hazards is reduced by the provision of good design, layout, and appropriate operating procedures. All personnel engaged in the handling of compressed gases shall be trained in accordance with Part 1, Chapter 8, and shall be aware of their responsibilities under *JSP 375 - MOD Health and Safety Handbook*.

1.9.3.09 Only approved and appropriate PPE shall be worn (see Part 2, Chapter 2).

1.9.3.10 Whenever a cylinder fire occurs, even if it has been brought under control or completely extinguished, the unit fire service (or local fire service) is to be alerted. If the situation becomes out of control, the use of FAFA has failed to extinguish the fire, or it is unsafe to attempt to use FAFA, further attempts shall be abandoned. Heat and flame increase the risk of explosion so it is essential that the emergency fire plan is activated and the area evacuated as quickly as possible.

1.9.3.11 The key actions by the person discovering a fire in a cylinder storage facility are:

a. Shout "FIRE, FIRE, FIRE!" to alert anyone in the vicinity.

b. Operate the FIRE ALARM.

c. Call the FIRE SERVICE using the method detailed in the fire/emergency plan.

d. Attempt to EXTINGUISH THE FIRE if safe to do so.

e. Ensure that all personnel EVACUATE the area.

1.9.3.12 **Evacuation**. The area is to be evacuated for a minimum of 200 m from any cylinder involved in a fire. If acetylene cylinders are involved the area may required to be evacuated for at least 24 hours.

1.9.3.13 The risk of cylinders exploding remains for some time after the fire has been extinguished; this is particularly pertinent for acetylene cylinders.

1.9.3.14 The emergency services will require specific information about the fire, such as:

a. Location

b. Quantity of gas cylinders involved

c. The names of the gases contained in the cylinders. In particular they will require to know if acetylene is involved.

d. Whether there are any personnel within the evacuated area

1.9.3.15 Cylinders which are not directly involved in the fire, and which have not become heated, should be moved as quickly as possible to a place of safety, provided that this can be done without undue risk. It should be confirmed that the cylinder valves are closed.

1.9.3.16 In addition to unit fire resources, the local fire service shall be alerted to any fire involving compressed gas as they have the necessary skills and equipment to deal with such incident. On their arrival, the local fire service shall be given command of the fire-fighting and rescue operation.

1.9.3.17 Fire hydrants, monitors and fixed water systems for compressed gas stores shall be designed to provide a water supply that can be controlled from a safe remote location. Any manually operated systems shall be clearly identified and the method of operation clearly indicated.

1.9.3.18 Excessive vegetation and unnecessary combustible material shall be removed from the vicinity of the storage area. See Part 2, Chapter 9, 2.9.3.33.

1.9.3.19 A telephone, suitable for use in an emergency situation, shall be provided. See Part 2, Chapter 9, 2.9.3.52.

1.9.3.20 **Gas Leaks and Escapes**. In the event of a gas leak from a valve which has not ignited, and if it is safe to do so, the valve should be securely closed. Carry out the following actions:

a. Eliminate sources of ignition.

b. Ventilate the area.

c. Control access until the area is safe.

If the valve cannot be closed, or the valve is still leaking, do not attempt to tighten the cylinder valve into the cylinder or tamper with safety devices. Take the following actions:

d. Eliminate sources of ignition.

e. Evacuate the area (with consideration of the flow of the gas).

f. Ventilate the area.

g. Call emergency services as appropriate.

h. If safe to do so, remove the cylinder to a safe, well ventilated area.

Where leaks are suspected test with an approved leak detection fluid. Part 2, Chapter 17, 2.17.3 refers. All cylinders found leaking are to be made safe. If maintenance is required to the valve or cylinder, then it is to be declared unserviceable and returned in accordance with Part 1, Chapter 6.

SECTION 4 – GAS CYLINDERS IN FIRES

1.9.4.01 Industrial gases can be classified with regards to the gas properties and fall into four main categories. They are:

a. **Oxidants**. These do not themselves burn but support combustion, possibly vigorously so. *Examples: oxygen, nitrous oxide*.

b. **Inerts**. These do not generally react with other materials. They do not support combustion or support life. *Examples: argon, nitrogen*.

c. **Flammables**. These gases when mixed with an oxidant and provided with an ignition source will burn. The gases are often referred to as fuel gases. *Examples: acetylene, hydrogen, LPG*.

d. **Toxics/Corrosives**. These react chemically with other materials and have the potential to cause injury or threaten life even in small concentrations. *Examples: chlorine, carbon monoxide, ammonia.*

WARNING: Gases may possess the properties of more than one main category, e.g. a gas may be flammable and toxic, so rules for allocating a primary category and a secondary category(ies) exist (see Part 2, Chapter 3).

1.9.4.02 Gases react differently in a fire situation; however all gas cylinders, regardless of contents, are potentially dangerous when exposed to a fire, due to the pressures inside the cylinder. It is important to try to identify which particular gas is being dealt with. The primary means of identifying the gas contents is by reading the label on the cylinder. It may not always be possible to read the label so there are other indicators such as shape, size of the cylinder and colour (particularly the colour on the shoulder).

1.9.4.03 Once the fire has been put out, most gas cylinders do not represent a hazard if they are not leaking and the incident may be drawn to a close. The exception to this is acetylene cylinders, therefore, it is important to be able to recognise acetylene cylinders. This will enable the correct and safe procedures to be followed where acetylene is involved whilst, if it is not, it will ensure safe handling of the incident and result in savings of emergency service resources.

1.9.4.04 Refer to Part 2, Chapter 3, for further information on identifying gas cylinders.

1.9.4.05 **Cylinders in Fires**. The owner, as well as the Support Authority with responsibility for the cylinder, shall be notified of any cylinder involved in a fire.

1.9.4.06 Cylinders that have been subjected to fire or heat, may have had their physical properties modified and therefore, may no longer be safe for further use. This is particularly critical with cylinders manufactured from composite or aluminium. Any cylinder that has been involved in a fire, or where there is a possibility that it has been affected by excessive heat, is to be declared unserviceable and returned in accordance with Part 1, Chapter 6. An Equipment Conditioning Label (U/S) (e.g. MOD Form 731) is to be attached to the cylinder indicating that the cylinder has been exposed to fire / heat. The following information is to be included on the label:

NOT TO BE FILLED. EXPOSED TO FIRE / HEAT.

1.9.4.07 All cylinders represent a potential hazard if directly involved in a fire because cylinders are pressure vessels, designed to withstand high internal pressure. If that pressure increases with heat, they may fail. This is particularly important if cylinders are directly impinged with flame as, in addition to the increase in internal pressure, the cylinder shell itself starts to lose its strength as a result of excessive heat. The nature of the failure and its consequences depends on the combination of cylinder design and gas type. Flammable gases clearly represent a greater risk but all failures will have significant consequences.

1.9.4.08 It is important to cool cylinders with water if that can be done safely. This applies to cylinders suffering direct flame impingement and also to those affected by radiant heat. Those cylinders, which have not failed, can be rendered safe with the application of cooling water. Internal pressure will be reduced as heat is removed from the cylinder and a heat or pressure weakened cylinder shell will recover most or all of its original strength as it is cooled. Personnel engaged in this activity should take a position that will provide adequate protection from exploding cylinders.

1.9.4.09 Just as there are a number of gas types (flammables, oxidants, toxics and inerts) there are also different gas storage conditions: compressed gas, liquefied gas and gas dissolved in a solvent (as in the case of acetylene). Some cylinders are equipped with safety devices, which are designed to relieve pressure by venting gas as the cylinder heats up. All cylinders may fail catastrophically in a fire situation and the effect of the consequent explosion will depend upon the nature of the gas contained.

1.9.4.10 Acetylene is a special case because it can undergo a self-sustaining internal decomposition reaction, producing heat, which may continue after the fire has been extinguished. By the time it has been discovered that acetylene gas cylinders have been heated, decomposition may have already started inside the cylinder which, if not cooled with water for a prolonged period, may lead to a cylinder explosion. Movement of a cylinder prior to the completion of this procedure may cause the cylinder to explode. The sequence of operations given in the flowchart at Annex A, is to be taken. If acetylene gas cylinders are directly involved in a fire, do not attempt to use FAFA; evacuate the area to a 200 m radius and await specialist assistance from the fire service. Acetylene cylinders are required to be kept cooled for a minimum period of 24 hours.

1.9.4.11 **Cylinders Containing Compressed Gas (Usually High Pressure Cylinders)**. These cylinders are thick walled and usually tested up to 1½ times their working pressure. Typical gases are oxygen, nitrogen and argon. Hydrogen is also stored in this way. As the cylinder heats up in the fire, the pressure inside the cylinder increases and the cylinder wall may also start to weaken at temperatures in the region of 300°C. If heat continues to be applied then the maximum safe working pressure of the cylinder may be exceeded. This may eventually cause the cylinder to fail in a violent manner resulting in the release of a considerable amount of energy. Subsequent events will depend upon the gas type. For inert gases this is the end of the event.

1.9.4.12 Cylinders containing oxidant, toxic or flammable gases may produce other hazards and specialist advice should be sought from the gas supplier. For example, flammable gases such as hydrogen or methane will rapidly expand explosively following the cylinder rupture because of the very high internal pressure. This could actually extinguish the fire by blasting it out but also could result in a delayed ignition of the unconfined gas cloud.

1.9.4.13 **Cylinders Containing Liquefied Gas**. Liquefied gases are generally of two types: high pressure (carbon dioxide, ethane) or low pressure (LPG – propane, butane). As the cylinder heats up in the fire, the liquefied gas absorbs some of the heat and boils, increasing the pressure in the cylinder. This will normally result in the operation of a safety relief device, fitted to the cylinder valve, which relieves the excess gas pressure. If the cylinder wall becomes excessively heated, the effective maximum working pressure of it is reduced and the cylinder may fail catastrophically. LPG cylinders failing under heat may result in a BLEVE. The boiling liquid in the cylinder rapidly vaporises and expands explosively. If there were a source of ignition, this would result in a fireball.

1.9.4.14 **Cylinders Containing Dissolved Acetylene**. Acetylene cylinders differ from other compressed cylinders in that they contain a porous filler material, known as a porous material, usually monolithic in form though older packed materials are still in use. They also contain a solvent, typically acetone, that is absorbed by the material. The acetylene dissolves into the acetone and is held by it in a stable condition. The function of the porous material is to evenly distribute the acetone throughout the cylinder and prevent the presence of large internal voids. The porous material contains thousands of small pores, which act as a stabiliser by dividing the acetylene into small units. If decomposition were to occur or a flame develop the small pores would act as flame arrestors. Some cylinders are equipped with relief devices but more modern cylinders are not. As the acetylene cylinder heats up in the fire, the porous material - an insulator; will gradually increase in temperature and the acetylene may undergo an internal decomposition (chemical reaction) creating further heating of the cylinder shell and increasing the internal pressure. This internal heating may continue after the fire has been extinguished. Several things may then happen:

a. The safety device on the cylinder (bursting disc or fusible plug) may operate, releasing acetylene to further intensify the fire. The cylinder will not necessarily explode but could still do so.

b. The cylinder shell will weaken due to the heat; this could lead to it splitting open resulting in an explosive ejection of the contents. The acetylene would expand rapidly in the form of a large fireball of up to 25 m radius.

1.9.4.15 **Acetylene Manifolded Cylinder Packs**. If bundles or packs of acetylene cylinders are involved in a fire then an Industry Representative (Competent Person) must be called. If the cylinders have been heated, the wetting test cannot be applied, as the cylinder shells in the centre of the bundle are not clearly visible. The cordon should be maintained and the cylinders cooled continuously for the 24-hour period. Specific risk assessment will be necessary to establish how to proceed at the end of this period. However, there are very few bundles or packs of acetylene cylinders in circulation.

1.9.4.16 **Non-Acetylene Cylinders**. For cylinders that are confirmed as not being acetylene, once water has been applied and the cylinder wall temperature reduced, then the cylinders are very unlikely to fail. Consideration may then be given to reduce the hazard zone.

1.9.4.17 **Acetylene Cylinders**. For acetylene, further procedures are required. Once the cylinder wall temperature has been cooled, any internal decomposition may continue for some time and cooling water must be sustained until this reaction has stopped. The Wetting Test is used to provide an indication of this. The cylinder is unlikely to fail unless it is moved or there is a leak of gas from it. The 24-hour cooling period has been established to allow sufficient time for internal decomposition to stop. The cordon may be considerably reduced, within the 24-hour period, once the external shell of the cylinder is cool, and provided there is no significant leak, thus minimising the disruption caused by the incident. During this period it will be necessary to prevent the cylinder from being moved or interfered with in any way.

Note: If the cylinder appears cool but is still leaking, there may be two problems:

a. Fresh acetylene can feed any suppressed decomposition, starting it up again

b. There is a flammability risk in the local area where the acetylene is leaking.

1.9.4.18 Annex A details the procedures for dealing with gas cylinders involved in a fire.

SECTION 5 – SPECIALIST ADVICE

1.9.5.01 **How to Identify the Cylinder Owner**. In the UK there are four major companies who supply gas cylinders. During an incident involving cylinders it is important to identify the gas company that owns the cylinder and/or the Support Authority responsible for the cylinder.

1.9.5.02 This will enable the gas company / Support Authority to provide assistance in identifying the contents of the cylinder and to provide any assistance required in order to manage the incident effectively. The owner of the cylinder can be identified in a number of ways:

a. Via the persons responsible for the gas store, by asking for the name of the gas supplier; and in the case of cylinders supplied under the DFG contract, DFG

b. From the cylinder label if it is possible to get close enough safely.

c. By inspecting the label on any other cylinders in safe locations elsewhere on the premises.

1.9.5.03 **Telephone Contact Numbers**. The following are the 24-hour telephone numbers of the four main cylinder gas companies:

a.	Air Products:	0500 02 02 02
b.	BOC:	0800 111 333
c.	Energas:	01482 329 333
d.	Air Liquide (previously Messer UK):	01675 462 695

1.9.5.04 These telephone numbers can be used by the emergency services to obtain information such as:

a. Help with identifying who owns the cylinder and the contact numbers of other gas companies.

b. What records there are of customer cylinder holdings, type and number.

c. Help with identifying the cylinder type i.e. LPG, compressed or liquefied gas or acetylene.

d. A broad description of the wetting test (or arranging for a competent person to be contacted).

e. How to arrange for cylinder collection at the end of an incident. The numbers can also be used to arrange for a specialist advisor to consult over the telephone or to attend the scene.

1.9.5.05 **Competent Person**. All gas companies who supply cylinder gases will train Competent Persons to support the Fire Service. The Competent Person will be able to provide advice on all aspects of dealing with gas cylinders involved in a fire. To request a Competent Person to attend the scene contact the gas company that owns the cylinders via the company contact numbers above.

BIBLIOGRAPHY

1. *Environmental Protection Act*, 1990.

2. *Health and Safety At Work, etc, Act* 1974.

3. *Control of Major Accident Hazard Regulations*, 1999.

4. *Control of Substances Hazardous to Health Regulations*, 2002.

5. *Environmental Protection (Prescribed Processes and Substances) Regulations*, 1991.

6. *Management of Health and Safety at Work Regulations*, 1999.

7. *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations*, 1995.

8. Joint Service Publication 375. *Ministry of Defence Health and Safety Handbook.*

9. Joint Service Publication 418. *Sustainable Development and Environment Manual*.

10. Joint Service Publication 426. *Ministry of Defence Fire Safety Policy*.

11. Joint Service Publication 498. *Major Accident Control Regulations*.

12. British Compressed Gas Association, Guidance Note 1 (1977). *Guidance Note on the Preparation of Major Emergency Procedures*.

13. British Compressed Gas Association, Guidance Note 2 (2005). *Guidance for the Storage of Transportable Gas Cylinders for Industrial Use*.

14. British Compressed Gas Association, Guidance Note 15 (2004). *Managing Gas Cylinders Involved in a Fire*.

15. British Compressed Gas Association, Code of Practice 18 (2005). *The Safe Storage, Handling and Use of Special Gases in the Micro-Electronics Industry*.

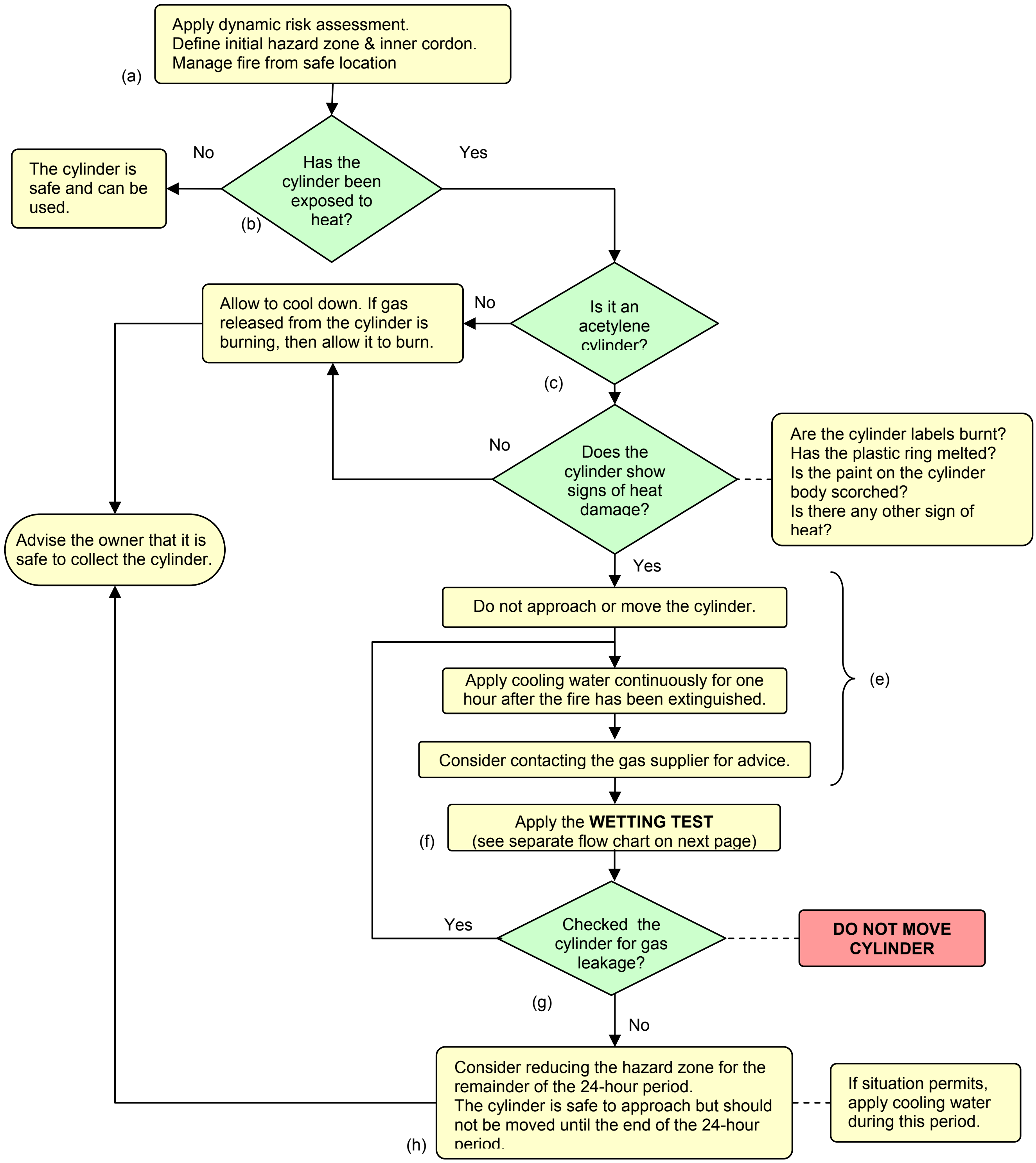
16 British Compressed Gas Association, Leaflet 6, *Cylinders in fires*

17. Fire Service Manual, Volume 2, Fire Service Operations, *Acetylene and Natural Gas Incidents*.

ANNEX A

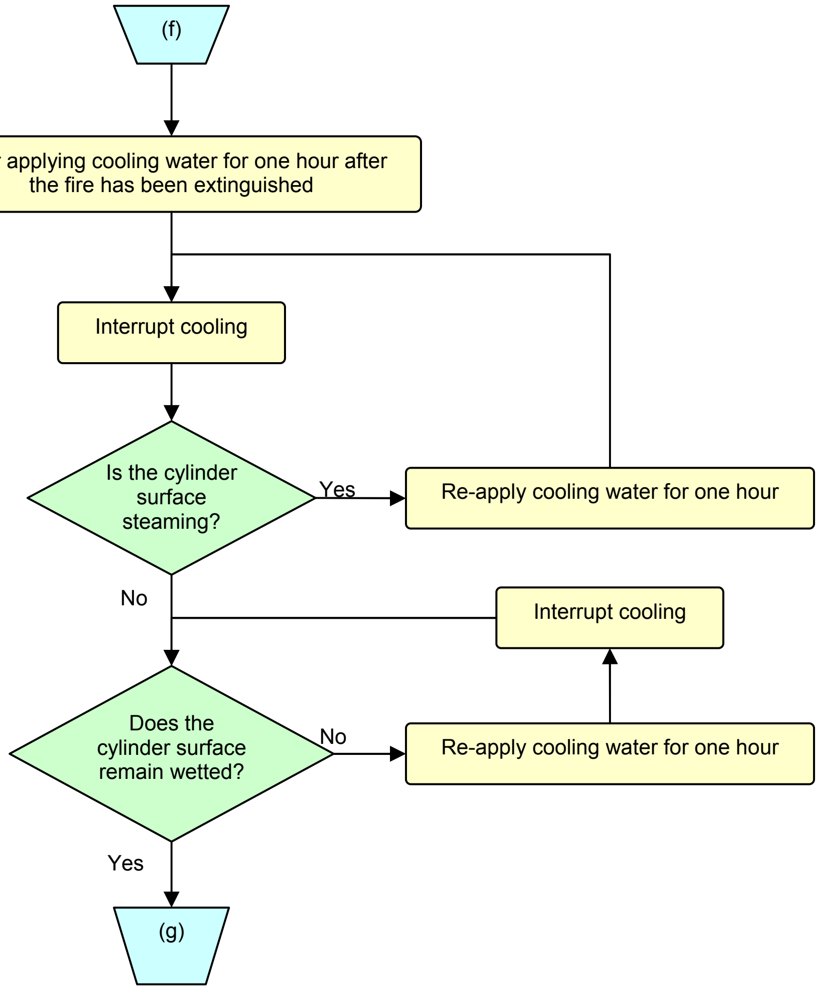
(introduced at paragraph 1.9.4.10)

PROCEDURES FOR DEALING WITH GAS CYLINDERS INVOLVED IN A FIRE



1.9.A.01 More detail of each process, the decisions and actions to be taken is given after the flowcharts.

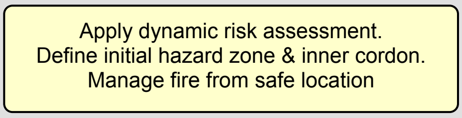
1.9.A.02 **The "Wetting Test"**. The wetting test is a tried and tested method, accepted globally, to see if an acetylene cylinder is undergoing an internal decomposition reaction. The test is only applicable to acetylene cylinders, as other compressed gas cylinders do not undergo this reaction.



Explanation of the Flow Diagram

Initial Procedure

(a)



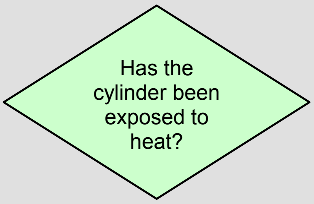
Background

1.9.A.03 All cylinders, other than those containing toxic materials, represent a broadly similar hazard if flames come in contact with them directly. With sufficient heat, oxygen, inert gas and flammable gas cylinders can all catastrophically fail or explode, potentially sending cylinders or parts of cylinders over considerable distances. The initial approach therefore needs to be common to all cylinders involved in fires.

Action

1.9.A.04 The incident commander will determine the initial hazard zone based on the dynamic risk assessment that will include allowing for any structures that might provide protection from flying material.

(b)



Background

1.9.A.05 If cylinders (including acetylene) have not been heated then they do not represent a hazard.

Action

1.9.A.06 Check to see whether there is any obvious fire damage to any structure or material near to the cylinders.

a. Do the cylinders appear to be scorched?

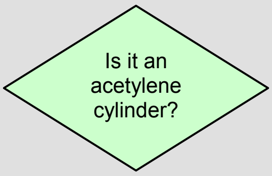
b. Are the labels burnt?

c. Are the plastic guard or test rings melted?

1.9.A.07 There needs to be absolutely no evidence of heat in order to answer “no”.

1.9.A.08 If it has not been exposed to heat, the cylinder is safe to use.

(c)



Background

1.9.A.09 Acetylene is different from other gases. It can decompose to its constituent elements if exposed to extreme heat and/or massive shock. This could result in a catastrophic failure similar to the combustion energy released from other fuel gas cylinders if they burst in a fire. Cylinder design using acetone and porous mass is such that acetylene is uniformly dispersed within the cylinder. If acetylene is heated, or if some event causes a cavity to be created within the cylinder and filled with acetylene, then decomposition could occur.

Action

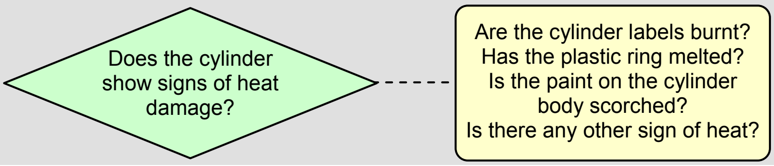
1.9.A.10 Attempt to distinguish between LPG and other cylinders on the basis of their shape. To distinguish positively between acetylene and other non-LPG cylinders should be on the basis of their colour (only acetylene cylinders are maroon) or by their markings (refer to Part 2, Chapter 3).

1.9.A.11 Contact the cylinder owner (Support Authority) by telephone for specialist advice. Consider asking for the attendance of a specialist at the scene, although there clearly has to be good visibility for this to be productive. If in doubt, treat the cylinder as though it is an acetylene cylinder, until a positive identification can be made. If the cylinders are not acetylene, allow them to cool down. If gas from the cylinder is burning, allow it to burn out. It should be noted that most LPG cylinders incorporate a relief device in the valve, which allows gas to vent freely, when the cylinder is heated. As the cylinder cools the venting should cease.

1.9.A.12 Once the cylinders are cold and no further gas is escaping inform the owner that they are safe to be collected.

Acetylene Cylinder Procedure

(d)



Background

1.9.A.13 It is important to assess whether the cylinder has been sufficiently heat affected for decomposition to be initiated. It requires a temperature in excess of 400°C to initiate decomposition. This is normally only achieved by direct impingement of flames on a cylinder.

Action

1.9.A.14 There are signs which can be used to detect possible heating:

a. Do any of the cylinder labels appear to be burnt?

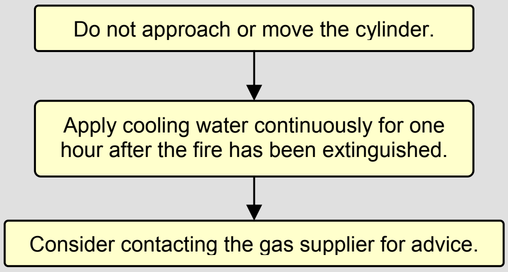
b. Are any of the plastic rings around the cylinder valve melted in any way?

c. Is the cylinder paintwork burnt or blistered?

d. Is there any visible bulge in the cylinder?

e. Does the cylinder surface steam or dry out quickly when water is applied?

(e)



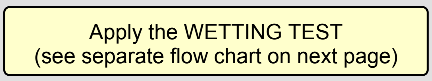
Background

1.9.A.15 An acetylene cylinder is designed to suppress decomposition and to self-extinguish if decomposition does occur. The porous mass contains thousands of small pores, which act as a stabiliser by dividing the acetylene into small units. If decomposition were to occur, the acetylene in some of the units would decompose slowly but the walls of the cells would absorb heat to the stage where decomposition can no longer continue. If a flame were to develop, the small pores would act as arrestors. This enables the cylinders to withstand most flashbacks and non-severe heating. Prototype acetylene cylinders are subjected to aggressive testing to prove this. Due to the density of the mass, at least one hour is required to cool the cylinder completely

Action

1.9.A.16 Apply cooling water for 1 hour.

(f)



Background

1.9.A.17 It is important to be able to identify if an acetylene cylinder is undergoing internal decomposition due to flashback or excessive heating. The tried and tested method, accepted globally, is the wetting test. The test may be performed immediately upon discovering acetylene cylinders that may have been exposed to heat, in order to establish if they are undergoing internal decomposition. It is also used during the cooling down process for cylinders which may have undergone an internal decomposition. The test then becomes a useful indicator to show the progress of the cooling down operation.

1.9.A18 When externally cool, the cylinder should be safe to approach as long as no gas is leaking but it must not be moved. An acetylene cylinder that has been subjected to severe heating as a result of being involved in a flashback, or adjacent fire, is potentially dangerous. Decomposition of the acetylene contained within the cylinder takes place and will continue until all of the acetylene is consumed or until the cylinder is effectively cooled. Acetylene cylinders are designed and tested to withstand such decomposition and can cool naturally without any problem; the porous mass is designed to assist in this. Cooling will slow the reaction and allow it to self-extinguish. In the worst case, inadequate cooling, perhaps caused by shielding, could lead to catastrophic failure due to the weakening of some part of the steel wall of the cylinder.

1.9.A.19 Even when a hot acetylene cylinder appears to have been cooled externally, a residual internal hot spot could still be present. Under test conditions an ongoing decomposition inside a cylinder could not always be detected (following cooling with water) – it follows that equipment such as thermal imaging cameras or infrared thermometers may only provide an initial indicator that the surface of the cylinder is hot. They cannot and must not be relied upon as indicators of safety. If there is also a large internal cavity due to damage to the porous mass, movement of a cylinder may accelerate decomposition and result in catastrophic failure without warning, hence the importance of applying the wetting test. Heat through decomposition will be very localised and porous mass has low thermal conductivity. Decomposition can therefore be present within the core of the cylinder whilst the walls are cool. However there will usually be evidence of heating on the cylinder, valve assembly or associated equipment if it has been involved in fire or been subjected to a flashback. It is for this reason that the wetting test was developed.

Action

1.9.A.20 The **wetting test** involves:

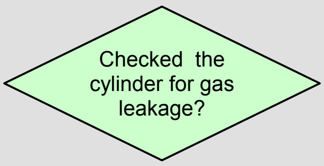
a. Getting a clear view of the cylinders from a safe location, protected from any possible blast.

b. Spraying sufficient water on to the cylinder to wet the entire surface of it.

c. Stopping spraying and looking for signs of steam rising from the surface of the cylinder.

d. If steam is not seen rising, checking to see whether the wetted cylinder surface dries out quickly.

(g)



Background

1.9.A.21 The wetting test has established that the cylinder shell has been cooled from its original temperature, but more importantly that the decomposition reaction is slowing down and dying away. If there is still any low-level decomposition within the cylinder then this will be fuelled, and potentially accelerated, if fresh acetylene passes through this area, i.e. if a leak pulls gas across the decomposition zone. The leak would need to be serious to stimulate rapid decomposition. A leak such as this would be seen from a melted fusible plug, should that be present, or a massive release from the valve. The porous mass should be adequate to self extinguish in the event of small leaks. If decomposition is fuelled, then the cylinder will heat up. This heating will then be detectable as the shell of the cylinder shows signs, once again, of heat.

1.9.A.22 The cylinder internal porous mass may have been severely damaged by the decomposition and therefore the remaining acetylene would be susceptible to shock. For this reason, the cylinder should never be moved until the full 24-hour cooling period has finished although it is safe to approach the cylinder as long as its shell is externally cool.

Action

1.9.A.23 Watch for massive release of gas. This should be audible and will result in major disturbance to the wetted surface. In case of major gas escape continue to cool cylinder as before.

(h)	Consider reducing the hazard zone for the remainder of the 24-hour period. The cylinder is safe to approach but should not be moved until the end of the 24-hour period.

Background

1.9.A.24 The wetting test (which will have involved one or more cycles consisting of ‘cool for one hour, interrupt and observe’) will have confirmed that any decomposition has died down and the cylinder shell is back to normal temperature. The cylinder should be safe to approach but should not be moved. The cordon may now be reduced. The cylinder should still be cooled as a sensible precaution but less water is required than for the previous cooling phase.

Action

1.9.A.25 After successfully completing the wetting test, continue to apply cooling water to the cylinder, this may be using less water than before. Consider reducing the hazard zone. The cylinder can now be approached though should not be moved until the 24-hour period is elapsed.

Collection of Cylinder

(i)	Advise the owner that it is safe to collect the cylinder.

Background

1.9.A.26 Once the cylinders are cool or, in the case of acetylene cylinders, at the end of the 24-hour period, the cylinder owner can check the cylinders for safety before removing.

Action

a. Once the cylinders are cool, the cylinder owner should be contacted to arrange for collection (see Part1, Chapter 6).

b. In the case of acetylene cylinders this will only be possible at the end of the full 24-hour period.

ANNEX B

(introduced at paragraph 1.9.3.03)

A GUIDE TO PREPARING EMERGENCY PROCEDURES FOR COMPRESSED GAS STORAGE AREAS

Serial (a)	Action (b)	Remarks (c)
1	State the hazard.	Highlight main safety precautions to be followed. Identify gas storage facilities as a restricted area.
2	Identify the risks.	Type of gases stored. Location of storage area. Degree of security.
3	Identify the areas that might be affected by the risk.	Distance to vulnerable areas (buildings, thoroughfares, etc). Distance from other dangerous sites (Ammunition dumps, fuel installations, etc).
4	Consider the best means for raising the alarm.	Shouting a warning is appropriate in relatively quiet small areas only.
5	Detail the locations of alarm systems.	
6	Consider how best to account for those persons within the storage area.	Everyone within the storage areas must be accounted for at all times. At all times, there is to be a nominated person in charge present.
7	Formulate a means of evacuating the storage area	Route plans and line drawings should be employed where practicable. Include evacuation routes and rendezvous points.
8	Detail the location(s) of emergency telephones.	
9	Specify the procedure for alerting the emergency services.	Employ a flow diagram if practicable. Ensure any switchboard or operator services involved have a copy of the plan.
10	Detail the locations of First Aid Fire Appliances (FAFA) and cooling/sprinkler systems.	Seek the advice of the Unit Fire Officer. Detail how personnel will be trained to use the FAFA.
11	Detail the actions to be taken by persons detecting leaks, fires, and other dangerous occurrences.	The actions of each person's unique responsibilities are to be listed in a separate annex. Where groups or teams are responsible for executing the same tasks (cordon controllers, medical teams, etc) their actions are to be listed in the same annex.
12	Nominate trained persons to undertake specific tasks.	
13	Detail the personal protective equipment (PPE) required by those involved in dealing with incidents.	Include the location of PPE. State the limit of PPE protection and use.
14	Include actions to be taken in the event of predictable local phenomena which have the potential to cause a hazard in a gas storage area.	Extreme weather conditions. Natural phenomena (earth quakes, volcano eruptions, etc). Operational considerations (effects of enemy weapons, sabotage, etc).

Serial (a)	Action (b)	Remarks (c)
15	Consider the advice given by the gas supplier and the Defence Fire & Rescue Service.	
16	Ensure compliance with relevant legislation, Codes of Practice, Guidance Notes and Standards.	BCGA GN15

Part 2

Chapter 1 (Sponsor – FSAT, SAFETY 3)

INTRODUCTION TO GASES

SECTION 1 – SCOPE

2.1.1.01 Accidents involving gas cylinders can cause serious injury or even death. JSP 319 provides practical advice on eliminating or reducing the risks associated with using gas cylinders.

2.1.1.02 This chapter is written around compressed gases, e.g. gases supplied in pressure receptacles as permanent gases, liquefiable gases or dissolved gases. Much of this chapter, especially legislation, also applies to gases supplied as cryogenic liquids, see Part 2, Chapter 10, for more details regarding the specifics of cryogenic liquids.

SECTION 2 – GENERAL

2.1.2.01 **The legal term that covers gas cylinders is "pressure receptacle"**. This is a generic term covering a number of types of pressure receptacle: tube, pressure drum, cryogenic receptacle, bundle of cylinders as well as cylinders themselves, plus the valve(s) fitted directly to the receptacle. For the purpose of this publication, the term "gas cylinder" or "gas container" shall be taken to mean all these various types of pressure receptacles.

2.1.2.02 Gas cylinders used in adverse or extreme conditions, such as for breathing apparatus, may require special precautions. Although the advice in this publication is valid for all uses of gas cylinders certain special precautions, such as different frequencies for periodic inspections, are not covered and if in doubt advice should be sought from the Support Authority responsible for the use of the equipment in-service.

2.1.2.03 The MOD has a duty to provide a safe workplace and safe work equipment and to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all its employees. It is the duty of every employee while at work to take reasonable care for the health and safety of themselves and of other persons who may be affected by their acts or omissions at work. Gas cylinders are potentially very dangerous, and consequently they have been designed and manufactured to be as safe as is reasonably practical for use in the workplace. All persons handling and/or using gas cylinders are to maintain the safe practices detailed in this publication and are to be aware of the potential for danger that exists within a cylinder.

2.1.2.04 **Gas Cylinders**. All gas cylinders have to be designed and manufactured to an approved standard to withstand everyday use and to prevent danger. They must be initially inspected before they are put into service to ensure they conform to the approved standard, and be periodically examined at appropriate intervals to ensure that they remain safe while in service.

2.1.2.05 **New Equipment**. If a new item of equipment is to be introduced into service which will contain a removable transportable gas cylinder, the Support Authority (Project Manager) is to consult with the DFG (Technical Team Manager) to establish whether any current in-service cylinders, or DFG supplied contractor cylinders are suitable for the equipment. Special-To-Type cylinders are to be avoided wherever possible.

Note: All gas cylinders which are required to be transported with a pressure charge, are required to meet the relevant legislation relating to the carriage of dangerous goods (see Part 2, Chapter 8). This is of particular importance when procuring gas cylinders from abroad.

2.1.2.06 **Storage**. When not-in-use or being transported, all gas cylinders are to be kept in an approved gas cylinder store which has been designed specifically for the storage of gas cylinders. Health and safety law requires that those responsible for work activities ensure that all hazards are identified, risks are adequately assessed and suitable control measures are put into service. Storage at a particular site is to be based on an understanding of the physical and chemical properties of the substances concerned, as well as the overall quantities and size of individual packages. The storage of any substance requires that that a suitable Risk Assessment is carried out to determine the potential for the item to cause significant harm or damage.

2.1.2.07 The potential hazards require that all persons on the storage site need adequate training to ensure that they are aware of the risks of storing dangerous substances and can take the precautions necessary to safely store and handle those dangerous substances.

2.1.2.08 When in a store, the properties of a substance, how it is stored and the control of ignition sources are all major factors in determining the likelihood of a fire or explosion incident occurring. All dangerous substances need to be assessed to determine a suitable segregation policy so as to reduce the potential for ignition. Often it is not the dangerous substance that is the first material ignited in a fire. For example, small quantities of dangerous substances stored in a general goods warehouse could significantly increase the severity of a fire. This will consequently increase the danger to any personnel in the area as well as the emergency services.

2.1.2.09 Gas cylinder stores are to be designed and managed in accordance with Part 2, Chapter 9.

SECTION 3 – HAZARDS

2.1.3.01 **Hazards of Gas Cylinders**. Gas cylinders are a convenient way to transport and store gases under pressure. The main hazards are:

a. Impact from the blast of a gas cylinder explosion or rapid release of compressed gas.

b. Impact from parts of gas cylinders or valves that fail, or any flying debris.

c. Contact with the released toxic or corrosive gases or fluids (such as chlorine).

d. Fire and/or explosion resulting from the escape of flammable gases or fluids (such as liquefied petroleum gas).

e. Oxygen-enrichment and increased fire risks from released oxidants, such as oxygen, nitrous oxide and fluorine.

f. Asphyxiation risks from released inert gases – most gases except air, oxygen and some diving/medical gas mixtures.

g. Some gases are heavier than air so released gases, and their associated hazards, collect in low areas, such as basements, cellars, cable ducts, drains, etc.

h. Impact from falling cylinders.

i. Manual handling injuries.

Note: **Crush Hazard**. Due to the mass, shape and size of many gas containers, most accidents with compressed gas cylinders occur during their handling. Full cylinders of compressed gas can weigh more than 100 kg and present a serious crush risk to hands and feet.

Hazards Associated with Pressurised Containers and Industrial Gases

Note: The properties of some of the common industrial gases are detailed within Annex A

2.1.3.02 **Pressure**. Most gases are supplied compressed in metal containers such as cylinders and drums. Whenever the properties of the gas or gas mixture permits, suppliers generally utilise the maximum pressure potential of the container. Pressures of up to 300 bar are common in the MOD. Some specialist containers are higher.

2.1.3.03 Pressure vessels can fail if over-pressurised or be weakened by exposure to excessive heat. General and localised heating may cause the internal pressure to increase and could, in extreme circumstances, result in a serious failure of the container. Conversely, steel gas cylinders are prone to brittle failure if they become very cold, e.g. by contact with cryogenic liquids. Corrosion or mechanical damage to the container, and especially the valve, could result in a rapid escape of gas which could generate sufficient thrust to propel the gas container or other adjacent objects.

2.1.3.04 **Gas Escape**. An uncontrolled release of gas, known as a gas escape, caused by the inadvertent opening or shearing-off of the cylinder valve can present a hazard to people and equipment regardless of the nature of the gas. The released pressure can also turn the cylinder into a powerful projectile.

2.1.3.05 **Pressure Release Devices**. Cylinders used for industrial gases are not generally fitted with pressure relief devices. Carbon dioxide cylinders are protected by bursting discs, and some acetylene cylinders are protected by bursting discs or fusible plugs. These devices operate either directly, due to excessive heat applied to the device (e.g. fusible plugs), or indirectly, by the heat raising the pressure in the cylinder (e.g. pressure relief valves or bursting discs). It should be noted that whilst these devices should protect the cylinders from catastrophic failure, their operation may give rise to a localised hazardous atmosphere.

2.1.3.06 Transportable vacuum-insulated cryogenic gas containers are fitted with pressure relief devices which, during normal operation, are designed to lift and vent any excess pressure.

2.1.3.07 **Valve Outlets**. There are a variety of different valve outlet connection standards and codes available. Extreme care must be taken to ensure only the correct connectors are used in accordance with the supplier's recommendations. If there is any doubt as to the suitability of the valve connector, the Support Authority responsible for the cylinder, or the gas supplier, is to be consulted.

SECTION 4 – HAZARDOUS GAS MONITORING

2.1.4.01 Despite the other precautions taken to minimise the effects of hazardous gas escapes, gas detection equipment shall be installed for specific gases unless it can be demonstrated that the largest foreseeable escape of any particular gas will cause no danger to the health of persons or damage to the environment. Nevertheless, gas monitoring is compulsory for gases which may damage the environment (e.g. 'F' gas refrigerants) and it is strongly recommended for very toxic gases, oxidants, flammable gases that form explosive mixtures with air and asphyxiants (see Part 2, Chapter 9).

2.1.4.02 Many gases are heavier (more dense) than air, so escaping gases may build up in low lying areas, such as basements, cellars, inspection pits, drains, cable ducts, etc. Such "confined spaces", are subject to legal controls, and the provision of gas monitoring may require detection at both the "normal" breathing zone of 1.5 m and at lower levels.

Note: Gas monitoring is a legal requirement in Confined Spaces. Conversely, hydrogen, a flammable gas, is much lighter than air (less dense) and may form pockets in poorly ventilated roof spaces. In this case, gas monitoring may require detection at both the "normal" breathing zone of 1.5 m and at higher levels.

2.1.4.03 Where asphyxiation or oxygen-enrichment is identified as a potential hazard, consideration shall be given to the installation and use of oxygen monitoring equipment. Monitoring shall be recorded and records kept for 2 years.

2.1.4.04 Ozone Depleting Substances (ODS), such as refrigerants, and gases with high Global Warming Potential (GWP) are subject to legal controls and a requirement for proactive management. Monitoring shall be carried out at regular intervals, defined by Regulations, in order to detect for leaks; leaks must be repaired promptly; and leakages must be recorded, and, where necessary, reported to the relevant MPTF Member. This leak management may be achievable by leak detection or by cylinder weighing (see Section 6 - Hazards to the Environment, and Part 2, Chapters 9 and 12).

2.1.4.05 Outputs from the gas detection system should be available at three levels:

a. Audible and/or visible alarm to warn personnel to take appropriate emergency or corrective action prior to dangerous concentrations being reached.

b. Automatic gas supply shut-off (bulk permanent tanks only).

c. Automatic operation of extraction or ventilation systems.

SECTION 5 – GAS CLASSIFICATIONS

2.1.5.01 **Specific Gas Hazards**. Gases are categorised by their primary hazard in order to minimise risks during transportation and storage; and this can be ascertained by the hazard labels on the gas cylinder (see Part 2, Chapter 3).

2.1.5.02 It is beyond the scope of this publication to cover the possible hazards of all gases. The safety data sheet is to be consulted for specific hazards. If there is any doubt concerning gas hazards, contact the Defence Fuels Group or the gas supplier for guidance before the gas is issued and used (see Part 1, Chapter 3, Annex A).

2.1.5.03 **Flammable Gases**. When mixed with air, flammable gases can freely propagate a flame. Mixtures of flammable gases with air or other oxidants have the potential to explode. The quantity and degree of confinement of the mixture is amongst the many factors contributing to the severity of an explosion caused by the ignition of a flammable and oxidising gas mixture.

2.1.5.04 **Pyrophoric Gases**. Pyrophoric gases may spontaneously ignite and burn in the presence of air and other oxidants. Under some conditions, spontaneous ignition may not occur, resulting in the formation of an unstable pyrophoric and oxidant gas mixture which may subsequently explode.

2.1.5.05 **Oxidising Gases**. Oxidising gases support combustion in a manner similar to oxygen, and will react with flammable gases and other combustible materials. Some oxidising gases will support combustion more vigorously than air or oxygen and may react spontaneously with some flammable gases and other materials.

2.1.5.06 Some organic materials such as hydrocarbon based oils, greases and plastics, may react explosively with oxygen and more powerful oxidants (e.g. fluorine). The severity of such an explosion will depend on pressure, temperature, reactivity and concentration of the reactive components. Metal fires may be initiated in the presence of oxidants and hydrocarbon oils, greases, and other organic contaminants or particulate matter.

2.1.5.07 **Toxic Gases**. When inhaled in low quantities, toxic gas can cause acute or chronic damage to health, and prolonged exposure can cause death. Although toxic gas would normally enter the body by inhalation, it may also be ingested or absorbed through the skin.

2.1.5.08 **Corrosive Gases**. Human tissue may be harmed if it comes into direct contact with corrosive gas. Many corrosive gases may also react with certain construction materials, possibly causing damage and failure. Some corrosive gases may only react with a material in the presence of moisture. The process of corrosion can include the production of other gases such as hydrogen, giving rise to possible pressure and flammability hazards.

2.1.5.09 **Asphyxiating Gases**. A potential asphyxiation hazard exists where any gas or gas mixture does not contain sufficient oxygen to support life. For fit people, the generally accepted minimum safe oxygen level is 19%. Asphyxiant gases or gas mixtures can displace the available oxygen in the atmosphere to a level which is unsafe. It should be noted that all gases are asphyxiants except oxygen, air, and gas mixtures manufactured specifically for breathing at atmospheric pressure. Many asphyxiating gases may well present other hazards such as fire or toxicity risks. The concentrations at which these other hazards can arise are likely to be well below those at which asphyxiation occurs.

2.1.5.10 **Other Gas Classifications**. There are a few gases which are carcinogenic, mutagenic and teratogenic. Where this is the case, information shall be provided by the supplier's safety data sheet and indicated on the gas container supply label. Where practicable, gases with such severe hazards should be substituted for less hazardous ones.

SECTION 6 – HAZARDS TO THE ENVIRONMENT

2.1.6.01 Substances with the potential to cause environmental pollution (prescribed substances), are those substances or classes of substances whose release into the environment is prescribed in Part I of the *Environmental Protection Act 1990*. They are listed in the *Environmental Protection (Prescribed Processes and Substances) Regulations 1991* (as amended), and cover releases to the environmental media of air, water and land. Care shall be taken whenever gases are released to the atmosphere. The need for MOD sites to discharge waste gases to the atmosphere has been greatly reduced by the conditions of the direct supply contract the MOD has with its contractor. However, if the operational situation requires the discharge of waste gases, the table at Annex B shall be followed. Discharges of Ozone Depleting Substances, such as refrigerants, shall be recorded and reported to the relevant MPTF Member; all discharges above 25 kg shall be reported by the MPTF Member to CESO(MOD) (see Part 2, Chapter 12).

2.1.6.02 The Montreal Protocol came into force on 1 January 1989 and is intended to phase-out, by the year 2020, the use of chemicals known to be responsible for depleting the ozone layer. Certain aspects of the *EC Regulation 3093/94*, which formalised the agreements at Montreal, were implemented in the UK by the *Environmental Protection (Controls on Substances that Deplete the Ozone Layer) Regulations 1996*. However, some gaseous Montreal Protocol substances for which there are no suitable alternative currently available, are held and managed centrally on behalf of the Defence Fuels Group. Details of the provisioning, management and focal points for Montreal Protocol gases can be found in Part 1, Chapter 3. Further information is available in *JSP 418, MOD Sustainable Development and Environment Manual*.

2.1.6.03 Concern over climate change has led to International Conventions, such as the Kyoto Protocol, and various European Union legislation, such as the *EC Regulation No 842/2006 on certain fluorinated greenhouse gases,* ('F' gases). This has lead to controls on certain classes of fluorinated gases, i.e. hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), with high Global Warming Potential (GWP); and targets for their reduction and replacement. MOD users are required to annually report their holdings, estimated discharges to atmosphere, measures taken to minimise emissions to atmosphere and progress being made on their replacement (see *JSP 418, Volume 2, Leaflet 5*).

2.1.6.04 Refrigerants and sulphur hexafluoride are classed as Hazardous Waste and are subject to the current Hazardous Waste Regulations. They shall not be discharged or given to contractors, but shall be recovered into recovery cylinders and arrangements made for DFG's contractor to collect them (see Part 2, Chapter 12).

2.1.6.05 The UK Government has introduced mandatory minimum qualifications for handlers of Ozone Depleting Substances. They specify minimum qualifications for personnel handling refrigerants and halons for use in refrigeration and air-conditioning systems, and its recycling, reclamation or destruction. This requirement came into force on 10th July 2006, with all existing workers to be qualified by 09th April 2007 (see Part 2, Chapter 12).

SECTION 7 – HEALTH AND SAFETY

2.1.7.01 The main causes of accidents are:

a. Inadequate training and supervision.

b. Poor installation.

c. Poor examination and maintenance.

d. Faulty equipment and / or design (e.g. badly fitted valves and regulators).

e. Poor handling.

f. Poor storage.

g. Inadequately ventilated working conditions.

h. Incorrect filling procedures.

i. Hidden damage.

2.1.7.02 **How to reduce the risks**. All gas cylinders have to be designed and manufactured to an approved standard to withstand everyday use and to prevent danger. They must be initially inspected before they are put into service to ensure they conform to the approved standard, and be periodically examined at appropriate intervals to ensure that they remain safe while in service. If ever a gas cylinder is considered to be unserviceable, or the contents of the cylinder cannot be accurately identified, it is to be made safe by a competent person, returned as unserviceable and a serviceable cylinder obtained as required (see Part 1, Chapter 6).

2.1.7.03 **Training**. Anyone who examines, refurbishes, fills or uses a gas cylinder should be suitably trained and have the necessary skills to carry out their job safely. They should understand the risks associated with the gas cylinder and its contents (see Part 1, Chapter 8). Recognised certified training is also mandatory for handlers of refrigerants and halons for use in refrigeration and air-conditioning systems, and its recycling, reclamation or destruction (see Part 2, Chapter 12).

2.1.7.04 **Health and Safety Awareness**. All personnel are to be made aware of their responsibilities when working with pressure equipment, whether transportable pressure vessels or fixed pressure systems. Line management are to ensure that they have implemented the requirements of the Health and Safety at Work Act and that they operate safe working procedures as defined within *JSP 375* and that where appropriate they have applied the *Defence Estates Safety Rules and Procedures*.

2.1.7.05 Site managers are to have a working knowledge of the *Health and Safety at Work, etc Act 1974*, and *Control of Substances Hazardous to Health Regulations 2002*. As a minimum standard, all personnel working with portable gas containers are to have a thorough knowledge of:

a. Safety regulations detailed in this document and all policies, procedures and operation/work instructions for the sites on which they are authorised to work.

b. Safety Data Sheets for the gases they are likely to be involved with.

c. Safe handling of gas containers.

d. Identification and hazards of gas container contents.

e. Gas properties (physical, chemical, hazardous).

f. Potential hazards of high pressure containers.

g. Procedure for the supply and disposal of gases, and associated activities.

h. Personal Protective Equipment (selection, location and use).

i. Emergency equipment (location and use).

j. Emergency procedures (gas leaks, fire, etc).

k. Gas container safety checks on receipt and before return to supplier.

l. Designated smoking and no-smoking areas.

2.1.7.06 **Operating Procedures**. Written Standard Operating Procedures (SOPs) shall be available and understood by all personnel. The accepted SOPs for the safe handling of gases and associated equipment shall be clearly detailed. SOPs shall be prepared by a competent person, issued formally, regularly updated, and reviewed annually. A system of control shall be employed to ensure that only the most recent issue of SOPs and any associated drawings/diagrams are in use; all superseded documents shall be destroyed. New equipment and modifications shall not be put into use until SOPs and drawings/diagrams have been issued or revised appropriately.

2.1.7.07 **Internal Auditing**. Regular internal audits shall be conducted and recorded. They are to be conducted at least twice a year, and may be integrated into a general auditing schedule. In particular, audits shall check that:

a. All operations are covered by authorised SOPs.

b. Latest issue of all SOPs and drawings/diagrams are readily available.

c. SOPs are being followed.

d. Unauthorised modifications have not been made to systems and procedures.

e. All personnel are adequately trained.

f. All specified safety and emergency equipment is available and in good condition.

g. Where Ozone Depleting Substances and/or 'F' gases are held, they are proactively managed in accordance with *JSP 418, Volume 2, Leaflets 4, 5 and 11* and Part 2, Chapter 9, as appropriate.

h. Unwanted part used cylinders of refrigerants and sulphur hexafluoride gas and mixtures are disposed in accordance the current Hazardous Waste Regulations. Unwanted, used product is to be recovered in accordance with MOD Policy (see Part 2, Chapter 12) and disposed off as Hazardous waste gases, as above.

2.1.7.08 **External Auditing**. Dangerous Goods compliance audits on transport associated activities will be undertaken periodically by the Defence Goods and Hazardous Stores Group.

SECTION 8 – BCGA

2.1.8.01 The British Compressed Gases Association (BCGA) is the British trade association representing companies in the industrial gases industry that manufacture and distribute gases, manufacture receptacles to contain them or equipment to use them. The BCGA seeks to promote safe practice in the manufacture, distribution, storage and use of compressed and liquefied gases.

2.1.8.02 BCGA publishes Codes of Practice and Guidance Notes that provide guidance on safe practice on the handling and use of gases. They are accepted as industry standards and are recognised as such by the regulatory authorities. Many of these are referenced in JSP 319.

Contact details:

British Compressed Gases Association
1 Gleneagles House,
Vernongate, Derby,
DE1 1UP
Tel: 01332 225120
Fax: 01332 225101
www.bcga.co.uk

BIBLIOGRAPHY

1. *Environmental Protection Act*, 1990.

2. *Health and Safety At Work, etc, Act*, 1974.

3. *Environmental Protection (Controls on Substances that Deplete the Ozone Layer) Regulations*, 1996.

4. *Environmental Protection (Prescribed Processes and Substances) Regulations*, 1991.

5. The *Hazardous Waste (England and Wales) Amendment Regulations*, 2009. No. 507.

6. The Special Waste Amendment (Scotland) Regulations, 2004. No. 112.

7. *Ozone Depleting Substances (Qualifications) Regulations*, 2006

8. *Control of Substances Hazardous to Health Regulations*, 2002, (COSHH)

9. *Dangerous Substances and Explosive Atmospheres Regulations*, 1998, (DSEAR)

10. *Management of Health and Safety at Work Regulations*, 1999

11. British Compressed Gas Association Guidance Note 2 (2005). *Guidance for the Storage of Gas Cylinders in the Workplace*.

12. *British Compressed Gases Association (2001). Pressure Systems Legislation – a Summary*.

13. British Compressed Gas Association Code of Practice CP18 (2005). *The Safe Storage, Handling and Use of Special Gases in the Micro-Electronics Industry*.

ANNEX A

(introduced at paragraph 2.1.3.02)

PROPERTIES OF INDUSTRIAL GASES

2.1.A.01 The main characteristics of commonly used compressed gases are described below.

2.1.A.02 With the exception of breathing air and oxygen, all gases in sufficient concentrations will asphyxiate without warning.

2.1.A.03 Safety Data Sheets are available for all gases; and are to be referred to. The safety data sheet will be issued with the gas cylinder. The safety data sheet shall always be considered the authoritative reference for gas characteristics.

2.1.A.04 **Acetylene:**	Colourless. Odour similar to garlic. Non-toxic. Flammable and will ignite from a spark or by contact with hot metal. Lighter than air (density 0.9). Asphyxiates by depleting oxygen. Explosive range in air: 2% to 82%. Explosive range in oxygen: 2% to 92%

Notes:

1. Acetylene under pressure above 0.62 bar (9.0 lb/in^2) is legally classified as an explosive, it is controlled by the *Explosives Act, 1875*, and needs Health and Safety Executive approval. To be considered as a potential fire and explosion hazard (see Part 1, Chapter 9).

2. Acetylene is produced by the action of calcium carbide in water. The acetylene gas produced is the most powerful and versatile of all the fuel gases which are commercially available. Its chemical formula is C_2H_2.

3. Some acetylene cylinders are fitted with bursting discs. These are set to operate at 30.6 bar.

4. Acetylene cylinders are not hollow. They contain a porous material which is impregnated with acetone. Acetone can dissolve 24 times its own weight of acetylene.

5. It is because of the presence of acetone that the cylinder is to be stood upright when in use. If the cylinder is laid on its side for a period the acetone will drain towards the cylinder valve and the mixture of acetone and acetylene will come out of the cylinder when the valve is opened.

WARNING: If an acetylene cylinder has been laid on its side then it is to be stood upright for a minimum period of 1 hour before any attempt is made to use it.

WARNING: Mechanical shock to the cylinder, due to mishandling or overheating, may cause decomposition giving rise to high temperatures and possible detonation, even in the absence of oxygen.

WARNING: Acetylene will react with copper, particularly in damp conditions to form copper acetylide. This is an impact explosive. It is for this reason that acetylene should not be allowed to remain in contact with pure copper or brass which contains more than 70% copper. Care is to be taken when selecting components for use in an acetylene system. Many components, e.g. pressure gauges (which traditionally utilise copper in the manufacture of bourdon tubes), have to be specifically designed for use with acetylene.

2.1.A.05 **Carbon Dioxide:**	Colourless. Slightly pungent odour in high concentrations. Toxic. Heavier than air. Asphyxiates by depleting oxygen, but is also toxic once the concentration reaches several percent by volume. Consideration must be given to the dangers of storage and use in confined spaces.
2.1.A.06 **Hydrogen:**	Colourless. Odourless. Non-toxic. Flammable and will ignite from a spark or by contact with hot metal. Lighter than air. Asphyxiates by depleting oxygen. Burns with a pale blue flame, which can be difficult to see. Gas may spontaneously ignite. A concentration of as little as 4% in air can burn. Considered a fire and explosion hazard.
2.1.A.07 **Inert Gases (Argon, Nitrogen, Helium, etc):**	Colourless. Odourless. Non-toxic. Can be lighter (e.g. helium) or heavier (e.g. argon) than air. Asphyxiates by depleting oxygen. Chemically inert. Consideration must be given to the dangers of storage and use in confined spaces.
2.1.A.08 **Methane:**	Colourless. Non-toxic. Flammable and will ignite from a spark or from contact with hot

	metal. Lighter than air. Asphyxiates by depleting oxygen. Must be considered as a potential fire and explosion hazard.
2.1.A.09 **Nitrous Oxide:**	Colourless. Odourless. Non-toxic. Vigorously supports combustion. Heavier than air. Asphyxiates by depleting oxygen. Oils, greases, and solvents may react violently with nitrous oxide.
2.1.A.10 **Oxygen:**	Colourless. Odourless. Non-toxic. Non-flammable. Oils, greases and solvents may react violently with oxygen and metals may also burn. Many materials that would not normally burn in air will readily burn in an oxygen rich atmosphere.

2.1.A.11 For Cryogenic Liquids, see Part 2, Chapter 10.

2.1.A.12 For LPG, see Part 2, Chapter 16.

2.1.A.13 For Refrigerants, see Part 2, Chapter 12.

ANNEX B

(introduced at paragraph 2.1.6.01)

WASTE GAS DISCHARGE TO ATMOSPHERE

Table 2.1.B1

Serial (a)	Hazardous Property (b)	Principles (c)
1	Toxic and Very Toxic	Routine: Discharge via appropriate abatement equipment; the efficiency of such equipment must be monitored while in use.
2	Toxic and Very Toxic	Non-Routine: Consider means of treating, controlling and discharging. If discharging to atmosphere, ensure that it is away from populated areas and air intakes, and diluted with air to ensure personnel are not exposed to concentrated levels.
3	Flammable Gases	All Disposal Operations: Avoid risk of explosive gas and air mixtures in storage areas. Ensure that there are no ignition sources where there is a risk of flammable gas release. If discharged directly to atmosphere, ensure that it is away from populated areas and air intakes. Flash-back arrestors are to be fitted.
4	Oxygen	All Disposal Operations: Minimise the risk of fire by avoiding the creation of an oxygen enriched atmosphere.
5	Asphyxiant Gases	All Disposal Operations: Minimise the risk of creating an asphyxiant hazard by avoiding atmospheric oxygen depletion.

Part 2

Chapter 2 (Sponsor – FSAT , SAFETY 3)

PERSONAL PROTECTIVE EQUIPMENT (PPE)

SECTION 1 – SCOPE

2.2.1.01 This chapter details the general requirement for the use of Personal Protective Equipment when handling or using gases, gas cylinders and/or cryogenic liquids, and lists specific Personal Protective Equipment to be used.

SECTION 2 – GENERAL

2.2.2.01 Personal Protective Equipment (PPE) refers to all equipment and products designed to be worn or held by a person at work to protect them against one or more risks to their health and safety.

2.2.2.02 **Requirement**: The use of PPE is always to be subject to a documented risk assessment. The procedure for carrying out a risk assessment is detailed in *JSP 375*. In this context, PPE is to be selected and provided with regard to the particular potential hazards to personnel involved in handling, supply and disposal of cryogenic liquids, liquefied gases, gas and gas containers in accordance with the requirements of *SI 2002, No.2667 (the Control of Substances Hazardous to Health Regulations, 2002)*. Risk Assessors are to make reference to the relevant equipment publications, manufacturers information and the Safety Data Sheet (SDS). As part of the Risk Assessment, a PPE Assessment is to be carried out (see JSP 375, Volume 2, Leaflet 13).

2.2.2.03 The majority of PPE provided by the MOD is detailed in *JSP 437*. Reference should be made to this document to identify suitable products that provide the characteristics identified by the PPE assessment.

Note: All PPE worn or held by a person at work to protect them against risks to health and safety should be ‘CE’ marked.

2.2.2.04 Line Managers are to ensure that:

a. Where a requirement for PPE is specified as part of a documented risk assessment, that a further assessment is made to determine the most suitable PPE for a particular application; and, if the circumstances demand, the person who will use it.

b. Ensure that PPE is provided and is worn.

c. Ensure that adequate information, instruction and training is provided and that personnel fully understand the rationale for using PPE.

2.2.2.05 All persons handling / operating gas cylinders or cryogenic liquids shall:

a. Use any PPE supplied to them in accordance with the training or instruction received.

b. Check PPE serviceability immediately prior to use and report immediately to their Line Manager any loss or defect in the PPE provided to them.

Note: In certain locations, or site conditions, additional protective clothing / PPE may be obligatory, e.g. hard hats, ear defenders and/or breathing apparatus, and that this may introduce PPE compatibility problems which could force an additional risk assessment and the provision of alternative styles of PPE. For example, the full face visor shown in Figure 2.2.A1 in Annex A is incompatible with breathing apparatus.

2.2.2.06 All PPE shall be stored in clearly marked locations that are away from areas likely to become contaminated; and should be decontaminated after use, before being returned to the designated storage location. Where appropriate, equipment (such as self-contained breathing apparatus) should be stored in containers and in the manner recommended by the supplier.

2.2.2.07 **Maintenance of PPE**. To ensure that it is kept in good functional condition, all PPE shall be inspected regularly in accordance with local orders and/or the authorised engineering inspection and maintenance schedules.

2.2.2.08 **Unserviceable PPE**. Adequate PPE is to be available to replace equipment removed for maintenance or repair. Any unserviceable PPE shall be clearly labelled and stored separately from serviceable equipment. Specific written procedures shall be produced to ensure that unserviceable PPE can not be used inadvertently.

Note: *JSP 437* mandates the use of *MOD Form 1197* to report unexpected or unacceptable failures in Defence Clothing Team procured PPE. The defect reporting policy and the MOD Form 1197 is available via JSP 886, Volume 6, Part 5 Clothing, Section 7.

2.2.2.09 **Breathing Apparatus**. All wearers of Respiratory Protective Devices (RPD) must be trained in its use and retraining / refresher training provided at suitable intervals. The nature of the atmosphere and the working environment will determine the protection required. Equipment used must be to the relevant BS EN standards (refer to *BS EN 529 Respiratory Protective Devices*. *Recommendations for selection, use, care and maintenance.* Guidance document).

2.2.2.10 All self-contained breathing apparatus shall be regularly cleaned and checked to ensure their correct operation and that air containers (including spare air containers) are fully charged; and the checks recorded. Such maintenance should also be carried out each time the equipment is used; and the maintenance recorded. If an in-house air container charging facility is available it shall be regularly maintained in accordance with the manufacturer's instructions.

2.2.2.11 **Barrier cream**. The use of skin barrier creams is undesirable when working with oxygen or oxygen equipment, as such creams are often hydrocarbon-based. Their use may lead to the contamination of oxygen equipment and they represent an increased fire hazard to personnel. Users / maintainers are to wear approved clean gloves.

Note: For similar reasons, the use of thin gloves, or latex gloves, that are internally “dusted” with talc, or other powder, is undesirable when working with high pressure oxygen and their use should be subject to an appropriate risk assessment.

2.2.2.12 **Gas monitoring**. If working in an environment where there is the potential for gas leaks, consideration should be given to using the following monitoring equipment:

a. Portable toxic gas monitor.

b. Portable oxygen enrichment/depletion monitor.

c. Portable flammable gas monitor.

d. Positive pressure breathing apparatus.

2.2.2.13 Some gases are heavier than air and may collect in low lying areas and/or basement areas, displacing ambient air, leading to either increased asphyxiation or fire risks (see, for example, Part 2, Chapters 9 and 10). Such areas may fall within the scope of the *Confined Space Regulations* and personnel shall not enter such areas without having complied fully with the requirements of this legislation (see *Confined Space Regulations* and *JSP 375*).

2.2.2.14 Portable monitors should be used to compliment permanent monitoring systems in fixed installations (see, for example, Part 2, Chapters 9 and 10). Portable monitors shall be calibrated and checked regularly in accordance with the manufacturer's instructions.

SECTION 3 – SPECIFIED PPE

2.2.3.01 **Emergency Use PPE**. Gases produce many hazards. The risk assessment should highlight the hazards that are likely and where there are increased risks. Where there is an increased risk, provision is to be made to provide PPE specifically for use in an emergency situation. This may include:

a. Self-contained positive pressure breathing equipment.

b. Face shield.

c. Chemically-resistant gauntlets/gloves

d. Chemically resistant apron or overalls.

e. Complete body protection suit (for area contaminated with corrosive gas).

2.2.3.02 The documented risk assessment shall also pre-identify measures to protect the health and safety of personnel entering these areas, such safety harnesses and the provision of standby personnel kitted out with Emergency Use PPE located outside the hazardous area.

PPE for use when handling / operating gas cylinders

Table 2.2.1

	Protection required
Hands	Heavy duty industrial gloves. (*BS EN 388*).
Feet	Wear safety boots or shoes (*BS EN ISO 20345* or *BS EN 345*) when handling cylinders. The impact resistant toe-caps shall be internal. No steel tips (hob-nails) on sole or heel. Anti-static sole. Metatarsal (midsole) protection recommended.
Eyes	Safety glasses are to be used when connecting or disconnecting gas cylinders. Use chemical goggles or face shield when handling the product in liquid form. (*BS EN 166*).
Clothing	Wear Coverall FR with long sleeves to cover exposed skin. (*BS EN 531*). Keep clean, maintained free from oil & grease. Secure at wrist. Not too loose.
Respiratory	RPD shall be used if there is a risk of high vapour concentration.

2.2.3.03 **PPE for use when handling Liquefied Petroleum Gas (LPG)**. PPE is always to be used when handling LPG, whether in bulk or packed (cylinders) form, as well as by personnel working in filling plants to minimise the risk of injury / accident.

Table 2.2.2

	Protection required
Hands	Use heavy duty industrial gloves when handling cylinders, (*BS EN 388*). Use rubber (neoprene) gloves if in contact with liquid, (*BS EN 374*). During the transfer / filling of LPG, gloves to resist cold burns are to be worn. (*BS EN 511*).
Feet	Wear safety boots or shoes (*BS EN ISO 20345* or *BS EN 345*) when handling cylinders. The impact resistant toe-caps shall be internal. No steel tips (hob-nails) on sole or heel. Anti-static sole. Metatarsal (midsole) protection recommended.
Eyes	Safety glasses are to be used when connecting or disconnecting gas cylinders. Use chemical goggles or face shield when handling the product in liquid form.
Clothing	Wear Coveralls FR with long sleeves to cover exposed skin, (*BS EN 531*). Keep clean, maintained free from oil & grease. Secure at wrist. Not too loose.
Respiratory	RPD shall be used if there is a risk of high vapour concentration.

2.2.3.04 **PPE for use when using oxy-fuel gas equipment**. Eye protection is essential at all times. It is necessary to protect against heat, glare and flying sparks. Goggles shall comply with *BS EN 175* and lenses with *BS EN 169*.

2.2.3.05 The outer lens is to be replaced before any build-up of welding splatter, dirt or scratches impede the operator's vision. Recommendations on the correct shade of filter lens to use are found in *BS EN 169*. A backing lens should be used if the filter lens is not robust in accordance with *BS EN 169*. Suitable clothing preferably made from flame-retardant (FR) material should be worn (*BS EN 470*). Suitable leather gloves or gauntlets (*BS EN 12477*) should be worn during operations or when handling metal.

2.2.3.06 **PPE for use when handling Cryogenic Liquids**. Many so-called non-flammable textile materials will burn fiercely in air containing as little as 30% oxygen, and no material should be considered totally safe. Fabrics such as nylon should not be worn as these can increase the severity of burns in a fire situation.

2.2.3.07 Clothes should be well fitting, yet easy to remove. All clothing is to be maintained clean and free from oil and grease. To minimise the risk associated with working in this environment outer clothing needs to be waterproof. Cryogenic liquid will run off in a similar fashion to water. There should be no open pockets or turn-ups where liquid can collect. All pockets require storm flaps. The hood, if fitted, must be stowable. Cuffs should be double layered to prevent the ingress of liquid. Gloves secured over the inner layer. Aprons are not recommended as they may trap liquid between the apron and inner clothing. Water-resistant outer clothing, manufactured from a material with close-formed fabric, such as Gortex™, is recommended.

2.2.3.08 Personnel who are required to work in a cryogenic workshop or storage area should use a set of dedicated clothing and other PPE, so as to maintain it in a 'clean' condition. Such clothing / PPE shall be marked for 'oxygen bay use only' (see Part 2, Chapter 10).

2.2.3.09 Persons who have been exposed to an oxygen-enriched atmosphere must not smoke or go near hot spots or sparks until they have properly ventilated their clothes in a normal atmosphere. A minimum ventilation period of 15 minutes, with movement of the arms and legs, and with the outer clothing loosened, may be necessary (see Part 2, Chapter 10).

2.2.3.10 Approved gloves (minimum specification *BS EN 511*) are essential to protect the hands when handling valves or metal parts through which a cryogenic liquid flows. Gloves should be a loose fit so that they may be readily removed should liquid splash onto them or into them; or in case of "freezing" onto cold metal parts. Gloves should incorporate an elasticated knitted wrist. Only a single layer of glove is to be worn (no inner layers). Gloves should be regularly checked for contamination e.g. by oil and grease, and any contaminated gloves are to be replaced. Hand gloves are to be the standard item used, however, where there is a specific requirement identified in the process risk assessment for the operator to have to work with hands at or above chest level gauntlet style gloves may be used.

2.2.3.11 A face shield prevents injury to exposed skin and particularly the eyes. In addition to the face shield, the use of safety glasses which specifically protect the eyes from liquid ingress should be considered as part of the PPE Assessment.

2.2.3.12 The wearing of jewellery specifically on the hands and wrists e.g. watches, rings, is not recommended when working with cryogenic liquids.

2.2.3.13 It is recommended that, wherever practicable, NBC equipment is **NOT** worn in a cryogenic liquids environment. When there is a requirement to wear NBC equipment, oxygen bay protective clothing is to be worn over the top of the NBC equipment. Refer to Part 2, Chapter 10, Paragraph 2.10.7.58.

2.2.3.14 The wearing of NBC equipment in a cryogenic liquid environment is to be specifically addressed when carrying out the documented Risk Assessment.

Table 2.2.3: Summary of PPE for use with cryogenic liquids.

	Protection required
Hands	PVC or leather gloves should always be worn when handling anything that is, or may have been, in contact with cold liquids or vapours. (*BS EN 511*). Gloves should be a loose fit so that they may be readily removed should liquid splash onto them or into them, or in case of "freezing" onto cold metal parts. Gloves should incorporate an elasticated knitted wrist. Sleeves should cover the ends of the gloves.
Feet	Safety boots (*BS EN ISO 20345* or *BS EN 345*). The impact resistant toe-caps shall be internal. No steel tips (hob-nails) on sole or heel. Anti-static sole. Metatarsal (midsole) protection recommended.
Eyes	Safety eye / face protection (*BS EN 166*). Chemical goggles or face shield. The face shield prevents injury to exposed skin and particularly the eyes.
Clothing	Non-nylon, Coverall FR or similar type clothing should be worn. Long sleeves / legs so that the skin is not exposed. No open pockets or turn-ups where liquid can collect. Overalls to be secured at the wrist. Cuffs should be double layered to prevent the ingress of liquid. Gloves secured over the inner layer. Trousers to be worn outside boots. Water-resistant outer clothing, manufactured from a material with close-formed fabric, such as Gortex™, is recommended.

2.2.3.15 Annex A, details the recommended PPE / clothing for use in cryogenic environment.

BIBLIOGRAPHY

1. JSP 375 - *MOD Health and Safety Handbook*

2. JSP 437 - *Personal Protective Equipment Catalogue.*

3. JSP 515 - *MOD Hazardous Stores Information System.*

4. JSP 886 – The Defence Logistic Support Chain Manual.

5. BS EN 166 - *Personal Eye Protection. Specifications.*

6. BS EN 169 - *Personal Eye Protection. Filters for Welding and Related Techniques. Transmittance Requirements and Recommended Use.*

7. BS EN 175 - *Personal Protection. Equipment for Eye and Face Protection During Welding and Allied Processes.*

8. BS EN 345 - Note: This has been replaced by BS EN ISO 20345

9. BS EN 374 - *Protective Gloves Against Chemicals and Micro-Organisms.*

10. BS EN 388 - *Protective Gloves Against Mechanical Risks.*

11. BS EN 470 - *Protective Clothing for Use in Welding and Allied Processes. General Requirements.*

12. BS EN 511 - *Protective Gloves Against Cold*.

13. BS EN 529 - *Respiratory Protective Devices. Recommendations for Selection, Use, Care and Maintenance. Guidance Document.*

14. BS EN 531 - *Protective Clothing for Workers Exposed to Heat*.

15. BS EN 12477 - *Protective Gloves for Welders*.

16. BS EN ISO 20345 - *Personal Protective Equipment. Safety Footwear*.

ANNEX A

(introduced at paragraph 2.2.3.14)

RECOMMENDED PPE / CLOTHING FOR USE IN A CRYOGENIC ENVIRONMENT

Table 2.2.A1

	Item, description	**NSN**
Head	Helmet	8415-99-132-1013 (White) 8415-99-132-1014 (Blue) 8415-99-132-1015 (Orange) 8415-99-869-1902 (Yellow) 8415-99-920-0977 (Red)
	Frame Attachment Industrial Safety Helmet	4240-99-662-8437
	Headband Industrial Faceshield (when helmet is not worn).	4240-99-978-8777
	Visor Faceshield (for above)	4240-99-978-8781 4240-99-978-8784
	Chinguard (for above)	4240-99-978-8787
	Ear defenders (for helmet)	4240-99-132-1371
Hands	Gloves, Cryogenic	8415 99 700-6621 (Large)
Feet	High Leg Safety Boots	8430-99-297-6732 / 6734 8430-99-869-1170 / 1184 8430-99-2822339 / 2341
Body	Coverall FR Navy Blue	8405-99-869-6250 / 6262
	Coverall FP Green	8415-99-225-7261 / 7273
	Smock (POL Suit)	8415-99-8696024 (Small) 8415-99-8696025 (Medium) 8415-99-8696026 (Large) 8415-99-8696027 (Extra Large)
	Salopettes (POL Suit)	8415-99-8696020 (Small) 8415-99-8696021 (Medium) 8415-99-8696022 (Large) 8415-99-8696023 (Extra Large)
	Storage bag	8415-99-5003933

Note: See also Figure A1.

Figure 2.2.A1: Recommended PPE / clothing for use in a cryogenic environment

Part 2

Chapter 3 (Sponsor – FSAT, SAFETY 3)

IDENTIFICATION OF GAS CONTAINERS

SECTION 1 – SCOPE

2.3.1.01 This chapter provides information on primary and secondary identification labelling and marking used to indicate the contents of a gas cylinder and the associated hazard(s) of the gas.

WARNING: The precautionary label is not to be removed or tampered with in any way.

WARNING: The colour of the cylinder is not to be altered.

WARNING: Pre-stamped markings are not to be altered in any way.

WARNING: Cylinders shall not be marked by stamping data on the cylindrical section.

SECTION 2 – GENERAL

2.3.2.01 Gas cylinders are supplied in various shapes and sizes, from small cylinders to banks of manifolded cylinders. The common sizes in general circulation are from 5 to 50 litres water capacity, ranging from 500 mm to 1500 mm in height and 150 mm to 230 mm in diameter. Weights range from 8 kg to 80 kg.

2.3.2.02 The shape of a cylinder does not provide any reliable information about its contents, LPG cylinders, however, when compared with other compressed gas cylinders, are wider and more squat in shape and are usually fitted with a welded foot ring making the standing cylinder more stable than others.

SECTION 3 – STANDARD IDENTIFICATION MARKING

2.3.3.01 **Cylinder identification**. The contents of a cylinder are primarily indicated by the information on its precautionary label. A secondary method of identification is by the colour code painted onto the cylinder; or more specifically onto the cylinder shoulder.

2.3.3.02 Contractor owned containers are most likely to be marked in accordance with the following standards:

a. *BS EN ISO 13769: 2006 - Gas Cylinders. Stamp marking*.

b. *BS EN ISO 7225, Gas Cylinders. Precautionary Labels.*

c. BS EN 1089-3 Transportable gas cylinders. Colour coding.

2.3.3.03 Medical gases comply with the colour coding system in *ISO 32 (ISO 32: 1977, Gas cylinders for medical use - Marking for identification of content)*.

2.3.3.04 MOD owned containers are marked in accordance with the following Defence Standard:

a. *Defence Standard 81-24. Identification Markings of Transportable Containers, Compressed Gas*.

2.3.3.05 Deviation from the standard colour and marking codes causes confusion and can be dangerous. The painting and marking of cylinders is only to be carried out by approved contractors or by approved MOD gas cylinder maintenance workshops. Under no circumstances are stamp-marking, painting, stencilling or local identification markings to be placed on cylinders without the specific permission of the owner (Support Authority) of that cylinder.

2.3.3.06 Where cylinders are over-packed for transportation, all cylinders within the packaging are to be correctly marked and identified, and the outer packaging is to be accurately marked and identified to show the contents (see Part 2, Chapter 8 – Transportation).

2.3.3.07 **MOD Identification Marks**. The following markings should be on all MOD cylinders:

a. The letters 'MOD' and the MOD Pheon '$\uparrow$' stampmarked on the shoulder.

b. All MOD owned cylinders should have a NATO Stock Number (NSN).

c. The MOD is identified as the owner on the identification label, or

d. The MOD is identified as the owner from information paint stencilled on the body of the cylinder.

2.3.3.08 **Stamp-marking**. Stamp-marking is used to provide durable and legible manufacturing, operational and certification information. Cylinders are stamp-marked by the manufacturers, the owners or by authorised persons only. The name of the industrial gas company will be stamped on the cylinder. This will allow identification as to who the cylinder owner is. For acetylene cylinders, the word ACETYLENE is stamped onto the neck. This will allow positive identification as to whether the cylinder is an acetylene cylinder.

2.3.3.09 On composite cylinders stamp-mark information may be printed on a label that is placed under the resin. This may be on the shoulder or the side-wall of a cylinder.

2.3.3.10 MOD personnel are not to stamp-mark any information onto a cylinder without the specific permission of the owner (Support Authority) of that cylinder.

2.3.3.11 **Precautionary labels**. The precautionary label is the primary method of identifying a cylinder and its contents (refer to BS EN ISO 7225). Precautionary labels are normally attached to the shoulder area of a cylinder. The purpose of the label is to facilitate the identification of each cylinder and its contents and to warn of the principle hazards associated with those contents.

Note: Precautionary labels and diamond hazard labels are allowed to be painted directly onto the cylinder for specified liquefied gases, e.g. LPG. UKLPG CP 29 and ADR refer.

2.3.3.12 The label is to be maintained on a cylinder such that it remains clearly visible and legible. In the event that a label becomes illegible, or is removed, then the cylinder should be returned and a serviceable cylinder obtained.

2.3.3.13 The label will consist of two parts:

a. A diamond hazard label that identifies the primary and any subsidiary risks associated with the gas contents.

b. A warning panel with the following information:

(1) Company Name (of the company supplying the gas and container)

(2) Address of the company in the United Kingdom

(3) Risk and Safety phases relating to the product

(4) EC label (for pure substances only)

(5) EC number, if applicable

(6) Product name and the chemical symbol of the gas

(7) UN identification number

(8) Proper shipping name

Note: Some labels may also have the items NATO Stock Number (NSN).

2.3.3.14 The diamond hazard label is to conform to the requirements of the *United Nations Recommendations on the Transport of Dangerous Goods, Model regulations*. All gases are assigned to Class 2. They are subdivided into one of three divisions based on the primary hazard:

a. Division 2.1 Flammable gases

b. Division 2.2 Non-flammable, non-toxic gases

c. Division 2.3 Toxic gases

2.3.3.15 A separate label is provided for each of these primary hazards. Where the gas also has a subsidiary risk(s), further diamond hazard labels(s) will be displayed, such as:

a. Subsidiary risk 5.1 Oxidizing substance

b. Subsidiary risk 8 Corrosive substance

2.3.3.16 These diamond hazard labels are displayed in Annex B.

Notes:

1. Diamond hazard labels are allowed to be reduced in size to fit gas cylinders according to the dimensions outlined in BS EN ISO 7225. Labels may overlap, however, the primary risk label and the figures appearing on the label are to remain fully visible and the symbols recognizable.

2. Reference is to be made to *JSP 800* for the MOD requirement for marking and labelling of dangerous goods during transportation. There are specific requirements for the marking of vehicles carrying dangerous goods. Refer to Part 2, Chapter 8.

SECTION 4 – ADDITIONAL IDENTIFICATION MARKING

2.3.4.01 **This way up label**. This way up labels are to be displayed on two opposite sides of a package containing refrigerated liquefied gases. This label is displayed in Annex C.

2.3.4.02 **Cryogenic label**. A cryogenic label is required to be displayed on packages containing refrigerated liquefied gases. It is compulsory on air freight. This label is displayed in Annex C.

2.3.4.03 **Tropical fill label**. There are two filling ratios to which a gas is supplied within a cylinder in the MOD.

a. Where the cylinder is to be used within the United Kingdom, then it will be supplied in the 'full' condition, at the maximum charge pressure.

b. If, however, the cylinder is to be supplied to a unit operating in an area where the ambient temperature is likely to be high, there is a danger that the internal pressure will rise, with increasing temperature. To ensure that the cylinder internal pressure stays within the prescribed limits for that cylinder then the cylinder will be supplied with a 'Tropical Fill' which will be less than the normal 'full' condition. These cylinders will have a Tropical Fill label attached to them. An example of this label is displayed in Annex D.

2.3.4.04 **Aviation standard gas (STANAG 7146)**. In order to comply with *STANAG 7146* – Assignment of NATO code numbers to gases used in aircraft cross-servicing – Certain gases used by NATO armed forces in aircraft cross-servicing operations will be identified with additional information indicating the NATO code number and the NATO product description. These gases are identified in *Defence Standard 81-24*. This information may be included on the precautionary label or, alternatively, an additional label will be attached to the cylinder. The label displayed in Annex D may be used.

2.3.4.05 **Expiry date label**. Some gases (e.g. breathing gases and medical gases) are allocated a life. Depending on the gas type this typically ranges from 2 years to 10 years. This is indicated by the supplier using a label attached to the plastic collar, or the upper body, of the cylinder. Once this life has expired the gas is no longer fit-for-purpose and the gas cylinder is to be returned. An example of a typical label is displayed in Annex D.

2.3.4.06 **Identification of contractors cylinders filled by MOD personnel**. When it is necessary for MOD personnel to fill contractor-owned cylinders, separate body and shoulder labels are to be attached to contractors cylinders on their 1st fill by MOD personnel stating that the cylinder has been filled by MOD personnel and that it requires an internal inspection on return to the contractor (see Part 2, Chapter 5). This label is displayed in Annex D.

2.3.4.07 These labels are available for demand via the MOD Gas Supply. Contact DFG for further advice.

Table 2.3.1

Description	Contractors Part No.	NSN
Label, Contractor cylinder filled by MOD	13165512	71C/0443/7690-99-9287998

2.3.4.08 **Cylinder Test Rings**. It is mandatory for every cylinder to have an initial inspection and test to ensure its serviceability before use, this is followed by regular periodic inspection and tests to ensure its continued serviceability whilst in service. The date that these inspection and tests are carried out is stamp-marked on the cylinder. Following an inspection and test each cylinder is allocated a life before its next periodic inspection and test becomes due.

2.3.4.09 Cylinder Test Rings provide a quick, visual reference that show when a cylinder is due for its next periodic inspection and test. They normally consist of two brightly coloured plastic discs, fitted between the cylinder and the valve, colour coded and shaped to indicate the month and year when the next periodic inspection and test is due.

2.3.4.10 A secondary use of these test rings is to indicate when a cylinder has been exposed to excessive heat. If any heat damage is evident on the rings the cylinder is to be returned and replaced with a serviceable item (see Part 1, Chapter 9).

Notes:

1. Only authorised personnel may fit cylinder test rings.

2. Only complete cylinder rings are allowed to be used. If cylinder test rings are damaged, the cylinder is to be returned and replaced with a serviceable item.

3. Some older cylinders tested to *BS 5430* could be stamped on the shoulder with either:

   a. The month/year of testing. or

   b. The year followed by a number in a circle to denote the quarter of the year of testing. When marked in this way only the year ring is fitted and a hole(s) punched in the ring to denote the quarter.

2.3.4.11 Details of the Cylinder Test Rings are in Annex A.

2.3.4.12 **Plastic collars**. Many cylinders rented from contractors will come with a white plastic collar fitted around the neck of the cylinder. This is an approved addition which allows the contractor to display all the technical, legislative and safety information relevant to that particular cylinder and its contents. This white plastic collar is not to be removed. In the event that a white plastic collar becomes removed, the cylinder is not to be used and it is to be returned to the contractor.

2.3.4.13 **Colour coding**. Colour coding, based on *BS EN 1089-3*, is a secondary method of identifying the contents of a gas cylinder. Colour coding is applied solely to the shoulder, or curved part, at the top of the cylinder, and is used to identify the hazard associated with the gas in the cylinder. Certain gases have been allocated a specific colour. Two concentric bands, or quartering, may be used to show where a gas has more than one hazard. While this colour code is being used to provide a degree of conformity, it is not a mandatory standard, and has not been adopted by all gas companies. Each gas company is allowed to adopt its own colours for the main body of the cylinder.

2.3.4.14 Many 'recovery' cylinders make use of a yellow band, usually around the shoulder, valve guard or upper portion of the cylinder. This will have the word "RECOVERY" or "RECOVERED REFRIGERANT" stencilled onto the band, normally in black in 50 mm letters. This is to highlight the fact that it has been used to recover product from a system and is likely to have some contamination. Recovery cylinders are typically used with refrigerants, or other controlled gases such as SF_6 (see Part 2, Chapter 12).

2.3.4.15 As a general rule, suppliers of refrigerant cylinders do not follow the colour standard detailed in *BS EN 1089-3*. It should be noted that the colour schemes applied to refrigerant cylinders differ between the various gas supply companies. Details of the colour scheme used by the current DFG contractor are published on the DFG/Contractor website (Part 1, Chapter 3 refers).

2.3.4.16 As a general rule, suppliers of LPG cylinders do not follow the colour standard detailed in *BS EN 1089-3*. It should be noted that the colour schemes applied to LPG cylinders differ between the various gas supply companies. Within the UK (UKLPG CP 29 refers) the following colour schemes are typical:

a. Propane with vapour off-take and manual valves – red.

b. Propane with vapour off-take and self-closing valves – red; or green but with either a red shroud or fitted with a clearly visible red identifying marker.

c. Propane with liquid off-take and manual valves – red or red with the cylinder shroud black.

d. Butane – blue.

Notes:

1. The system of colour coding is based on a paint chart (*RAL 840 HR*) developed by Reichs-Ausschus für Lieferbedingungen (RAL) in Germany. It is in-line with European standards, such as *EN 1089-3*; and, whenever practical, it is used on all transportable gas cylinders used by the MOD.

2. This colour code system has replaced that previously used within the UK (*BS 349*) and it is possible there are still gas cylinders in use that are colour coded in accordance with *BS 349*.

3. Apart from medical gases, the colour coding system is not mandatory. There is no universal colour coding standard. Different Nations, manufacturers, etc, may apply different colours for the same gas. Colour coding is not to be relied upon as the sole means of identifying the contents of a gas container.

2.3.4.17 Gases, and gas mixtures, are identified by a colour classification indicating the property of the contents in accordance with the risk diamond on cylinder labels.

Table 2.3.2

Hazard Label	Colour Code
Toxic and/or corrosive	Yellow
Flammable	Red
Oxidizing	Light Blue
Inert (non-toxic, non-corrosive, non-flammable, non-oxidizing)	Bright Green

2.3.4.18 The colour Bright Green is not used for inhalation (e.g. breathing apparatus).

2.3.4.19 When a gas or mixture has two hazard properties then the cylinder shoulder is coloured in accordance with the primary hazard.

2.3.4.20 The colour of the secondary hazard can also be applied to the cylinder shoulder. The colours may be applied either as bands or quadrants.

Table 2.3.3

Gas Hazard	Colour Code
Toxic (and/or corrosive) and flammable	Yellow plus Red
Toxic (and/or corrosive) and oxidizing	Yellow plus Light Blue

2.3.4.21 **Specific gases**. The following gases are identified by specific colours:

Table 2.3.4

	Colour Code
Flammable gas	
Acetylene	Maroon
Oxidizing gases	
Oxygen	White
Nitrous Oxide	Blue

Note: There are two Maroon colours in use for acetylene. The majority of cylinders within the UK will be coloured in accordance with *BS 381C No. 541*, but cylinders in Europe will be coloured to *RAL 3009* in accordance with *BS EN 1089-3*.

2.3.4.22 Additionally, inert gases for medical and industrial applications are further differentiated by use of the following colours:

Table 2.3.5

Gas	Colour Code
Argon	Dark Green
Nitrogen	Black
Carbon Dioxide	Grey
Helium	Brown

2.3.4.23 When inert gases are mixed, combinations of the optional colours of the specific component gases, listed above, can be used to identify the cylinder contents.

2.3.4.24 Medical and breathing gas mixtures containing oxygen are identified using the following colours. These colours are not used for industrial gas mixtures.

Table 2.3.6

Gas	Colour Code
Air or Synthetic Air	White plus Black
Oxygen / Helium	White plus Brown
Oxygen / Carbon Dioxide	White plus Grey
Oxygen / Nitrous oxide	White plus Blue

Note: Valve protection caps fitted to cylinders are not included in the colour code, and are generally left unpainted.

2.3.4.25 **Reflective tape on acetylene cylinders**. High visibility photo-reflective tape is being applied to all acetylene cylinders provisioned by UK gas suppliers. Its purpose is to make the cylinders more visible, therefore easier to identify, by fire-fighters involved in a fire. Typically the tape will be positioned on, or just below, the shoulder, and will be in the form of a band around the circumference of the cylinder. Alternatively some UK companies may apply the tape to a plastic collar around the shoulder. In all cases the tape will have the word “ACETYLENE” printed on it.

2.3.4.26 This tape is not to be removed. If the tape is excessively damaged or removed, the cylinder is to be declared unserviceable and returned in accordance with Part 1, Chapter 6.

2.3.4.27 Exceptionally, where acetylene cylinders are in-use at forward operating bases, and where the use of high visibility tape is not acceptable (in a military context), then the high visibility tape may be covered with a masking tape. All such masking tapes are to be removed when the cylinder is returned from the forward operating base

BIBLIOGRAPHY

1. United Nations - *Recommendations on the Transport of Dangerous Goods, Model Regulations.*

2. ISO 32: 1977 - *Gas Cylinders for Medical Use - Marking for Identification of Content.*

3. BS EN 1089-3: 2004 - *Transportable Gas Cylinders. Colour Coding*.

4. BS EN ISO 7225: 2007 - *Gas Cylinders. Precautionary Labels.*

Note: BS EN ISO 7225 has superseded BS EN 1089-2, Transportable Gas Cylinders. Precautionary Labels.

5. BS EN ISO 13769: 2006 - *Gas Cylinders. Stamp marking*.

6. BS 349:1973 - (withdrawn/superseded).

7. BS 5430 - (withdrawn/superseded).

8. NATO STANAG 7146 - *Assignment of NATO Code Numbers to Gases Used in Aircraft Cross Servicing.*

9. Defence Standard 81-24. - *Identification Markings of Transportable Containers, Compressed Gas*.

10. JSP 800 – *Defence Movement and Transport Regulations.*

11. UKLPG Code of Practice 29 – Hazard Information and Packaging Labelling for Commercial LPG Cylinders.

12. ADR – The European Agreement Concerning the International Carriage of Dangerous Goods by Road.

ANNEX A

(introduced at paragraph 2.3.4.11)

CYLINDER TEST RINGS

Table 2.3.A1

YEAR		
Date of Withdrawal	**Shape**	**Colour**
2000	Circle	Aluminium
2001	Hexagon	Red
2002	Hexagon	Blue
2003	Hexagon	Yellow
2004	Hexagon	Green
2005	Hexagon	Black
2006	Hexagon	Aluminium
2007	Square	Red
2008	Square	Blue
2009	Square	Yellow
2010	Square	Green
2011	Square	Black
2012	Square	Aluminium
2013	Circle	Red
2014	Circle	Blue
2015	Circle	Yellow
2016	Circle	Green
2017	Circle	Black
2018	Circle	Aluminium
2019	Hexagon	Red
2020	Hexagon	Blue
2021	Hexagon	Yellow
2022	Hexagon	Green
2023	Hexagon	Black
2024	Hexagon	Aluminium

MONTH		
Month	**Shape** (Notes 2, 3)	**Colour**
January	Circle, 1 cut out	Light Blue
February	Circle, 2 cut outs	Light Blue
March	Circle, 3 cut outs	Light Blue
April	Circle, 1 cut out	Light Green
May	Circle, 2 cut outs	Light Green
June	Circle, 3 cut outs	Light Green
July	Circle, 1 cut out	Pink
August	Circle, 2 cut outs	Pink
September	Circle, 3 cut outs	Pink
October	Circle, 1 cut out	Purple
November	Circle, 2 cut outs	Purple
December	Circle, 3 cut outs	Purple

Notes:

1. The sequence of colour and shape of the annual cylinder test rings is repeated on an 18-year cycle, hence 2018 is a repeat of 2000.

2. The cut-out on the monthly ring may be a half circle on the outer diameter of the ring or a full circle within the ring, dependant on the space available.

3. The cut-out will be repeated at 180 ° intervals.

2.3.A.01 This is available as a chart from DFG.

ANNEX B

(introduced at paragraph 2.3.3.16)

EXAMPLES OF DIAMOND HAZARD LABELS USED FOR GASES

2.3.B.01

Class 2.1, Flammable gases

Background red; Symbol flame in black or white; Figure 2 in bottom corner.

MOD: F/PKG/252 Package,
(100mm x 100mm or 250mm x 250mm)

2.3.B.02

Class 2.2, Non-Flammable, Non-Toxic gases

Background green; Symbol gas cylinder, black or white; Figure 2 in bottom corner.

MOD: F/PKG/214 Package
(100mm x 100mm or 250mm x 250mm)

2.3.B.03

Class 2.3, Toxic Gases

Background white; Symbol skull and crossbones, black; Figure 2 in bottom corner.

MOD: F/PKG/253 Package
(100mm x 100mm or 250mm x 250mm)

2.3.B.04

Class 5.1, Oxidizing substances

Background yellow; Symbol flame over circle, black; Figure 5.1 in bottom corner.

MOD: F/PKG/259 Package
(100mm x 100mm or 250mm x 250mm)

2.3.B.05

Class 8, Corrosive substances

Background upper white, lower black; Symbol liquid spilling from 2 glass vessels and attacking a hand and metal, black; Figure 8 in bottom corner.

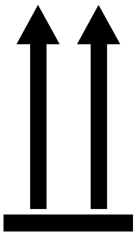
MOD: F/PKG/264 Package
(100mm x 100mm or 250mm x 250mm)

ANNEX C

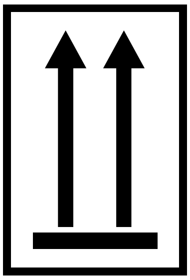
(introduced at paragraph 2.3.4.01)

EXAMPLES OF LABELS USED WHEN TRANSPORTING LIQUEFIED GASES

2.3.C.01 **This way up labels. Two black or red arrows on white or suitable contrasting background**



or



2.3.C.02 **Cryogenic liquid label**

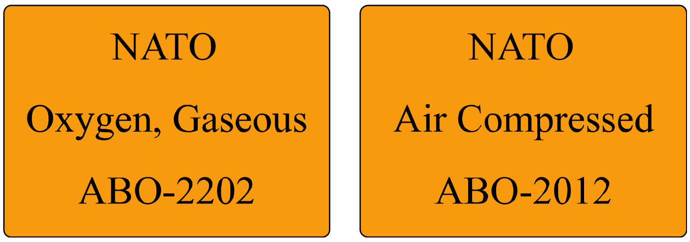
ANNEX D

(introduced at paragraph 2.3.4.03b)

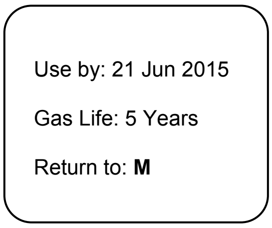
EXAMPLES OF ADDITIONAL LABELS USED ON GAS CONTAINERS

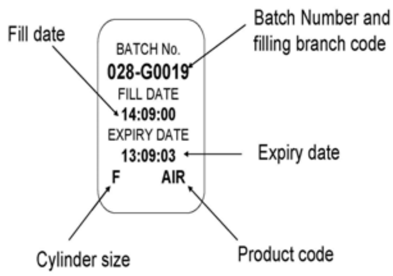
2.3.D.01 **Example of a Tropical Fill label.**

2.3.D.02 **Example of labels used to indicate compliance with STANAG 7146.**

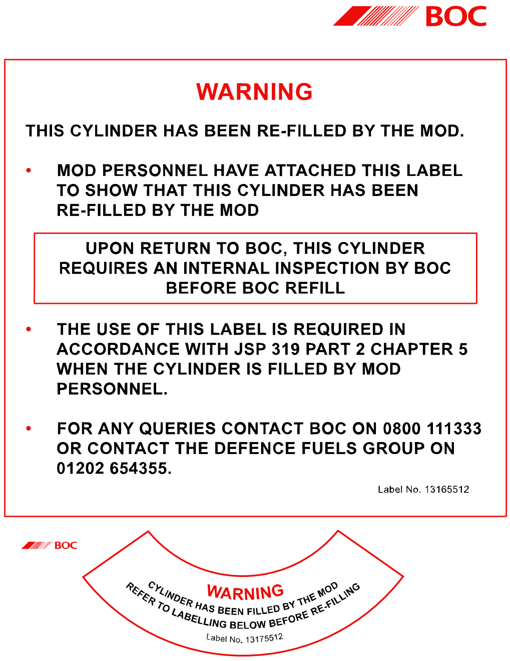


2.3.D.03 **Examples of labels indicating the life details of a gas.**

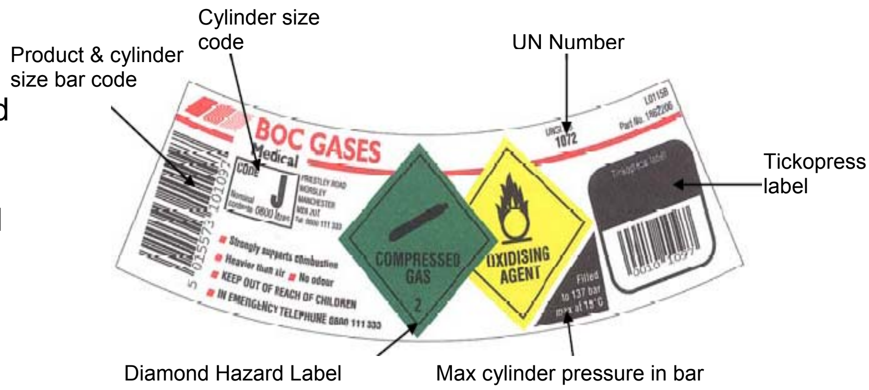


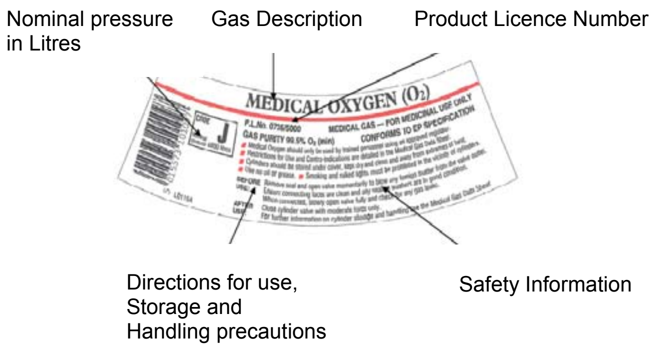


2.3.D.04 Example of labels used to identify contractors cylinders filled by MOD personnel. It includes a shoulder label and a body label.



2.3.D.05 Examples of a precautionary label and additional product and safety information displayed on a medical gas cylinder.





Part 2

Chapter 4 (Sponsor – FSAT, SAFETY 3)

PROCUREMENT, MAINTENANCE & DISPOSAL

SECTION 1 – SCOPE

2.4.1.01 This chapter provides information on the manufacture, procurement, maintenance and disposal of transportable gas cylinders.

SECTION 2 – MANUFACTURE AND PROCUREMENT OF TRANSPORTABLE GAS CYLINDERS

2.4.2.01 **Manufacture / procurement of transportable gas cylinders**. The MOD does not manufacture its own gas cylinders. However, it is necessary to ensure that all gas cylinders procured for use by the MOD meet the relevant standards and are safe for use in the military environment.

2.4.2.02 The following points should be considered when procuring a transportable gas cylinder for use in any military platform or equipment:

a. Gas cylinders are only to be obtained from reputable manufacturers.

b. All gas cylinders have to be designed and manufactured to an approved standard. The design and manufacturing standard shall be approved by the UK Competent Authority (the Department for Transport (DfT)).

Note: U.S. Department of Transport (DoT) cylinders are not currently recognised by the UK Competent Authority.

c. Cylinders should be UN marked or Pi marked; and, gas cylinders used in breathing apparatus require a CE mark.

d. All cylinders shall be initially inspected and tested before they are put into service to ensure that they conform to the approved standard. This is to be carried out by an authorised inspection body, if approved this will be indicated with the appropriate stamp-mark on the cylinder (see *BS EN ISO 13769:2006 Gas Cylinders. Stamp marking*).

e. All gas cylinders will have to be transportable. They shall meet the appropriate road, rail, sea and air transport regulations for the carriage of dangerous goods, as well as associated UK legislation (see Part 2, Chapter 8).

f. The cylinder and its contents are to be correctly identified, by label and colour code (see Part 2, Chapter 3).

g. The cylinder shall be compatible with the gas for its intended service (see *BS EN ISO 11114*).

h. Ensure the cylinder can provide the pressure, capacity and volume flow-rate required.

i. Determine the space envelope that is available in which to fit the cylinder and its valve.

j. The valve should be UN marked or Pi marked.

k. Ensure the valve is compatible with the cylinder and the intended gas (see *BS EN ISO 11114*).

l. Where practical use a valve that is operated by a hand-wheel.

m. Determine the correct valve outlet (see *BS 341-3:2002*). There is a range available which is dependent on the properties of the gas. The valve shall always meet the relevant standard.

n. All cylinders are required to be periodically inspected and tested, at appropriate intervals, to ensure that they remain safe whilst in service. This is to be carried out by an authorised inspection body. On satisfactory completion of the periodic inspection and test the date the test was carried out will be stamp-marked on the gas cylinder (see *BS EN ISO 13769:2006 Gas Cylinders. Stamp marking*).

o. The date of the next periodic inspection and test is to be indicated by the use of cylinder test rings (see Part 2, Chapter 3).

p. All appropriate drawings, manufacturing, inspection and testing documentation and certification records are to be examined by the Support Authority to ensure the necessary manufacturing requirements have been carried out. These documents are to be safely stored by the Support Authority, or their responsible agents, for the life of the cylinder.

q. Avoid Special-To-Type cylinders wherever possible. Always seek advice on whether existing in-service cylinders are suitable. Minimising the variety of cylinders increases availability and compatibility and maximises the efficiency of the logistics chain.

2.4.2.03 The DFG is the lead organisation for the provision of transportable gas cylinders. Advice can be sought from the DFG on any aspect of procuring transportable gas cylinders.

SECTION 3 – REPAIR AND TESTING OF GAS CYLINDERS

2.4.3.01 **Repair/testing of cylinders**. Cylinders are not to be repaired, or modified, in service. If a cylinder is determined to be unserviceable it is to be returned and a serviceable cylinder obtained (see Part 1, Chapter 6).

2.4.3.02 Painting, stencilling, re-labelling of cylinders is only to be carried out by authorised persons as detailed by the owner/Support Authority responsible for the cylinder. If the paint finish, marking or labelling require replacement then the cylinder is to be declared unserviceable, it is to be returned and a serviceable cylinder obtained (see Part 1, Chapter 6)

2.4.3.03 The *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (Amendment) Regulations, 2005*, define the responsibilities of a number of conformity assessment bodies, i.e. Appointed Persons, Notified Bodies, Approved Bodies, Approved Persons, and Inspection Bodies. In order to attain one or more of these positions an organisation must first gain UKAS Accreditation and then be Appointed by the DfT.

2.4.3.04 Minor repairs may be carried out where refurbishment work does not affect the integrity of the cylinder, but only in UKAS Accredited, DfT Appointed, cylinder test shops by suitably trained, competent personnel.

2.4.3.05 The Cryogenics and Gas Section (CGS) at DSG Stafford operate a cylinder test shop. CGS have the ability to inspect and test a range of MOD owned cylinders. For further information contact the CGS manager (9)5551 5181.

2.4.3.06 Transportable gas cylinders are to be maintained to the relevant standards which are either those directly referenced in ADR or those recognised by the DfT (or previously by HSE).

2.4.3.07 MOD owned cylinders that require maintenance or periodic inspection and testing, are to have the work carried out in an UKAS Accredited, DfT Appointed, test shop. Full details of the work carried out is to be recorded on a suitable form (e.g. RAF Form 7255 - Cylinder maintenance Test & Inspection Record (as detailed in JAP 100A-02)) and records of this work are to be kept for the life of the cylinder.

2.4.3.08 Valves are only to be removed from MOD owned cylinders by specifically trained personnel using procedures that ensure that either the cylinder does not contain any pressure or that the valve is captured during the removal process.

2.4.3.09 **Manifolded Cylinder Packs**. Manifolded Cylinder Packs (MCP) - also known as bundles - contain several cylinders (typically 15 or 16) manifolded together, providing a single source of gas. The cylinders will be enclosed in a robust framework.

2.4.3.10 MCPs are designed and supplied as an individual unit:

a. Do not modify or attempt to disassemble a MCP.

b. Cylinders are never to be removed.

c. No direct heat source is to be applied to the frame, cylinders or manifold.

SECTION 4 – DISPOSAL OF CYLINDERS

2.4.4.01 **Disposal of cylinders**. When a gas cylinder is determined to be unfit for further service, or if it is no longer required for use by the MOD, disposal action is to be taken. Advice/authority is to be sought from the Support Authority responsible for the cylinder. There are generally two courses of action to be taken for MOD owned cylinders:

a. If serviceable, the cylinder may be placed on the market for re-sale via the Disposal Services Agency.

b. If unserviceable, or of no market value, the cylinder is rendered unfit for future use as a gas container and is scrapped.

Note: Only the owner of a cylinder can authorise the disposal of a cylinder. In all cases cylinders which are provided to the MOD under a rental agreement are to be returned to the contractor. Any disposal action will remain the contractors responsibility.

2.4.4.02 There are specific requirements which have to be followed when scrapping a gas container. CGS at DSG Stafford have the facility to correctly mutilate and dispose of gas containers. Alternatively there is an arrangement with DFG's contractor to dispose of gas cylinders. Advice can be sought from DFG. See Part 1, Chapter 3, Annex A.

BIBLIOGRAPHY

1. European Commission for Europe. Inland Transport Committee. *Restructured ADR: European Agreement Concerning the International Carriage of Dangerous Goods by Road*.

2. *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations*, 2004.

3. *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (Amendment) Regulations*, 2005.

4. BS 341-3:2002 - *Transportable gas container valves - Part 3: Valve outlet connections*.

5. BS EN ISO 11114 - *Transportable gas cylinders - Compatibility of Cylinder and Valve Materials with Gas Contents*.

6. BS EN ISO 13769:2006 - *Gas Cylinders. Stamp marking.*

7. JAP 100A-02 - *Military Aviation Engineering Documentation Procedures*.

Part 2

Chapter 5 (Sponsor – FSAT, SAFETY 3)

GAS PRODUCTION AND CYLINDER FILLING

SECTION 1 – SCOPE

2.5.1.01 This chapter provides information on equipment, that is available for use in the MOD, that can be used to fill a gas cylinder. It highlights those gas cylinders that are not allowed to be filled by MOD personnel and details the procedures to be followed to fill an authorised gas cylinder.

SECTION 2 – GENERAL

WARNING: Anyone producing gas or carrying out the filling of gas cylinders is to wear the appropriate personal protective equipment (see Part 2, Chapter 2)**.**

WARNING: Before using any hazardous substance or material, the user is to be conversant with the hazards and associated information detailed on the applicable Safety Data Sheet.

SECTION 3 – GAS PRODUCTION EQUIPMENT

2.5.3.01 **Gas Production Equipment**. The majority of gas cylinders are supplied for the MOD, filled with the appropriate gas, via the direct supply contract the DFG has with its prime contractor.

2.5.3.02 The production of gases is to be strictly controlled within the military environment. This activity is only to be carried out by appropriately trained, authorised and competent personnel.

2.5.3.03 **Liquid Oxygen and Liquid Nitrogen Production Plant**. Aviation standard liquid oxygen, liquid nitrogen, gaseous breathing oxygen and gaseous nitrogen may be produced by the Liquid Oxygen and Liquid Nitrogen Production Plant. The Support Authority for this plant is the AC PT. The equipment is operated and maintained by appropriately qualified and trained personnel from the Cryogenic & Gases Section DSG Stafford, CSSU Cyprus and JFLU Falkland Islands who each have a plant permanently on-site.

Table 2.5.1: Equipment details

Item description	Publication	NSN
Liquid Oxygen and Liquid Nitrogen Production Plant	AP 119L-0404-1236A+5F	71AS/3655-01-3234670
High Pressure Nitrogen Charging Panel, MK8	AP119L-0612-123+5F	71AS/3655-99-2519029
High Pressure Oxygen Charging Panel, MK8	AP119L-0612-123+5F	71AS/3655-99-5685943

2.5.3.04 Only personnel who have been formally trained (on the equipment Support Authority authorised course) in plant operations, and received the appropriate 'Q' annotation, are permitted to operate this equipment. The names of such personnel are to be clearly displayed adjacent to the equipment.

2.5.3.05 Cylinders are only to be filled via the High Pressure Oxygen & Nitrogen Charging Panels, MK8, with the prior approval of the DFG and the AC PT; and all cylinders so filled shall be clearly identified with permanently attached labels (see Part 2, Chapter 3 (identification) & Chapter 5 (filling)).

2.5.3.06 The cylinder filling procedure detailed in the relevant equipment publications is to be followed.

2.5.3.07 Oxygen and nitrogen produced by these plants is required to comply with *Defence Standard 68-284* and *Defence Standard 58-96* respectively.

2.5.3.08 **Nitrogen Concentration Trolley**. Aviation standard gaseous nitrogen may be produced using the Nitrogen Concentration Trolley (NCT). Only personnel who have been formally trained (on the equipment Support Authority authorised course) in operating the NCT, and received the appropriate Q annotation, are permitted to operate the NCT.

2.5.3.09 The Support Authority for this plant is the AC PT.

Table 2.5.2: Equipment details:

Item description	Publication	NSN
Nitrogen Concentration Trolley	AP 119F-2746-123 & 5F	71N/1730-01-5031613
Cylinder Filling System	GSE Schedule 03/05	71N/3655-99-9023545

2.5.3.10 **The Cylinder Filling System** is used to support cylinders (an 'A' frame) during the filling process and utilises a common manifold which allows sampling of the gas to take place. The Cylinder Filling System can be stowed in its transit case when not in use.

2.5.3.11 The Support Authority for this plant is the AC PT.

2.5.3.12 When the NCT is to be used to fill cylinders, it is necessary to use the Cylinder Filling System and to monitor the water content using the Cermax Dewpoint Meter. The prior approval of the DFG and the AC PT is to be obtained before filling cylinders; and all cylinders so filled shall be clearly identified with permanently attached labels (see Part 2, Chapter 3 (identification) & Chapter 5 (filling)).

2.5.3.13 The cylinder filling procedure detailed in the equipment publications is to be followed.

2.5.3.14 Nitrogen produced by this equipment is required to comply with *Defence Standard 58-96*.

2.5.3.15 **Filling from liquid or gaseous pressure systems**. Before filling cylinders or other pressure receptacles from any pressure system, the user is to ensure that the system is designed and authorised for that purpose. Gas, or cryogenic liquid, storage systems and their associated pipe work and protective devices are classed as pressure systems and are required to comply with the *Pressure Systems Safety Regulations, 2000*; there are certain exceptions, but most if not all such systems in cryogenic liquids and gases workshops will be subject to these regulations. *JSP 375, Volume 2, Leaflet 30* refers. Reference is also to be made to *Defence Estates Safety Rules and Procedures 02, JSP 375, Volume 3*. These regulations, amongst others, require that a written scheme of examination is completed for each pressure system. Further advice is available in Part 2, Chapter 10.

2.5.3.16 **Air Compressors**. All air compressors and their associated pipelines are to conform to the *Pressure Systems Safety Regulations (PSSR) 2000*. Detailed information is available in *JSP 375, Volume 2, Leaflet 30*. All air compressors are to have regular maintenance, inspection and testing, for which procedures are to be laid down and records kept.

2.5.3.17 All compressed air pipelines and outlets are to be clearly identified with their contents and working pressure. All component parts are to be bonded together and the whole system bonded to earth, with a maximum resistance to earth of 1 ohm.

2.5.3.18 **Air Compressors for filling breathing air / diving quality air cylinders**. Breathing air compressor systems shall be designed, built and operated in accordance with a recognised standard, such as *BS EN 529* or the (maritime) *Defence Standards 02-314, 02-316* and *02-373*, as appropriate; other air compressors shall not be used to provide breathing air for cylinder charging. *JSP 375, Volume 2, Leaflet 42*, which applies specifically to RPE, also provides guidance. Ideally any compressed breathing air supply shall be obtained from an oil-free compressor. To reduce contamination from particulate matter it is recommended that the supply from the compressing plant limits the particulate matter size by passing the gas through a 5 micron absolute filter.

2.5.3.19 Compressors are only to be operated by competent personnel who have received appropriate training and authorisation.

2.5.3.20 To minimise the risk of introducing contaminants compressors are to be sited in a well ventilated and clean environment. Inlet air to the compressor is to be drawn from an area that is free from potentially flammable, noxious or corrosive concentrations of fumes or vapours, including vehicle, plant and aircraft exhaust fumes. When in use care is to be taken that inlet air is not excessively laden with moisture or dust.

2.5.3.21 Compressors that provide breathing quality air are to be clearly identified as such. All breathing air is to be tested on a regular basis and is to meet the specifications and requirements detailed in Part 2, Chapter 6.

SECTION 4 – GENERAL REQUIREMENTS FOR FILLING CYLINDERS

2.5.4.01 **Filling gas cylinders**. The filling of pressure receptacles may only be carried out using authorised/approved appropriate equipment, with qualified, trained, competent staff using the relevant standards and procedures.

2.5.4.02 Personnel filling cylinders are not to carry out any defect rectification, painting or stencilling on cylinders. If any cylinder requires maintenance it is to be returned as unserviceable and a serviceable item obtained. The cylinder is to be returned, with an appropriately annotated Equipment Conditioning Label (e.g. *MOD Form 731*), in accordance with Part 1, Chapter 6.

2.5.4.03 **Medical gas**. Service units are NOT to manufacture gases for medical purposes, or fill medical cylinders, without the appropriate authorisation from M&GS Team, AC PT and DFG (see Part 2, Chapter 13).

2.5.4.04 **Acetylene**. Service units are NOT to manufacture acetylene, or fill acetylene cylinders. All acetylene cylinders are to be obtained via the DFG direct supply contract; or, for overseas deployment from an approved local supplier, subject to prior authorisation from DFG.

2.5.4.05 **Manifolded Cylinder Packs**. Manifolded Cylinder Packs of cylinders are NOT to be filled by MOD personnel without specific authority from the DFG.

2.5.4.06 **Palletized cylinders**. All cylinders are to be removed from pallets and independently filled. The only exception is if an authorised written procedure exists which ensures that only serviceable cylinders are filled.

2.5.4.07 **Contamination of gaseous systems**. Many gaseous systems, particularly those for aviation or weapons systems are very sensitive to contamination. Experience has shown that it is very easy to contaminate these gaseous systems, especially with water. The user needs to ensure that all components, e.g. cylinders, hoses, meters, pipelines, manifolds, etc, are purged and dried before they are connected together. If you have ‘wet’ hoses, components or test equipment, it can take days to dry out, and once contaminated some hoses will never dry. In particular it is very important to ensure that all components are manufactured from suitable materials i.e. materials that are not hydroscopic and that will not react with the gas. It is also beneficial to keep the system as compact as possible, with minimum hose / pipe lengths. When not in use, all open orifices need to be sealed to prevent any possible contamination.

2.5.4.08 **Flexible hoses**. Whether flexible hoses are installed as part of a pressure system, or independently provided for filling purposes, they are to be approved and supplied by the system sponsor. They are to be inspected for their suitability for the particular gas to be delivered, their pressure rating, their expiry date and for any damage. Any unserviceable hoses are to be replaced. Before connecting hoses ensure the inlet / outlets are free from any contamination. When not in use all hoses are to be blanked to minimise any contamination.

2.5.4.09 **Positive pressure valves**. Contractor owned cylinders are generally fitted with a positive pressure valve. This will only allow the cylinder to be emptied down to a pressure of around 2 bar, thus maintaining a residual pressure which prevents the ingress of contaminants. If any contractor-owned cylinders are found to have no residual pressure, are suspected of contamination, or have an unacceptable odour, they are to be declared as unserviceable and are not to be filled. Return in accordance with Part 1, Chapter 6.

2.5.4.10 **Disposable Cylinders**. Gas cylinders which are labelled as "disposable", "non-returnable", "non-refillable" or similar are not to be refilled or used as decant/recovery cylinders.

2.5.4.11 **Temporary Facilities for re-filling specialist oxygen cylinders on Operations and Exercises**. Where it is necessary to provide temporary facilities for the re-filling of specialist MOD owned oxygen cylinders e.g. in support of military parachutists on operations or exercises, and where it may be impractical to fully comply with the requirements detailed within JSP 319 the procedures detailed at Annex B are to be followed.

SECTION 5 – FILLING PROCEDURES

2.5.5.01 **Pre-fill procedures**. The pre-fill procedures are to include the following checks:

2.5.5.02 **Identify the owner of the cylinder**. Before filling, the identity of the owner of a cylinder is to be established (see Part 2, Chapter 3) and their authorisation to fill the cylinder obtained. MOD owned cylinders can be filled by suitably trained MOD personnel where this is required and authorised within the appropriate publication. Contractor owned cylinders, rented by the MOD, are only to be filled if authority is granted by the DFG (or relevant Support Authority) and the contractor. Standing authorisations to fill contractor owned cylinders are listed in Annex A. If it is required to fill a contractor owned cylinder that is not listed, authority is first to be obtained from the DFG (or relevant Support Authority).

2.5.5.03 **Ensure the cylinder is correctly marked and identified**. The cylinder is to be correctly marked and the contents accurately identified. The proposed contents are to correspond with the identification label and shoulder colour on the cylinder (see Part 2, Chapter 3). MOD personnel are NOT to change the contents of any cylinder from its intended service. If there is any doubt as to the contents of a cylinder then it is to be returned and replaced with a serviceable item. If there is any falsification or defacing of markings it is to be returned as unserviceable (see Part 2, Chapter 3 (identification) and Part 1, Chapter 6 (returns)).

2.5.5.04 **Examine the cylinder for serviceability**. It is to be established that the cylinder to be filled is in a serviceable condition and that there is no damage which might affect safety. The cylinder is to be clean and free of foreign material (such that the cylinder can be assessed for mechanical damage that would prevent it from being filled safely). The cylinder is to be clean and free of all oil and grease. The cylinder is not to be filled if it displays any abnormalities such as arc burns, bulging, severe corrosion, heat/fire damage or significant mechanical damage. There are to be no illicit repairs. Unserviceable cylinders are to be clearly identified as such and are not to be filled. Return in accordance with Part 1, Chapter 6. If required, contact the DFG for further advice.

Note: It is particularly important that the base of a welded cylinder is inspected for corrosion or rusting. Any evidence of such corrosion will render the cylinder unserviceable.

2.5.5.05 Ensure the compatibility of the cylinder for filling with the product to be carried (see *BS EN ISO 11114*).

2.5.5.06 Ensure the cylinder and its accessories conform to current standards and regulations.

2.5.5.07 From the marking on the cylinder establish that it has been examined by a relevant inspection body (see Part 2, Chapter 3). Ensure that the cylinder is permitted to be filled in the country of the filling station.

2.5.5.08 **Verification of internal cylinder condition**. Where it is possible that liquid can get into cylinders, internal corrosion can occur. Cylinders without special valves which prevent ingress of contamination e.g. non-return / positive pressure valves, or where there is a risk of internal corrosion of the cylinder material, shall be checked for liquid ingress, when there are doubts about the cylinders internal condition.

2.5.5.09 This check shall be carried out by using a residual pressure check, or check weighing, or moisture analysis or any other method which could confirm the presence of liquid contamination.

2.5.5.10 If liquid is detected, a visual internal inspection has to be performed by a competent person. Any such cylinders detected in service are to be declared unserviceable and replaced with a serviceable item. Unserviceable cylinders are to be returned with a suitably annotated Equipment Conditioning Label (*MOD Form 731*). Return in accordance with Part 1, Chapter 6.

2.5.5.11 **Verification of integrity of neck ring/threaded boss**. Establish that the neck ring / threaded boss and guard (if fitted) are serviceable for the intended purpose, and that the neck ring, if one exists, is not loose. If there is a permanent valve guard or a welded-on shroud, it is to be checked to ensure it is properly attached.

2.5.5.12 **Verification of valve integrity and suitability**. Establish that:

a. The valve is correctly fitted and not leaking.

b. The valve is easy to operate.

c. Any safety devices are undamaged.

d. The outlet threads and body are not damaged and are in good working order.

e. The hand-wheel, or key operated spindle, is operable.

f. It is suitable for its intended gas.

g. It is clean and not contaminated e.g. by oil and grease.

h. The valve attaches correctly to the filling connector.

2.5.5.13 **A check for the correct filling pressure**. All cylinders are designated a particular maximum Working Pressure. Cylinders are NOT to be filled to any pressure greater than Working Pressure. The Working Pressure should be stamp-marked on the shoulder of the cylinder (see *BS EN ISO 13769:2006*). Indicated by the letters “PW” followed immediately by the figures for the Working Pressure (in bar), e.g. PW230.

Note: Older cylinders may have a different method of identifying the Working Pressure (see *Defence Standard 81-24* for examples of pre-2003 markings).

2.5.5.14 If filling cylinders in locations where the ambient temperature is significantly different (higher) than the UK, there is a danger that the internal pressure will rise, with increasing temperature, above the allowable Working Pressure. To ensure that the cylinder internal pressure stays within the prescribed limits for that cylinder then the filler is to ensure that the gas filling ratio and developed pressure are appropriate for that location (ambient temperature).

2.5.5.15 Reference should be made to *BCGA CP 35,* Filling ratios and developed pressures for liquefied and compressed gases.

2.5.5.16 **Check that the cylinder is in date for its periodic inspection and test**. The date of the initial inspection and test and any subsequent periodic inspection and testing will be stamp-marked on the shoulder. As a visual reference the month/year of the due date of the next periodic inspection and test is indicated by coloured plastic cylinder test rings fitted between the cylinder and the valve (see Part 2, Chapter 3). An out-of-date cylinder is not to be filled. Out-of-date cylinders are to be returned with a suitably annotated Equipment Conditioning Label (*MOD Form 731*) and replaced with a serviceable cylinder. Return in accordance with Part 1, Chapter 6.

2.5.5.17 **Verification of the tare weight (liquefied gases)**. The amount of liquefied gas charged into a cylinder is determined by weight, or if charged at a pressure lower than the vapour pressure, by pressure shown on a vapour pressure / temperature chart for that specific gas. The weight of gas to be charged into a cylinder is determined from the water capacity and the filling ratio for the specific gas or by the maximum permissible filling weight, if indicated.

2.5.5.18 **Filling checks**. During the filling process the filler is to ensure that:

a. Filling is carried out in a clean, well-ventilated area, away from sources of ignition.

b. All filling equipment is to be designed, constructed and suitable for use with that gas. This is particularly important for oxygen, where all materials used are to be oxygen compatible.

c. Cylinder valves are always opened and closed slowly. Rapid movement can result in momentarily high pressures.

d. To help prevent excessive temperature rises cylinders are not to be filled too quickly.

e. That the valve is not blocked and that the operation is progressing satisfactorily e.g. temperature rise checks of cylinder.

f. That the valve does not leak in the open position e.g. by the use of leak detection fluid. If leakage is suspected check areas such as at the bonnet or at the gland nut.

Note: In the event of any leakage, then filling is to be stopped and the cylinder/connections vented. The leak is to be rectified before proceeding. Leaks are not to be rectified whilst the system is pressurised.

g. Residual or excess gases are vented to a safe location, preferably outdoors in a safe, well-ventilated area.

2.5.5.19 **Post Fill Checks**. The filler is to ensure that:

a. It is within its safe operating limits.

b. It is not overfilled or over pressurised. In the event of inadvertent overfilling, any excess gas must be removed in a safe manner and the cylinder checked for further fitness for service.

c. For liquefied gases, immediately after disconnecting from the filling line, the weight shall be checked by use of a scale capable of determining the gas content of that cylinder within the tolerances shown at Table 2.5.3, according to the cylinder water capacity. The weight of the cylinder is not to exceed the total weight allowed for the cylinder and gas combination.

d. The valve is closed.

e. A leak test is carried out. If leakage is suspected check for seat leakage at the valve outlet, also check the interface between the valve and the cylinder. For welded cylinders attention shall also be paid to the welds to ensure the cylinder is free from leaks.

f. If not required for immediate use, fit appropriate blanks and, if applicable, protection caps.

g. The valve guard, if fitted, is secure and serviceable.

h. Ensure the contents and hazards are correctly identified on the Precautionary label, and that the Precautionary label is secure (see Part 2, Chapter 3).

i. If the gas has a life allocated, ensure the date of fill, the gas life and the expiry life are clearly indicated.

j. When contractor owned cylinders have been filled follow the procedure detailed in Paragraph 2.5.5.20.

Table 2.5.3: Maximum allowable deviation in tare weight and gas weight

Cylinder water capacity (*V*) (litres)	Maximum allowable deviation in tare weight (grammes)
$0.5 < V \leq 5.0$	± 50
$5.0 < V \leq 20$	± 200
$V > 20$	± 400

2.5.5.20 **Control procedure to be followed when filling contractor owned cylinders**. As well as the previously detailed filling procedures, the following control procedure is to be followed when a contractor owned cylinder is filled by MOD personnel, or by sub-contractors working for the MOD.

a. Separate body and shoulder labels are to be attached to the contractors cylinder on the 1st fill by MOD personnel (or their sub-contractors) stating that the cylinder has been filled by MOD personnel and that it requires an internal inspection on return to the contractor. Details of suitable labels are shown in Part 2, Chapter 3. These labels are available via the DFG gas supply contract. Contact DFG FHE3 for further advice (see Part 1, Chapter 3)

b. All cylinders filled by MOD personnel (or their sub-contractors) are to be used within a controlled environment e.g. a detachment or within a specialist unit. The detachment/specialist unit personnel are to locally control all such cylinders by reference to their individual serial numbers.

c. When a gas cylinder becomes due for its periodic inspection and test, or is no longer required, it is to be returned to the contractor.

d. All returned cylinders are to be declared unserviceable. Unserviceable cylinders are to be returned with a suitably annotated Equipment Conditioning Label (e.g. *MOD Form 731*). The label is to state "Cylinder filled by MOD personnel. Internal inspection required before further use". Return in accordance with Part 1, Chapter 6.

Note: When returning cylinders ensure that an annotated Equipment Conditioning Label (e.g. *MOD Form 731*) and the body and shoulder labels detailed above are securely attached to each cylinder.

2.5.5.21 **Leak Detection**. Information on equipment available for leak detection is detailed in Part 2, Chapter 17.

BIBLIOGRAPHY

1. *Pressure Systems Safety Regulations*, 2000.

2. BCGA Code of Practice 35 - *Filling ratios and developed pressures for liquefied and compressed gases.*

3. BS EN 529 - *Respiratory Protective Devices - Recommendations for Selection, Use, Care and Maintenance - Guidance Document*.

4. BS EN 1439 - *LPG Equipment and Accessories - Transportable Refillable Welded and Brazed Steel Cylinders Liquefied Petroleum Gas (LPG) - Procedure for Checking Before, During and After Filling*.

5. BS EN 1919 - *Transportable Gas Cylinders - Cylinders for Liquefied Gases (excluding acetylene and LPG) - Inspection at Time of Filling*.

6. BS EN 1920 - *Transportable Gas Cylinders - Cylinders for Compressed Gases (excluding acetylene) - Inspection at Time of Filling*.

7. BS EN ISO 11114 - *Transportable Gas Cylinders - Compatibility of Cylinder and Valve Materials with Gas Contents*.

8. BS EN 12021 - *Respiratory Protective Devices - Compressed Air for Breathing Apparatus*.

9. BS EN 13096 - *Transportable Gas Cylinders - Conditions for Filling Gases Into Receptacles - Single Component Gases*.

10. BS EN 13099 - *Transportable Gas Cylinders - Conditions for Filling Gas Mixtures Into Receptacles*.

11. BS EN 13365 - *Transportable Gas Cylinder - Cylinder Bundles for Permanent and Liquefied Gases (excluding acetylene) - Inspection at the Time of Filling*.

12. BS EN 13385 - *Transportable Gas Cylinders - Battery Vehicles for Permanent and Liquefied Gases (excluding acetylene) - Inspection at the Time of Filling*.

13. BS EN ISO 13769:2006 - *Gas Cylinders. Stamp marking*.

14. BS 1710 – Specification of identification of pipelines and services.

15. Defence Standard 02-314 - *Compressed Air Systems (Category 2)*.

16. Defence Standard 02-316 - *Requirements for Compressed Purification Equipment (Category 2)*.

17. Defence Standard 02-373 - *Code of Practice for Compressed Air Systems Cleanliness (Category 2)*.

18. Defence Standard 58-96 - *Pure Gases for Weapons Systems and Detector Cooling Applications*.

19. Defence Standard 68-284 - *Compressed Breathing Gases for Aircraft, Diving and Marine Life-Support Applications*.

20. Defence Standard 81-24 - *Identification Marking of Transportable Containers, Compressed Gas*.

ANNEX A

(introduced at paragraph 2.5.5.02)

CONTRACTORS AUTHORISATION TO FILL CYLINDERS

Table 2.5.A1

Equipment	Equipment Location	Cylinder Owner	Cylinders allowed to be filled
ASU 71AS/3655-01-3234670	1. Canada, Goose Bay CLOSED	BOC	1. Oxygen 71C/O443/6830-99-1644081 2. Nitrogen 71C/O443/6830-99-2484372
ASU 71AS/3655-01-3234670	1. Falklands 2. Cyprus 3. Stafford 4. Detachments	BOC	1. Oxygen 71C/O443/6830-99-1644081 2. Nitrogen 71C/O443/6830-99-2484372
NCT 71N 5031613	1. Authorised Training 2. Detachments	BOC	1. Nitrogen 71C/O443/6830-99-2484372
Juniper Replenishment Rigs	Aviation Maintenance Bays	BOC	1. Nitrogen 71C/O443/1730-99-5499095 2. Air 71C/O443/1730-99-2887119
Airfield Arrester Barrier	Various military airfields	BOC	1. Nitrogen. 71C/O443/6830-99-7609398 (BOC - 151302-BC)
Diving Gas Cylinders	All diving units	BOC	1. Breathing Air. 6830-99-9356401 (BOC – 154037-YD-CF)

Note: Permission to fill cylinders is obtained by DFG as part of the contractual agreement with its contractor(s).

ANNEX B

(introduced at paragraph 2.5.4.11)

TEMPORARY OXYGEN SUPPORT FACILITY FOR RE-FILLING SPECIALIST OXYGEN CYLINDERS ON OPERATIONS AND EXERCISES

2.5.B.01 Where it is necessary to provide temporary facilities for the re-filling of specialist oxygen cylinders on military operations or exercises the requirements of JSP 319 are to be followed, however where it may be impractical to fully comply with the requirements detailed within JSP 319 the following procedures are to be followed.

2.5.B.02 Gaseous replenishment is a hazardous process. Throughout the planning arrangements for the facility, the safety of all personnel as well as the potentially dangerous practice of gaseous replenishment, are to be the primary considerations.

2.5.B.03 A single person is to be appointed as the person in-charge of the oxygen support facility. That person is to be responsible for the safe operation of the facility and for compliance with JSP 319.

2.5.B.04 **Assessment**. A written assessment of the site is to be carried out by the person in-charge of the oxygen support facility. The assessment is to identify and to include mitigation against all potential hazards and to determine how gas cylinders will be refilled in a safe, controlled environment. The hazards include oxygen enrichment, the sudden release of stored energy within a cylinder and fire. The assessment is to be approved by the senior officer responsible for the exercise/operation.

2.5.B.05 **Infrastructure**. When available a dedicated facility is to be used. If available infrastructure is minimal or an operating area has no dedicated buildings every attempt is to be made maximize safety, to minimise any hazards and to meet the appropriate regulations.

2.5.B.06 A reduction in building build integrity requires an associated increase in safety distances from other activities, operations or accommodation.

2.5.B.07 **Power generation**. If it is necessary to rely on portable generators for a power supply the potential hazard from these is to be included within the initial risk assessment.

2.5.B.08 **Ventilation**. Thorough ventilation is necessary at all times.

2.5.B.09 **Safety distances**.

a. Safety distances detailed at Part 2, Chapter 9, Annex A are the minimum necessary. These may be increased as necessary.

b. If necessary, temporary boundaries are to be established.

c. Consideration is to be given to the location of personnel, other hazardous materials and to the standard of the local infrastructure (especially electrical installations). Of particular concern is the release of oxygen into the atmosphere and the potential movement of oxygen enriched vapour away from the site.

2.5.B.10 **Fire**.

a. A minimum of two fire extinguishers suitable for use on a Class C (gases or liquefiable gases) are to be available at the site.

b. Do not allow smoking or naked lights.

2.5.B.11 **Signage**. Temporary warning signs are to be erected at the four sides of the area. They are to warn of the hazard of compressed gases and oxygen, restrict access and provide information on the activity taking place.

2.5.B.12 **Access**. The facility is to be a dedicated site and access to unauthorized persons prevented. Emergency access and egress routes are to be established.

2.5.B.13 **Safety equipment**.

a. All personnel are to wear the correct PPE. Part 2, Chapter 2 refers.

b. The use of personal oxygen monitors is recommended.

2.5.B.14 **Training**. All personnel are to competent at handling and operating oxygen equipment / cylinders and are to have had appropriate training.

2.5.B.15 **Oxygen refill equipment**. All equipment used for refilling oxygen cylinders is to be dedicated for that purpose and built specifically for oxygen to the appropriate standards. Suitable equipment is to be procured for use on detachments and supported by the parent unit or the Equipment Support Authority.

2.5.B.16 **Re-filling cylinders**. Where practical the refilling of cylinders is to be carried out in a controlled environment at a standard temperature to ensure that the maximum working pressure of the cylinder is not exceeded through environment and temperature changes. Reference may be made to BCGA CP 35. The procedures detailed within JSP 319, Part 2, Chapter 5 are to be followed.

Part 2

Chapter 6 (Sponsor – FSAT, PST)

GAS TESTING

SECTION 1 – SCOPE

2.6.1.01 This chapter is concerned with the testing of gases and cryogenic liquids. It discusses the main categories of gases available under the MOD gas supply contract and describes what user testing, if any, is required. Where user testing is required, the necessary test equipment and the test specifications are referenced.

2.6.1.02 The test requirements given in this chapter are arranged by end-use categories, e.g.:

a. Aviation breathing gases and cryogenic liquids.

b. Diving gases and diving gas mixtures (see also Part 2, Chapter 14).

c. Other cryogenic liquids (see also Part 2, Chapter 10).

d. Calibration gas mixtures.

e. Industrial gases.

f. Liquefied Petroleum Gases (LPG), in cylinders and in bulk (see also Part 2, Chapter 16 and Part 3).

g. Medical gases (see also Part 2, Chapter 13).

h. Refrigerants (see also Part 2, Chapter 12).

i. Welding and cutting gases (see also Part 2, Chapter 15).

SECTION 2 – GENERAL

2.6.2.01 DFG is the technical authority for the MOD on the quality assurance and the testing of gases and cryogenic liquids. Within DFG the Technical Team Manager is responsible for all quality assurance activities. The Technical Team Manager will advise on all aspects of gas quality and specification (see Part 1, Chapter 3, Annex A).

2.6.2.02 The DFG nominates and contracts with a laboratory for the testing and analysis of gases. This laboratory is approved by the DFG and for critical gases will have the appropriate United Kingdom Accreditation Service (UKAS) certification. This laboratory will also take part in the NATO Aviation Breathing Oxygen Correlation Programme (see paragraph 2.6.3.52). Details of the laboratory are at Annex D. Units can contact the Technical Team Manager within DFG for advice on gas testing and the use of the DFG approved laboratory (see Part 1, Chapter 3, Annex A).

2.6.2.03 Before carrying out any work:

a. Users must be aware of the hazards associated with the use of gases (see Part 2, Chapter 1).

b. Users must select and use the necessary Personal Protective Equipment (see Part 2, Chapter 2).

c. Users must correctly identify the gas and its container; handle and use them appropriately (see Part 2, Chapter 3 and Chapter 7).

d. If applicable, users must be aware of the hazards and safety requirements of cryogenic liquids (see Part 2, Chapter 10).

e. Read the relevant Safety Data Sheets (SDS) (see Part 2, Chapter 1, Annex A).

SECTION 3 – AVIATION GASES AND CRYOGENIC LIQUIDS

2.6.3.01 **Aviation Breathing Oxygen in gaseous form**. These products are supplied in cylinders and manifolded cylinder packs (MCPs) by a gas supply company. They are purchased against, and shall comply with, the requirements specified in *Defence Standard 68-284* for breathing oxygen. Each cylinder or MCP will have a label indicating the gas Use-By date. This is three years from the date of filling. Users are to confirm the gas is within this shelf life.

Note: On single cylinders the Batch Filling Label and Use-By date label is affixed onto the cylinder neck collar; whilst on MCP's it will be attached somewhere on the cylinder frame.

2.6.3.02 Users are to carry out moisture (water content) testing on a representative selection of breathing oxygen cylinders and all MCP breathing oxygen cylinder packs before they are put into service. The appropriate dewpoint meter and sampling system (see paragraph 2.6.12.02) shall be used to carry out this test. Where cylinders are delivered in pallets, typically consisting of 15 cylinders, two cylinders from each pallet load are to be tested for moisture.

2.6.3.03 If required, the user may carry out an odour test (see Annex C).

2.6.3.04 Breathing oxygen cylinders and MCPs that fail to meet the moisture standard, or the odour test, specified in *Defence Standard 68-284,* for breathing oxygen, shall be declared unserviceable and returned in accordance with Part 1, Chapter 6.

Note: Personnel handling / testing these cylinders are to take every precaution necessary to minimise the risk of contamination (see Part 2, Chapter 7).

2.6.3.05 The Technical Team Manager within DFG is to be informed of all cases of non-compliance (see Part 1, Chapter 3, Annex A).

Note: For the policy regarding contaminated breathing oxygen systems in aircraft refer to Part 1, Chapter 7, paragraph 1.7.3.13.

2.6.3.06 **Aviation Breathing Oxygen in gaseous form, produced in Out of Area Operations (OOA)**. Oxygen produced by the Liquid Oxygen and Liquid Nitrogen

Production Plant (NSN: 71AS/3655-01-3234670) is required to comply with the requirements specified in *Defence Standard 68-284* for breathing oxygen.

2.6.3.07 See paragraphs 2.6.3.02 to 2.6.3.05 for user testing requirements; and see Part 2, Chapter 5, for filling of gas cylinders.

2.6.3.08 **High Purity Nitrogen in gaseous form**. These products are supplied in cylinders and MCPs by a gas supply company. They are supplied for use in aircraft and missile systems. They are purchased against, and shall comply with, the requirements specified in *Defence Standard 58-96, Clause 7*.

2.6.3.09 Users are to carry out moisture (water content) testing on a representative selection of cylinders and all MCPs before they are put into service. The appropriate dewpoint meter and sampling system (see paragraph 2.6.12.02) shall be used to carry out this test. Where cylinders are filled in pallets, typically consisting of 15 cylinders, a minimum of two cylinders from each pallet load are to be tested for moisture.

2.6.3.10 Nitrogen cylinders and MCPs that fail to meet the moisture standard specified in *Defence Standard 58-96, Clause 7*, shall be declared unserviceable and returned in accordance with Part 1, Chapter 6.

Note: Personnel handling / testing these cylinders are to take every precaution necessary to minimise the risk of contamination (see Part 2, Chapter 7).

2.6.3.11 The Technical Team Manager within DFG (see Part 1, Chapter 3, Annex A) is to be informed of all cases of non-compliance.

2.6.3.12 **High Purity Nitrogen in gaseous form, produced in OOA Operations**. Nitrogen produced by the Liquid Oxygen and Liquid Nitrogen Production Plant (NSN: 71AS/3655-01-3234670) is required to comply with *Defence Standard 58-96, Clause 9*.

2.6.3.13 Users shall carry out moisture testing on the gaseous nitrogen before it is used to charge cylinders or MCPs. The appropriate dewpoint meter and sampling system (see paragraph 2.6.12.02) shall be used to carry out this test.

2.6.3.14 Gaseous nitrogen produced by the Nitrogen Concentration Trolley (NCT) (NSN 71C/1730-01-5031613) shall comply with *Defence Standard 58-96, Clause 9*. Before this nitrogen is used to fill gas cylinders, its moisture content shall be tested using the appropriate dewpoint meter and sampling system (see paragraph 2.6.12.02) and compliance with the moisture limit specified in *Defence Standard 58-96, Clause 9*, confirmed.

2.6.3.15 See Part 2, Chapter 5, for details regarding the filling of gas cylinders.

2.6.3.16 **General Requirements and Storage Tank Maintenance for Cryogenic Aviation Gases**. All aviation cryogenic gases are to be stored in conditions which ensure that the quality of the product remains within specification. If any maintenance activity is carried out which may introduce contamination, or if contamination is suspected, then the contents of the storage tank are to be quarantined and a sample carried out. The product is not to be used until a satisfactory result is obtained. If contamination is confirmed then the tank is to be blown down, warmed up and purged (see Table 2.6.1). It is recommended that units align their storage tank maintenance activities with the sampling / testing of the product. Extensions to maintenance activities and / or sampling / testing will not be automatically granted, and in all cases require the authority of the appropriate Support Authority.

2.6.3.17 Unless periodic maintenance is due the contents of in-use MOD owned bulk storage tanks are to be maintained to at least 25 % of the tank capacity. This will help to prevent a build up of contamination and reduce the need for purging. If a tank capacity falls below 25 % then the tank is to be blown down (see Table 2.6.1).

2.6.3.18 Definitions of the terms ‘blow-down and purge’ and ‘blow-down, warm-up and purge’, and subsequent actions to be taken are detailed below in Table 2.6.1.

2.6.3.19 Sampling of MOD owned LOx/LiN storage tanks, gas production plants and aircraft replenishment trolleys is a unit engineering responsibility.

Note: The requirement for testing contractor owned tanks is detailed within paragraph 2.6.3.48.

2.6.3.20 Once a sample has been taken an RAF Form 3811 is to be raised and it is to be forwarded with the sample to the DFG nominated Test Laboratory (see Annex D) for analysis as soon as is practicable.

2.6.3.21 The DFG’s nominated Test Laboratory will report the results to DFG and the unit concerned. The Technical Team Manager within DFG (see Part 1, Chapter 3, Annex A) will analyse the results and advise the following of any subsequent actions, as required:

a. The Unit.

b. The Equipment Support Authority.

c. The Supplier.

d. Appropriate DFG personnel.

e. Any other units that may be affected.

Table 2.6.1: Definitions of the terms ‘blow-down and purge’ and ‘blow-down, warm-up and purge’, and subsequent actions to be taken.

Blow-down. This is the total removal of liquid oxygen or liquid nitrogen from a storage vessel as rapidly as is practical and safe to do so, by raising the tank to normal decanting pressure, and draining through the bottom fill / drain valves. It is then refilled with fresh product after which a sample of the liquid is to be sent to DFG’s nominated Test Laboratory (see Annex D) for analysis for conformance to the relevant specification. The product is to be quarantined until a satisfactory result has been obtained.
Blow-down, warm-up and purge. This is the total removal of liquid oxygen or liquid nitrogen from a storage vessel as rapidly as is practical and safe to do so. This is followed by a "warm-up" during which the inner vessel is brought

(forced or naturally) to ambient temperature (15 °C). When the inner vessel has reached ambient temperature, it is purged using dry gaseous oxygen, or dry, oil-free gaseous nitrogen for LOx vessels, and dry, oil-free gaseous nitrogen for LiN vessels.

On refilling with fresh product a sample of the liquid is to be sent to the DFG's nominated Test Laboratory (see Annex D) for analysis for conformance to the relevant specification.

The product is to be quarantined until a satisfactory result has been obtained.

A list of the current in-service cryogenic liquid storage tanks and trolleys is detailed below in Table 2.6.2.

Table 2.6.2: MOD owned LOx / LiN storage tanks.

Storage Tank / Trolley	Mk. No.	Publication No.	Sampling
100 litre Trolley	-	AP 119F-2723-125F	paragraph 2.6.3.43 refers
200 litre Trolley	-	AP 119F-2723-125F	paragraph 2.6.3.43 refers
200 litre Trolley	MK 2	AP 119F-2745-1235F	paragraph 2.6.3.43 refers
2400 litre Tank	MK 1	AP 119L-0507-135F	Yes
2400 litre Tank	MK 2	AP 119L-0508-1235F	Yes
4000 litre Tank	-	AP 119L-0503-16A	Yes
9000 litre Tank	-	AP 119L-0505-1	Yes
18000 litre Tank	-	AP 119L-0505-1	Yes

Note: The Support Authority for this equipment is the AC PT.

2.6.3.22 The procurement of aviation cryogenic liquids via local arrangements whilst operating out-of-area is to be in accordance with the procedures detailed in Part 1, Chapter 3.

2.6.3.23 Bulk Aviation Breathing Oxygen in liquid form intended for breathing purposes is purchased against, and shall comply with, the requirements specified in *Defence Standard 68-284* for liquid oxygen.

2.6.3.24 The supplier will provide a Certificate of Conformity to the Defence Standard with each delivery of liquid oxygen. Units are to check the certificate to ensure the product has met the specification. Units are to hold these certificates for a minimum period of 18 months from the date of delivery.

2.6.3.25 The unit is to carry out an odour assessment (see Annex A) and a visual examination (see Annex B) of the liquid oxygen at the time of delivery and prior to transfer into MOD owned storage tanks. If the product being delivered does not conform to the Defence Standard, or any contamination is evident from the above tests, the whole delivery is to be rejected. TheTechnical Team Manager and Supply Chain Manager (see

Part 1, Chapter 3, Annex A) are to be informed. If required by the Technical Team Manager within DFG a sample shall be taken from the delivery tanker and sent for analysis to DFG's nominated Test Laboratory (see Annex D).

2.6.3.26 **MOD owned bulk Aviation Liquid Oxygen storage tanks**. Samples of product from all MOD owned LOx storage tanks (see Table 2.6.2) are to be drawn at weekly intervals by an authorised, trained person and assessed for odour (see Annex A) and a visual examination (see Annex B) is to be carried out. A record of such weekly sampling is to be recorded on the equipment *MOD Form 755G*, detailing:

a. Date.

b. Serial number of tank.

c. Name / rank of the person carrying out the sampling.

d. Brief result of test (e.g. satisfactory / unsatisfactory).

e. Follow up action generated.

2.6.3.27 Samples of LOx shall be taken from all MOD owned bulk storage tanks (see Table 2.6.2) at each base on a six-monthly basis (see 2.6.3.16) and sent for test to DFG's nominated Test laboratory (see Annex D), accompanied by a *RAF Form 3811*. The *RAF Form 3811* should specify that the sample be tested against *Defence Standard 68-284*, for liquid oxygen.

2.6.3.28 MOD owned LOx storage tanks are to be blown-down, warmed-up and purged every 6 months (see Table 2.6.1 and Table 2.6.2).

Note: There is no requirement for 6-monthly blow-down, warm-up and purging of Aircraft LOx Replenishment Trolleys (see Table 2.6.2).

2.6.3.29 A blow-down (see Table 2.6.1) is also to be carried out when the moisture content exceeds the limits stated in *Defence Standard 68-284* for LOx and when Odour is detected. Instructions for carrying out these procedures are provided in the publications detailed in Table 2.6.2.

2.6.3.30 Records of such 'blow-downs' or 'blow-down, warm up and purges' are to be recorded on *MOD Form 755G*.

2.6.3.31 Bulk Aviation Nitrogen in liquid form intended for use on aircraft and missile systems is purchased against, and shall comply with, the requirements specified in *Defence Standard 58-96, Clause 7.*

2.6.3.32 The supplier will provide a Certificate of Conformity to the Defence Standard with each delivery of liquid nitrogen. Units are to check the certificate to ensure the product has met the specification. Units are to hold these certificates for a minimum period of 18 months from the date of delivery.

2.6.3.33 The unit is to carry out a visual examination (see Annex B) of the liquid nitrogen at the time of delivery and prior to transfer into MOD owned storage tanks. If the product being delivered does not conform to the Defence Standard, or any contamination is evident from the above test, the whole delivery is to be rejected. The Technical Team Manager and Supply Chain Manager (see Part 1, Chapter 3, Annex A) are to be informed. If required by the Technical Team Manager within DFG a sample shall be taken from the delivery tanker and sent for analysis to DFG's nominated Test Laboratory (see Annex D).

2.6.3.34 **MOD Owned Bulk Aviation Liquid Nitrogen storage tanks**. Samples of product from all MOD owned LiN storage tanks are to be drawn at weekly intervals by an authorised, trained person and a visual examination (see Annex B) carried out. If contamination is suspected, an odour assessment may be carried out in accordance with Annex A, taking due account of all Safety Warnings. A record of such weekly sampling is to be recorded on the equipment *MOD 755G*, detailing:

a. Date.

b. Serial number of tank.

c. Name / rank of the person carrying out the sampling.

d. Brief result of test (e.g. satisfactory / unsatisfactory).

e. Follow up action generated.

2.6.3.35 Samples of LiN, for use in aircraft and missile systems only, shall be taken from all MOD owned bulk storage tanks (see Table 2.6.2) at each base on a six-monthly basis (see 2.6.3.16) and sent for test to DFG's nominated Test laboratory (see Annex D), accompanied by a *RAF Form 3811*. The *RAF Form 3811* should specify that the sample be tested against *Defence Standard 58-96, Clause 7*.

2.6.3.36 MOD owned LiN storage tanks are to be blown-down, warmed-up and purged every six months (see Table 2.6.1 and Table 2.6.2).

2.6.3.37 A blow-down (see Table 2.6.1) is also to be carried out when the moisture content exceeds the limits stated in *Defence Standard 58-96* for LiN. Instructions for carrying out these procedures are provided in the publications detailed in Table 2.6.2.

2.6.3.38 Records of such 'blow-downs' or 'blow-down, warm up and purges' are to be recorded on *MOD Form 755G*.

2.6.3.39 **Liquid Oxygen and Liquid Nitrogen Production Plant and associated 2400 litre Transportable Tanks**. For details regarding the operation of the Liquid Oxygen and Liquid Nitrogen Production Plant (NSN 71AS/3655-01-3234670) see Part 2, Chapter 5.

2.6.3.40 In addition, samples of gaseous oxygen and/or gaseous nitrogen from the Production Plant shall be taken during every production run and tested by authorised, trained personnel for purity, in accordance with *AP 119L-0404-1236A+5F,* for moisture (water content) and trace contaminants using the MIDAC I Series Industrial FTIR Spectrometer (71AS/6650-99-1348762) (see *AP119L-0322-12*). The results of these tests shall be logged in the appropriate manner.

2.6.3.41 Laboratory cryogenic liquid samples shall be taken every 3 months from all 2400 litre Liquid Oxygen Transportable Tanks (see Table 2.6.2) which are filled from the Liquid Oxygen and Liquid Nitrogen Production Plant (71AS 3655-01-3234670). The

Cosmodyne Cryogenic Sampler (see paragraph 2.6.12.08) together with the appropriate hose and connector shall be used to take a sample of liquefied gas directly from the appropriate Liquefied Gas Outlet Port from the tank only.

2.6.3.42 The cryogenic liquid sample shall be sent for test to DFG nominated Test Laboratory (see Annex D). Each sample shall be accompanied by a *RAF Form 3811, Application for Test or Calibration*, specifying that the sample be tested against *Defence Standard 68-284,for liquid oxygen.*

2.6.3.43 **Aircraft LOx replenishment trolleys (100 & 200 litre)**. For details regarding the MOD owned LOx replenishment trolleys see Table 2 6.2.

2.6.3.44 Units are to carry out an odour assessment (see Annex A) and a visual examination (see Annex B) of the LOx in aircraft LOx replenishment trolleys before the first use of the trolleys for servicing an aircraft in any 24 hour period.

2.6.3.45 No laboratory testing of the product within these trolleys is necessary when they are in regular use and replenished from an on-site bulk tank that is subjected to sampling and laboratory testing (approved DFG contractor supplied storage tanks or MOD tanks detailed in Table 2.6.2). Aircraft LOx replenishment trolleys are to be blown-down (see Table 2.6.1) when any contamination is suspected. Details of such blow-downs are to be recorded on the equipment *MOD Form 755G*. LOx trolleys are also to be blown-down (see Table 2.6.1) when maintenance operations, carried out in accordance with the relevant Air Publication (AP), require the opening of the system and the exposure of the contents to the air.

2.6.3.46 When brought into use after a period of storage, trolleys are to be subject to blow down, warm-up and purge (see Table 2.6.1); and then filled and sampled. A satisfactory laboratory result is to be obtained before the trolley is returned to service.

2.6.3.47 Where a trolley is used as a stand-alone supply, i.e. not replenished from a DFG approved on-site bulk tank that is subjected to sampling and laboratory testing, a Certificate of Conformity is to be obtained from the LOx supplier and kept by the unit for a minimum period of 18 months. A copy is to be sent to the Technical Team Manager within DFG (see Part 1, Chapter 3, Annex A). A sample shall be taken from the trolley. A satisfactory laboratory result is to be obtained before the trolley is used.

2.6.3.48 **Contractor owned cryogenic liquid bulk storage vessels**. The contractor will remain responsible for maintaining the quality of any product within their own vessels. The contractor is to supply the user unit with a Certificate of Conformity detailing the quality of the product against the required specification. For aviation standard gases the contractor will sample on a monthly basis and provide a Certificate of Conformity after each sample. Units are to check the certificate to ensure the product has met the specification.

2.6.3.49 One copy of the Certificate of Conformity is to be retained by the unit and one copy sent to the Technical Team Manager within DFG (see Part 1, Chapter 3, Annex A). The unit is to hold these certificates for a minimum period of 18 months from the date of the sample.

2.6.3.50 Samples of product from aviation gas storage tanks are to be drawn at weekly intervals by a MOD authorised, trained person and a visual examination (see Annex B) is to be carried out; and, for liquid oxygen only, assessed for odour (see Annex A). If contamination is suspected, an odour assessment may be carried out in accordance with Annex A, taking due account of all Safety Warnings A record of such weekly sampling is to be recorded.

2.6.3.51 The MOD will always retain the right to independently test any product with which it is supplied. If the quality of the product is suspect then a sample is to be taken and sent for test to DFG's nominated Test laboratory (see Annex D) accompanied by a *RAF Form 3811*. For liquid nitrogen if contamination is suspected, an odour assessment may be carried out in accordance with Annex A, taking due account of all Safety Warnings.The *RAF Form 3811* should specify that the sample be tested against the appropriate Defence Standard. Before taking a sample advice is to be sought from the Technical Team Manager within DFG (see Part 1, Chapter 3, Annex A).

2.6.3.52 **Aviators Breathing Oxygen Correlation Programme**. The UK MOD participates in the Aviators Breathing Oxygen (ABO) Correlation Programme. The ABO Correlation Programme is managed by the United States Air Force Petroleum Office which conducts the programme on behalf of the USA Department of Defence, ASIC and NATO allies. The programme is managed within the UK by the Technical Team Manager within DFG (see Part 1, Chapter 3, Annex A) and involves the DFG nominated test laboratory (see Annex D).

SECTION 4 – COMPRESSED NATURAL BREATHING AIR (CNBA); DIVING GASES AND GAS MIXTURES

2.6.4.01 **CNBA in cylinders**. When CNBA is supplied, by a gas supply company, in cylinders and MCPs it is to be procured against the requirements specified in *Defence Standard 68-284* for CNBA.

2.6.4.02 When provided via the MOD gas supply contract each cylinder will be supplied with a Certificate of Conformity. Each cylinder or MCP will have a label indicating the gas Use-By date. Users are to confirm the gas is within this shelf life. No additional testing is required.

2.6.4.03 **CNBA from a compressor system, general requirements**. CNBA produced by the user, either for immediate use or, for cylinder filling. Where this breathing gas is being used for aircraft use, marine life-support applications, fire-fighting and emergency escape on board ships and submarines, or dedicated breathing air supplies for Compression Chambers, then it shall comply with the requirements specified in *Defence Standard 68-284*, for CNBA.

Note:
1. For CNBA used solely for diving applications, it shall comply with the requirements in paragraph 2.6.4.09.

2. For compressors located on HM Ships and Submarines further information is detailed within BR 2000(89).

2.6.4.04 For all other applications, including air-line fed respiratory protection systems, such as paint spray booths, and respiratory protection device cylinder filling applications for fire fighting, it shall comply with the requirements of *BS EN 12021*.

Note: MOD policy for compressed air respiratory protection systems is published in *JSP 375, Volume 2, Leaflet 30, Leaflet 42 and Leaflet 49*.

2.6.4.05 Compressor systems employed to produce CNBA fall within the scope of the Pressure Systems Safety Regulations 2000 (PSSR) (see *JSP 375, Volume 2, Leaflet 30*); the Control of Substances Hazardous to Health Regulations (COSHH); and guidance given in BS EN 529. The regulations require an assessment of risks; a scheme of system examinations; and record keeping. In respect of CNBA, this includes a periodical check on the quality and the flow rate of the delivered air.

2.6.4.06 The frequency and range of quality testing is to be determined by a Risk Assessment. The assessor shall ensure that wherever a compressor is located, the quality of CNBA it supplies is not compromised by nearby contaminants. The quality of the CNBA produced shall be tested by a competent person at least once every three months, and more frequently when the quality of the CNBA supplied cannot be assured. Testing for the quality of CNBA is to be carried out on mobile or temporary compressors before the first use at any new location. Additionally, testing for the quality of CNBA is to be carried out whenever maintenance has been completed which may have introduced contamination into the system.

2.6.4.07 CNBA testing may be carried out using the test equipment detailed in Section 12. Test samples are to be sent for analysis to a UKAS certified laboratory. Records of all testing carried out are to be kept.

2.6.4.08 Testing should include an assessment of odour (see Annex C) and taste, and all samples are to be colourless.

2.6.4.09 **CNBA from a compressor system solely for diving applications**. CNBA produced by the user, either for immediate use or, for cylinder filling. Where this breathing gas is being used for diving applications, then it shall comply with the requirements specified in *Defence Standard 68-284*, for CNBA.

Notes:

1. If the CNBA is to be used as a raw material for blending diving gas mixtures, see Paragraph 2.6.4.18.

2. If the CNBA is to be used solely for Adventurous Training diving then it shall comply with the requirements of BS EN 12021.

2.6.4.10 CNBA manufactured using approved diving plant, can be tested on location by trained competent personnel under the authorisation of MOD Superintendent of Diving. This testing may be carried out using the test equipment detailed in Section 12, Table 2.6.7, or test equipment to at least an equivalent specification approved for use by the MOD Superintendent of Diving. The frequency and range of testing is to be determined by a Risk Assessment. However, the quality of the CNBA produced shall be tested at least once every three months, and more frequently when the quality of the CNBA supplied cannot be assured. The assessor shall ensure that wherever a compressor is located, the quality of CNBA it supplies is not compromised by nearby contaminants, this is of particular concern where the CNBA supply is from mobile compressors. The quality of CNBA produced by mobile compressors is to be tested each time a compressor is relocated to a new dive site. Additionally, testing for the quality of CNBA is to be carried out whenever maintenance has been completed which may have introduced contamination into the system.

2.6.4.11 On an annual basis, a sample of the CNBA produced by each diving plant is to be sent for analysis to a UKAS certified laboratory. In every case, CNBA supplied for diving applications shall, as a minimum, meet the quality standard in BS EN 12021. The National Foreword to this standard requires that all contaminant levels are below one tenth of the eight-hour Workplace Exposure Limit (WEL). As it is not reasonably practicable to test for all contaminants, the risk assessment is to guide what other contaminants will require testing.

2.6.4.12 The competent person is to carry out an assessment of all test results to ensure that the CNBA remains fit for purpose and within specification. The competent person is to compare the test results achieved on each test against the historical records and is to determine whether any adverse trends are developing, and is to take any necessary rectification action. At the annual test, to allow a valid comparison to be made, the laboratory and user test samples are to be taken at the same time and any differences are to be within the chemical detector tube manufacturers stated tolerances.

2.6.4.13 Records of all testing carried out are to be kept for a minimum period of six years. The test results shall be filed in accordance with the instructions issued by the MOD Superintendent of Diving. All records relating to sampling/testing of gases are to be made available for inspection to authorised external inspection bodies as appropriate.

2.6.4.14 Procedures for the use of diving gases are detailed in *BRd 2806* or for Adventurous Training diving in the *Joint Service Sub-Aqua Diving Regulations*. Further guidance concerning the frequency of CNBA testing can be found in *BS EN 529*, *HSE L5* and *HSE Diving Information Sheet No 9*.

2.6.4.15 Diving gas sampling cylinders are available (see paragraph 2.6.12.14).

2.6.4.16 **Diving gases and diving gas mixtures**. This includes CNBA; oxygen for diving; specified mixtures of oxygen and nitrogen (Nitrox); specified mixtures of oxygen and helium (Heliox); or specified mixtures of oxygen, helium and nitrogen (Trimix). These gases are procurred against the requirements specified in *Defence Standard 68-284*, for CNBA, oxygen-nitrogen mixtures, oxygen-helium mixtures, or oxygen-nitrogen-helium mixtures, as appropriate.

2.6.4.17 Each cylinder or MCP supplied via the MOD gas supply contract will have a label indicating the gas Use-By date. This is either five or ten years from the date of filling, depending on the product. Users are to confirm the gas is within the appropriate shelf life. A Certificate of Conformity is supplied with each cylinder or MCP.

2.6.4.18 Where CNBA, manufactured using approved diving plant, by a trained competent person under the authorisation of MOD Superintendent of Diving, is used to produce Nitrox diving gas, by volumetric mixing with pure oxygen, the CNBA is to comply with the requirements for Nitrox (≤ 40 % oxygen) specified in *BS 8478*, **not** to the **CNBA** requirements specified in Def Stan 68-284. The resulting Nitrox is to comply with the requirements for Nitrox specified in *BS 8478*.

Note: Some "diving gases" are available in the form of calibration mixtures, supplied with Certificates of Analysis, for verifying test equipment (see paragraph 2.6.6.03).

2.6.4.19 The use of diving gases and diving gas mixtures is controlled by written instructions and procedures issued by the MOD Superintendent of Diving, see Part 2, Chapter 14, for further details. This includes a determination, by measurement, of the oxygen content of the diving gas / diving gas mixture.

2.6.4.20 Where relevant, see Part 2, Chapter 5, for filling of gas cylinders.

SECTION 5 – OTHER CRYOGENIC LIQUIDS

2.6.5.01 **Product scope**. This category includes liquid oxygen supplied for engineering maintenance purposes; liquid nitrogen supplied for engineering maintenance purposes, for medical purposes, or for veterinary requirements; solid carbon dioxide; and, liquid argon.

2.6.5.02 **Liquid oxygen**. Used only for engineering maintenance purposes is purchased against, and shall comply with, the requirements specified in *BS 4364*.

2.6.5.03 There is no requirement for User testing/sampling of this product.

2.6.5.04 Liquid oxygen is also available as a medical gas (see Section 9).

2.6.5.05 **Liquid Nitrogen**. Used only for engineering maintenance purposes, such as cooling-down bearings and other components for shrink fitting; or for medical or veterinary use is purchased against, and shall comply with, the requirements specified in *BS 4366*.

2.6.5.06 There is no requirement for User testing/sampling of this product.

2.6.5.07 **Solid Carbon Dioxide**. Known also as "Dry Ice") used for engineering purposes, such as cooling-down bearings and other components for shrink-fitting, is purchased against, and shall comply with, the requirements specified in *BS 4105*.

2.6.5.08 There is no requirement for user testing/sampling of this product.

Note: Liquid carbon dioxide is also available from gas cylinders (see paragraph 2.6.7.09).

2.6.5.09 **Liquid Argon.** The product is sold by purity, such as N5.0 (99.999 % pure). In practice, liquid argon will be stored in insulated tanks and converted to gas for inerting, missile use, or flushing purposes. Where this product is being used to supply gaseous argon for missile or weapons applications, the gas produced shall comply with *Defence Standard 58-96, Clause 8*.

2.6.5.10 There is no requirement for User testing/sampling of this product.

Note: Argon intended for welding purposes is purchased against, and shall comply with, the requirements specified in *BS EN 439* (see Section 11).

2.6.5.11 **Contractor owned cryogenic liquid bulk storage vessels**. The contractor will remain responsible for maintaining the quality of any product within their own vessels. The contractor is to supply the user unit with a Certificate of Conformity detailing the quality of the product against the required specification. Units are to check the certificate to ensure the product has met the required specification.

2.6.5.12 One copy of the Certificate of Conformity is to be retained by the unit. The unit is to hold these certificates for a minimum period of 18 months from the date of delivery. There is no requirement for user testing/sampling of this product.

2.6.5.13 The MOD will always retain the right to independently test any product with which it is supplied. If the quality of the product is suspect then a sample is to be taken and sent for test to DFG's nominated Test laboratory (see Annex D) accompanied by a *RAF Form 3811*. The *RAF Form 3811* should specify that the sample be tested against the appropriate Defence Standard. Before taking a sample advice is to be sought from the Technical Team Manager within DFG (see Part 1, Chapter 3, Annex A).

SECTION 6 – CALIBRATION GAS MIXTURES

2.6.6.01 **Calibration mixtures for submarine use**. Depending upon its "grade", every cylinder of volumetric calibration gas mixture is filled to within ± 10 % (relative) or ± 5 % (relative) of its nominal specified mixing ratio; and is then analysed by the supplier, who issues a UKAS Certificate of Calibration for the cylinder detailing the actual concentrations of the gas mixture. Unless otherwise specified on the Certificate, these calibration gases and gas mixtures shall be regarded as having a "life" of two years from the date of filling the cylinder. If not used up by then, the cylinder shall be replaced with a new calibration gas or mixture at the end of the life period.

2.6.6.02 No user testing of these gas mixtures is necessary.

2.6.6.03 **Calibration gases, general use**. This category includes some pure gases as well as calibration gas mixtures; the latter are made either volumetrically or gravimetrically. Pure gases are supplied with a Certificate of Analysis.

2.6.6.04 Depending upon its "grade", every cylinder of Volumetric calibration gas mixture is filled to within ± 10 % (relative) or ± 5 % (relative) of its nominal specified mixing ratio; and is then tested by the cylinder filler, who issues a Certificate of Analysis detailing the actual concentrations of the gas mixture. Gravimetric calibration gases are filled to whichever is the greater of ± 1% (relative) and ± 2 ppm; and the mixture is then tested by the cylinder filler, who issues a Certificate of Analysis detailing the actual concentrations of the gas mixture.

Note: Gas mixtures are subject to two variables: Filling tolerance and analytical tolerance. For example a nominal 20 % mixture of a specified gas in another specified gas, filled to ± 5 % (relative) is likely to contain between 19 % and 21 % of the minor component. An Alpha standard will be analysed to ± 1 % (relative); a Beta standard to ± 2 % (relative); and a Certified mixture between ± 2 and 5 % (relative). Thus, a nominal 20 % Alpha mixture will be supplied with, e.g., an analytical Certificate of Analysis specifying the contents as: 20.4 % (± 1 %) (relative) = 20.4 ± 0.2 % of the minor component in a balance of the major component. A comparable uncertified mixture would be labelled as e.g. 20 % ± 10 %

(relative) (= 20 ± 2 %), or ± 5 % (relative) (= 20 ± 1 %), of the minor component in a balance of the major component, depending on the filling grade requested.

Note: Some diving gases and gas mixtures are also available in the form of calibration gases to enable test equipment to be calibrated.

2.6.6.05 These calibration gases and gas mixtures shall be regarded as having a "life" of between six months to five years from the date of filling the cylinder dependant on the type of gas or gas mixture involved. The expiry life of the gas will be indicated on a label attached to the cylinder. If not used up by then, the cylinder shall be replaced with a new calibration gas or mixture at the end of the life period.

2.6.6.06 No user testing of these calibration gases is necessary.

SECTION 7 – INDUSTRIAL GASES

2.6.7.01 **Various Industrial Gases not specified elsewhere in this Chapter**. To some extent the term “Industrial gases” is a ‘catch all’ category for gases that do not fall into the other named end-use categories. Examples of such gases available under the DFG supply contract are balloon gas, compressed air, sulphur hexafluoride (SF_6), liquid nitrogen and liquid carbon dioxide. Of these, balloon gas has no specification, it is helium containing trace amounts of air; the others are covered by British Standard specifications.

2.6.7.02 No user testing of these gases is required.

2.6.7.03 **Compressed air and Compressed Natural Breathing Air (CNBA)**. Compressed air and CNBA is supplied, by a gas supply company, in cylinders / MCPs.

2.6.7.04 Where this product is to be used for breathing purposes, see the guidance given in Section 4.

2.6.7.05 Where this product will not be used for breathing, there is no requirement for user testing of contractor filled cylinders / MCPs.

2.6.7.06 **Pure Air**. Pure air, to *Defence Standard 58-96, Clause 8*, is a non-breathing gas used for thermal imaging systems, detector cooling and weapon systems. Pure air is available in small 414 bar (6000 lb/in^2) special-to-type cylinders, as specified in *Defence Standard 81-91*; these pure air cylinders are only available from specialist electronics / weapons systems suppliers.

2.6.7.07 Pure Air Generators, such as the High Pressure Pure Air Generator, (HIPPAG), provide a means of generating pure air for missiles and replenishing pure air cylinders.

2.6.7.08 Analysis of cylinders of pure air can be undertaken by DFG’s nominated Test Laboratory (see Annex D) by prior arrangement through the Technical Team Manager within DFG (see Part 1, Chapter 3, Annex A).

2.6.7.09 **Carbon dioxide, liquid and gaseous**. Carbon dioxide is supplied in gas cylinders which, depending upon their internal valve configuration, will deliver either gaseous carbon dioxide (gas-delivery) or liquid carbon dioxide (liquid-delivery). Cylinders intended to supply liquid carbon dioxide are fitted with an internal dip tube, and this is indicated by a white line painted upon the body of the cylinder; carbon dioxide cylinders without dip tubes do not have a white line.

Note: Liquid-delivery cylinders intended to supply liquid carbon dioxide when the cylinder is vertical are fitted with a long dip tube and this is indicated by a long white line. Other liquid-delivery cylinders only supply liquid carbon dioxide when they are either horizontal or partially inverted: these cylinders are indicated by a short white line, or a curved white line, respectively.

2.6.7.10 Carbon dioxide is sold by purity, such as Industrial grade (to *BS 4105*), N4.5 (99.995 % pure), or N5.0 (Research Grade) (99.999 % pure). *BS 4105*, Type 1, Industrial grade liquid carbon dioxide is intended for non-food applications, such as purging, inerting and life-raft inflation; whereas, Type 2 is suitable for industrial food applications, such as beverages, gas packing, food freezing and chilling. Carbon dioxide is also available as a welding gas (see Section 11).

2.6.7.11 No user testing of this gas is necessary; however, the user shall confirm by external visual inspection that the correct type of cylinder is being used, i.e. gas-delivery or liquid-delivery.

SECTION 8 – LIQUEFIED PETROLEUM GASES

2.6.8.01 **Liquefied Petroleum Gases (LPG), in cylinders and in bulk**. These gases are purchased against the requirements specified in the relevant British Standards, such as *BS 4250* (see Part 1, Chapter 5). For LPG cylinders see Part 2, Chapter 16; for bulk LPG see Part 3.

2.6.8.02 No user testing of these gases is necessary.

SECTION 9 – MEDICAL GASES

2.6.9.01 **Medical gases**. These gases are procured from a gas supply company that holds the necessary medical Product Licences to produce these medical gases. They are manufactured against UK and European Pharmacopoeia Specifications. See Part 1, Chapter 4 and Part 2, Chapter 13, for further details on medical gases.

2.6.9.02 Medical gas cylinders are typically supplied with a usable life of up to three years. The expiry date of the life will be indicated by a label on the cylinder shoulder area. For examples see Part 2, Chapter 3, Annex D. No user testing of these gases is necessary.

2.6.9.03 **Medical Gas Pipeline Systems**. Where Medical Gas Pipeline Systems (MGPS) and Dental Gas Systems (DAVS) are installed quality testing is to be carried out in compliance with Health Technical Memorandum (HTM) – 02. This requires that an authorised Quality Controller Pharmacist who has specialist knowledge, training and experience of MGPS and DAVS carries out quality testing of the gases whenever contamination is suspected; if the pipeline has been opened to atmosphere; and on a three monthly routine basis. The Quality Controller Pharmacist will provide a Certificate of Conformity for each gas. For further information see Part 2, Chapter 13, Section 7.

SECTION 10 – REFRIGERANTS

2.6.10.01 **Refrigerants**. See Part 2, Chapter 12, for further details on Refrigerant gases.

2.6.10.02 No user testing of these gases is necessary.

SECTION 11 – WELDING GASES

2.6.11.01 **Welding, shielding and cutting gases**. These gases include oxygen, acetylene, argon, carbon dioxide, helium, hydrogen, nitrogen and various shielding gases and gas mixtures. They are generally purchased by the MOD against the relevant British Standards, such as: *BS EN 439, BS 4105, BS 4364* and *BS 4366*. Whilst a number of proprietary welding and shielding gases are in everyday use, the MOD procurement policy is to order using the relevant *BS EN 439* equivalents. See Part 2, Chapter 15, for further details on welding and cutting gases.

2.6.11.02 Certificates of Conformity may be requested from the supplier. This should be specified at the time of the demand.

2.6.11.03 No user testing of the above gases is necessary.

SECTION 12 – TEST AND SAMPLING EQUIPMENT

2.6.12.01 The following test, measurement and sampling equipment and sampling cylinders are available for use:

Note: The DS&TE PT manage a range of gas detection equipment for use within the MOD. They can supply, calibrate and provide advice on test and measurement equipment.

2.6.12.02 **Cermax Dewpoint Meter and Sampling System**. This is a portable instrument designed for the measurement of dewpoint and moisture content in gases. See Table 2.6.3.

2.6.12.03 The Support Authority for this instrument is the AC PT.

Table 2.6.3

Item Description	Publication	NSN
Cermax Dewpoint Meter and Sampling System (Nitrogen)	AP 119L-0321-12	71B/1660-99-7837029
Cermax Dewpoint Meter and Sampling System (Oxygen)	AP 119L-0321-12	71B/1660-99-9888087

2.6.12.04 **LOx/LiN Cryogenic Sampler**. This equipment is charged with a cryogenic liquid which it converts into a gas suitable for filling a sample cylinder. See Table 2.6.4.

2.6.12.05 The Support Authority for this equipment is the AC PT.

Table 2.6.4

Item Description	Publication	NSN
LOx/LiN Cryogenic Sampler	AP119L-0313-1	71BG 2252385

2.6.12.06 **Aviation Gases Sample Cylinders**.

2.6.12.07 The Support Authority for these cylinders is the DFG (see Part 1, Chapter 3, Annex A). See Table 2.6.5.

Table 2.6.5

Item Description	Water Capacity	NSN
Oxygen Sample Cylinder	3.3 litre	71C/8120-99-8073913
Nitrogen Sample Cylinder	3.3 litre	71C/8120-99-7548099

Note. These cylinders are provided inside a transit case. Except when being filled, these cylinders are always to be stored / transported in the transit case.

2.6.12.08 **Cosmodyne Cryogenic Sampler**. This equipment is charged with a cryogenic liquid which is allowed to vaporise and therefore contain a representative sample of the cryogenic liquid for laboratory analysis. See Table 2.6.6.

2.6.12.09 The Support Authority for this equipment is the AC PT.

Table 2.6.6

Item Description	Water Capacity	Publication	NSN
Cosmodyne Cryogenic Sampler	4.4 litre	AP119L-0323-12	71BG/6695-00-7262721

2.6.12.10 **Factair Safe Air Tester**. This equipment is designed to allow user testing for the quality of compressed natural breathing air. It consists of a breathing air testing device, which uses disposal chemical reagent tubes for measuring specific contaminants, e.g. carbon dioxide, carbon monoxide and oil mist.

2.6.12.11 The chemical reagent detector tubes are sometimes "known" by the name of their manufacturer, e.g. "Drager tubes"; although detector tubes are also made by other manufacturers. These tubes, identified by manufacturer's part number, are designed to measure a specific gas contaminant, in air, over a specific gas concentration range (see specific manufacturer's handbook for further details).

2.6.12.12 Detector tubes should be selected in accordance with the test equipment operating instructions. See Table 2.6.7.

2.6.12.13 Information on the range of Factair Safe Air Tester equipment and accessories is available in Table 2.6.7.

Table 2.6.7

Item description	Support Authority	NSN	Remarks
Factair F3000 Safe Air Tester	DS&TE PT	1680-99-598-6300	
Factair F2235 Safe Air Tester	DS&TE PT	6630-99-732-2569	
Factair F2235 Safe Air Tester	DS&TE PT	6630-99-957-5623	
Detector tubes: Oil	DSG	6630-12-189-3124	Also see alternative oil Impactor, para 2.6.12.18
Detector tubes: H_2O	DSG	6630-12-189-3127	
Detector tubes: CO	DSG	6630-12-189-3125	
Detector tubes: CO_2	DSG	6630-12-189-3126	

Note: RAF Cosford run a training course for the Factair Safe Air Tester, in addition Factair offer a free on-line course for the Factair Safe Air Tester.

2.6.12.14 **Diving Gases Sample Cylinder**. Sample cylinder for diving gases. See Table 2.6.8.

Table 2.6.8

Item Description	Water Capacity	NSN
Diving Gas Sample Cylinder	5.5 litre	0869-99-110-3276
Diving Gas Sample Cylinder	1.2 litre	6820-99-172-2256

2.6.12.15 **Compressed Breathing Air Sampling Kit**. This sampling kit is designed to be used to take samples of compressed breathing air for laboratory analysis. Typically used in conjunction with the Factair Safe Air Tester, see 2.6.12.10. See Table 2.6.9.

Table 2.6.9

Item Description	Support Authority	NSN
Compressed Breathing Air Sampling Kit	DS&TE PT	34E / 6830-99-666-1085

2.6.12.16 **Domnick Hunter Portable Air Purity Test Kit**. This equipment is designed to allow user testing for the quality of compressed natural breathing air. See Table 2.6.10.

2.6.12.17 The test kit is supplied for use onboard HM Ships and Submarines.

Table 2.6.10

Item Description	Support Authority	NSN
Domnick Hunter Portable Air Purity Test Kit	DES Ships FEW MES MAS	6630-99-3728629
Detector tubes Oil		6630-99-746-7235
Detector tubes H_2O		6630-99-435-6388 or 6630-99-346-4078
Detector tubes CO		6630-99-551-0905
Detector tubes CO_2		6630-99-852-5321or 6630-99-605-7639

2.6.12.18 **Factair Oil Impactor**. An alternative to the Oil Detector Tube detailed in Table 2.6.7 is the Oil Impactor. See Table 2.6.11:

Table 2.6.11

Item Description	Support Authority	NSN
Oil Impactor 0.1 – 1.0 mg/m^3	DSG	6630-12-381-7870

2.6.12.19 **Portable Gas Detector**. Portable gas detectors are designed to be clipped to clothing and used as personnel indicators of the local atmosphere. See Table 2.6.12.

Table 2.6.12

Item Description	Support Authority	NSN
Crowcon Tetra3, 4 sensor gas detector. Typical Sensors: Flammable 0-100 % LEL Oxygen 0-25 % Hydrogen Sulphide 0-100 ppm Carbon Monoxide 0-500 ppm	DS&TE PT	6665-99-667-5938

BIBLIOGRAPHY

British Standards

1. BS EN 439 - *Welding Consumables – Shielding Gases for Arc Welding and Cutting*.

2. BS EN 529 - *Respiratory Protective Devices - Recommendations for Selection, Use, Care and Maintenance* - Guidance Document.

2. BS EN 12021 - *Respiratory Protective Devices – Compressed Air for Breathing Apparatus*.

3. BS EN 60376 - *Specification of Technical Grade Sulphur Hexafluoride (SF_6) for Use in Electrical Equipment*.

4. BS 4105 - *Liquid Carbon Dioxide, Industrial*.

5. BS 4250 - *Commercial Butane and Commercial Propane*.

6. BS 4364 - *Industrial Oxygen*.

7. BS 4366 - *Industrial Nitrogen*.

8. BS 8478 – *Respiratory protective devices – Breathing gases for diving and hyperbaric applications*.

Defence Standards

9. Defence Standard 58-96: - *Pure Gases for Weapons Systems and Detector Cooling Applications*.

10. Defence Standard 68-284: - *Compressed Breathing Gases for Aircraft, Diving and Marine Life-Support Applications*.

11. Defence Standard 81-91: - *High Pressure Pure Air Equipment for Detector Cooling Applications*.

Air Publications

12. AP119L-0001-2(R): - *Gas (Including Liquid Gas) Production, Storage & Test Equipment*.

13. AP 119L-0320-12 - *Breathing Oxygen Odour Test Equipment* (71BG/0041594 & 71BG/5625580).

14. AP 119L-0321-12: - *Michell Cermax Dewpoint Meter and Sampling System* (Oxygen 71B/1660-99-9888087) and (Nitrogen 71B/1660-99-7837029).

15. AP119L-0322-12: - *MIDAC I Series Industrial FTIR Spectrometer* (71AS/6685-99-4747200).

16. AP 119L-0323-12: - *Cosmodyne Cryogenic Sampler Type TTU-131/E* GEMS Type Code WCA (71BG/6695-99-7262721).

17. AP 119L-0404-1236A+5F: - *Liquid Oxygen and Liquid Nitrogen Production Plant* (NSN 71AS/3655-01-3234670).

18. AP119L-0612-1235F: - *High Pressure Oxygen & Nitrogen Charging Panels MK8* (71AS/3655-99-5685943) (Oxygen) & (71AS/3655-99-2519029) (Nitrogen).

19. AP119L-0313-1 - *Liquid Oxygen and Nitrogen Samplers*.

20. AP 119F-2746-1235F: - *Nitrogen Concentration Trolley (NCT)* (71N/1730-01-5031613).

RN Publications

21. BRd 2806 – *UK Military Diving Manual.*

22. BR 2000(89) – *Compressed Gas System Design and Engineering Practices.*

Joint Service Publications

23. JSP 375, Volume 2, Leaflet 29: - *Diving Safety Policy.*

24. JSP 375, Volume 2, Leaflet 30: - *Compressors.*

25. JSP 375, Volume 2, Leaflet 42: - *Protection of Persons Using Compressed Air – RPE*.

26. JAP 100A-01 - Military Aviation Engineering Policy and Regulations

27. JAP 100A-2, Military Aviation Engineering Documentation Procedures

MOD / RAF Forms

28. RAF Form 3811 - *Application for Test or Calibration*.

29. MOD Form 731 - *Equipment Conditioning Label*.

30. MOD Form 755G - *Ground Support Equipment Maintenance / Fault Work order.*

Health and Safety Executive

29. HSE L5 - *Control of substances hazardous to health*. The Control of Substances Hazardous to Health Regulations 2002 (as amended) *Approved Code of Practice and guidance*.

30. HSE information sheet. *Diving Information Sheet No 3 – Breathing gas management.*

31. HSE information sheet. *Diving Information Sheet No 9 – Diver's breathing air standard and the frequency of examination and tests.*

32. HSE EH 40 – *Workplace Exposure Limits: Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002 (as amended*). (Note: Latest version is to be used).

ANNEX A

(introduced at paragraph 2.6.3.25)

ODOUR ASSESSMENT OF LIQUID OXYGEN AND LIQUID NITROGEN

2.6.A.01 **Principle**. The liquefied oxygen or nitrogen is allowed to evaporate in a semi-enclosed container and subjected to an olfactory assessment.

2.6.A.02 This is a subjective test.

2.6.A.03 **Apparatus**. See Table 2.6.A1.

Table 2.6.A1: Apparatus and Consumables

Short Description of item	NSN
Beaker, Low Form, 400 ml, Borosilicate glass.	63C / 6640-12-1245668
Watch glass, 100 mm, Borosilicate glass.	63C / 6640-12-3658455
Filter Paper, 70 mm, Whatman No.1.	63C / 6640-99-4887392

WARNING: Care should be taken as the evaporation of liquid oxygen can give rise to oxygen-enrichment in the immediate surroundings and cause increased fire risks. In these circumstances, consideration should be given to having a second person on hand to ensure the safety of the tester.

WARNING: Care should be taken as the evaporation of liquid nitrogen can give rise to oxygen-depletion in the immediate surroundings and cause asphyxiation or death. In these circumstances, consideration should be given to having a second person on hand to ensure the safety of the tester.

WARNING: Care should be taken to avoid cold burns and frost bite when handling liquid oxygen or nitrogen, or vessels in contact with liquefied gases.

WARNING: Suitable PPE, including gloves or gauntlets, and eye and face protection shall be used (see Part 2, Chapter 2).

2.6.A.04 **Quality Considerations**. Ensure the tester(s) is not suffering from a cold, exposure to tobacco smoke, or any other condition that could adversely affect the tester's ability to carry out the test.

2.6.A.05 Ensure that the tester washes her/his hands in plain unscented soap. Ensure that there are no other odours present, such as cosmetics, perfumes, contaminated clothing, etc. that could mask or adversely affect the test.

2.6.A.06 Ensure that the room or work area is free of any odours that could mask or adversely affect the test.

2.6.A.07 **Method of Test for Odour**. Pour approximately 100 ml of the liquid oxygen or nitrogen into a clean 400 ml beaker, rotate gently to cool the beaker down to cryogenic gas temperature and pour off the liquid.

2.6.A.08 Place a clean 70 mm diameter filter paper into the bottom of the beaker and add 200 ml of the liquid oxygen or nitrogen sample. Cover the beaker with a clean 100 mm diameter watch glass so as to prevent atmospheric constituents from being absorbed by the exposed liquid.

Note: The convex face of the watch glass, i.e. the face shaped like the outside of a circle, should be in contact with the beaker and the concave face, i.e. the face shaped like the inside of a circle, should face upward.

2.6.A.09 Allow the liquid to evaporate to dryness in an area free from air currents and extraneous odours.

2.6.A.10 Remove the watch glass and check the odour of the beaker's contents at frequent intervals until the accumulated frost on the outside of the beaker has completely melted. Any odour will be most noticeable when the beaker has warmed nearly to room temperature. Wherever possible the assessment should be carried out by more than one person.

2.6.A.11 Record the fact that this test has been carried out and note any odour.

ANNEX B

(introduced at paragraph 2.6.3.25)

VISUAL EXAMINATION OF LIQUID OXYGEN AND LIQUID NITROGEN

2.6.B.01 **Principle**. The liquefied oxygen or liquid nitrogen is allowed to evaporate in a semi-enclosed container, which is then visually inspected for the presence of suspended matter or particles.

2.6.B.02 This is a subjective test.

2.6.B.03 **Apparatus**. See Table 2.6.B1.

Table 2.6.B1: Apparatus

Short Description of Item	NSN
Beaker, Low Form, 400 ml, Borosilicate glass.	63C / 6640-12-1245668
Watch glass, 100 mm, Borosilicate glass.	63C / 6640-12-3658455
Filter Paper, 70 mm, Whatman No.1.	63C / 6640-99-4887392.

WARNING: Care should be taken as evaporation of liquid oxygen can give rise to oxygen-enrichment in the immediate surroundings and cause increased fire risks.

On the other hand, evaporation of liquid nitrogen can give rise to oxygen-depletion in the immediate surroundings and generate an increased risk of asphyxiation or death.

WARNING: Care should be taken to avoid cold burns and frost bite when handling liquefied gases, or vessels in contact with liquefied gases.

WARNING: Suitable PPE, including gloves or gauntlets, and eye and face protection shall be used (see Part 2, Chapter 2).

2.6.B.04 **Method of Visual Examination**. Allow a supply of liquid oxygen or liquid nitrogen, as appropriate, to flow into a clean 400 ml beaker until it is approximately one third full. Rotate gently to cool the beaker down to cryogenic gas temperature and pour off the liquid.

2.6.B.05 Place a clean 70 mm diameter filter paper into the bottom of the beaker and add 200 ml of liquid oxygen or liquid nitrogen sample to the beaker. Cover the beaker with a clean 100 mm diameter watch glass so as to prevent atmospheric constituents from being absorbed by the exposed liquid and allow the liquid to evaporate down to between 75 to 100 ml in an area free from air currents and extraneous odours.

Note: The convex face of the watch glass, i.e. the face shaped like the outside of a circle, should be in contact with the beaker and the concave face, i.e. the face shaped like the inside of a circle, should face upward.

2.6.B.06 Examine the liquid oxygen or liquid nitrogen for the presence of suspended matter and visual impurities. Liquid oxygen is paramagnetic and has a pale blue colouration, liquid nitrogen is clear in colour.

2.6.B.07 Record the fact that this test has been carried out and note the presence of any suspended matter and/or visual impurities.

ANNEX C

(introduced at paragraph 2.6.3.03)

ODOUR ASSESSMENT OF GASEOUS OXYGEN, COMPRESSED NATURAL BREATHING AIR, OR DIVING GASES

2.6.C.01 **Principle**. A sample of breathing gas is to evaporate in a semi-enclosed container and subjected to an olfactory assessment. For high-pressure breathing oxygen, only, a dedicated test kit is used and the oxygen is breathed through a face mask.

2.6.C.02 This is a subjective test.

WARNING: Care should be taken as gaseous oxygen, or Diving Gas mixtures containing more than 21% oxygen, can give rise to oxygen-enrichment in the immediate surroundings and cause increased fire risks. In these circumstances, consideration should be given to having a second person on hand to ensure the safety of the tester.

WARNING: Extreme Caution should be taken before assessing Diving Gas mixtures containing less than 21% oxygen. These gas mixtures may not support life when breathed at ambient pressure; they could give rise to oxygen-depletion in the immediate surroundings and generate increased risks of asphyxiation or death. In these circumstances, consideration should be given to having a second person on hand to ensure the safety of the tester.

WARNING: This test may be hazardous if attempts are made to carry out it directly from high-pressure cylinders; as gas under pressure can cause damage to the lungs and/or eyes. Consideration should be given to reducing the pressure of the supplied gas, to 2 bar (30 lb.in^{-2}) or less, in the case of a free-flow supply, by means of a pressure regulator; and, to the provision of suitable eye and ear protection.

Note: Specialised test equipment is available for use with Breathing Oxygen cylinders and MCPs and this should be used in preference to the methodology given in paragraph 2.6.C.06 (see also paragraph 2.6.C.09), this provides a flow restricted to 15 litre/minute at 3.5 bar.

2.6.C.03 **Quality Considerations**. Ensure the tester(s) is not suffering from a cold, exposure to tobacco smoke, or any other condition that could adversely affect the tester's ability to carry out the test.

2.6.C.04 Ensure that the tester washes her/his hands in plain unscented soap. Ensure that there are no other odours present, such as cosmetics, perfumes, contaminated clothing, etc, that could mask or adversely affect the test.

2.6.C.05 Ensure that the room is free of any odours that could mask or adversely affect the test.

2.6.C.06 **Procedure (excluding high-pressure Breathing Oxygen)**. A regulated flow of gas is directed into a clean, odour-free, beaker, and the gas subjected to an olfactory assessment using short breaths only (see paragraph 2.6.C.05). Wherever possible the assessment should be carried out by more than one person.

2.6.C.07 The odour, if any, is rated as satisfactory or unsatisfactory.

Note: It should be borne in mind that gases may not always be odourless and a gas should be classified as satisfactory if it has a slight odour that can be easily tolerated for long periods.

2.6.C.08 As part of this assessment it may help to give a brief description of any odour, preferably by reference to an understood characteristic, such as e.g. oily, acidic, musty, sulphurous.

2.6.C.09 **Procedure (high-pressure Breathing Oxygen)**. This test is carried out in accordance with AP 119L-0320-12, using either the Type A, 230-Bar Test Kit, fitted with a G5/8 inch Bullnose cylinder adapter, or the Type B, 300-bar, Test Kit, fitted with a NEVOC cylinder adapter (see Table 2.6.C1). Both test kits are fitted with a facemask to facilitate the assessment of odour; and should be maintained and be operated in accordance with *AP 199L-0320-12*.

Table 2.6.C1

Item Description	Publication	NSN
Type A, 230-bar Test Kit, fitted with a G5/8 inch Bullnose cylinder adapter	AP 119L-0320-12	71BG/0041594
Type B, 300-bar, Test Kit, fitted with a NEVOC cylinder adapter	AP 119L-0320-12	71BG/5625580

2.6.C.10 For further details regarding the availability of the Test Kit, please refer to the relevant Support Authority: AC PT.

Note: This equipment should not be used for gases other than breathing oxygen, especially not for non-breathing gases or low-oxygen content diving mixtures that may not support life when breathed at ambient pressure.

ANNEX D

(introduced at paragraph 2.6.3.20)

DFG NOMINATED TEST LABORATORY

2.6.D.01 **Address and contact details:**

Point of contact: Analytical Services Manager BOC Gases

BOC Gases
Analytical Services Department
Northern Technical Centre
Sheffield
S20 3RP

BOC
A Member of The Linde Group

Telephone: 01142 512233

Fax: 01142 512323

Contact JSP 319 Author for further details

Note: The Nominated Test Laboratory participates in the NATO Aviator's Breathing Oxygen (ABO) Correlation Program, refer to 2.6.3.52.

2.6.D.02 **RAF Form 3811**. An *RAF Form 3811, Application for Test or Calibration,* is to be raised in triplicate for all gas samples that are to be analysed:

a. One copy is to accompany the sample to the DFG's nominated test laboratory.

b. One copy is to be retained by the Unit.

c. One copy is to be sent to the Quality Assurance section within DFG (see Part 1, Chapter 3, Annex A).

2.6.D.03 All copies are to carry the same serial number that is to be recorded in a register of *RAF Form 3811* held by the unit.

Note: RAF Form 3811 is available as an electronic download from the Catalogue of Forms within JAP 100A-02.

Part 2

Chapter 7 (Sponsor – FSAT, SAFETY 3)

HANDLING AND USE

SECTION 1 – SCOPE

2.7.1.01 This chapter details the general requirements and safety precautions necessary when handling, either manually or mechanically, and/or using gas cylinders.

SECTION 2 – GENERAL

2.7.2.01 The handling and lifting of gas containers is a potentially hazardous operation; and the MOD policy is to avoid, wherever practicable, carrying out manual handling operations. All employees and line management are to take every precaution to ensure injury does not occur.

2.7.2.02 Gas cylinders are generally heavy and are relatively unstable due to the base diameter to height ratio. Large cylinders can weigh over 100 kg when full and being tall and thin they are easily toppled over. In particular, when moving liquefied gas cylinders from the vertical position the centre of gravity will alter and this may affect the stability of the cylinder.

2.7.2.03 Accidents can be caused by cylinder mishandling and unsafe storage. The destructive potential arising from the uncontrolled release of gas from a high-pressure cylinder can be considerable. It is essential that proper training and instruction is given to all personnel involved in gas cylinder handling. Gas cylinders are only to be handled and used by properly trained persons. Improper cylinder handling techniques can lead to injuries to the back, hands, feet and chest. Where there is a risk of injury, an assessment may indicate that the risk of injury is unavoidable. In such cases, wherever practicable, the operation should be mechanised; training shall be given and, as a minimum, appropriate handling aids provided.

2.7.2.04 A suitable and sufficient risk assessment of the risk of injury from manually handling gas containers is to be carried out, in accordance with the *Manual Handling Operations Regulations 1992*. (*JSP 375, Volume 2, Leaflet 4*, is intended to aid Line Managers/Assessors and the workforce within the MOD to comply with the *Manual Handling Operation Regulations 1992*, which came into force on 1 January 1993, and all other statutory requirements). Manual Handling training is required for all personnel who handle gas containers. A BCGA Publication – *Guidance Note 3, The application of the manual handling operations regulations to gas cylinders* – is available to assist in carrying out a risk assessment on manual handling.

Notes:

1. There is a range of proprietary handling equipment available to assist in the handling of gas cylinders. Contact DFG for further advice (see Part 1, Chapter 3, Annex A).

2. It is a legal requirement that manual handling aids are regularly checked and maintained.

2.7.2.05 The use of lifting equipment and other work equipment is also subject to the requirement for suitable and sufficient risk assessments under the Provision and Use of Work Equipment Regulations, 1992; and the Lifting Operations and Lifting Equipment Regulations, 1998. (*JSP 375, Volume 2, Leaflet 8*, is intended to aid Line Managers/Assessors and the workforce within the MOD to comply with the *Provision and Use of Work Equipment Regulations, 1992*; and *Leaflet 9*, is intended to aid Line Managers/Assessors and the workforce within the MOD to comply with the *Lifting Operations and Lifting Equipment Regulations, 1998*, and all other statutory requirements).

2.7.2.06 All cylinders shall have their contents identified as defined in Part 2, Chapter 3. Content identification labels are applied after filling, and the identification labels are to be present during transportation, delivery to user and during use. If the contents cannot be accurately identified the cylinder is not to be used, the cylinder is to be labelled as unserviceable and returned, in accordance with Part 1, Chapter 6.

2.7.2.07 It is potentially very hazardous to use gas cylinders for anything other than the purpose for which they were designed. Misuse could result in damage being caused to the cylinder or its valve, and could lead to leakage of hazardous gas or create a hazard during subsequent filling of the cylinder. Any cylinder or other gas container which is known to have been misused shall be set aside and not issued for use or refilled; it is to be labelled as unserviceable and returned, in accordance with Part 1, Chapter 6. The gas supplier and the Support Authority are to be notified so that the appropriate safety measures can be taken.

2.7.2.08 All personnel handling, lifting or using gas cylinders are to use the appropriate PPE (see Part 2, Chapter 2).

2.7.2.09 Every effort is to be made to prevent contamination of the gas, particularly by preventing ingress via the valve outlet. New deliveries of gas cylinders will have the valve outlets blanked and/or will be protected by a shrink-wrap cover. All valve outlets are to be fitted with blanks at all times when not in use to help prevent the ingress of contamination. This applies to part-used cylinders and those that are nominally empty. Any external contamination of the cylinder or valve is to be removed. If contamination of the gas is suspected, or if any contamination is believed to have affected the properties of the cylinder or its fixtures and fittings it is to be labelled as unserviceable and returned in accordance with the procedures detailed in Part 1, Chapter 6.

SECTION 3 – GAS AND CYLINDER LIFING

2.7.3.01 **Cylinder lifing**. Before transporting, handling or use of a gas cylinder the operator is to check the cylinder is within its prescribed life. There are two distinct 'lifes' that need to be considered.

2.7.3.02 **Mechanical life of the cylinder**. All transportable gas cylinders are required to have an Inspection and Test on initial manufacture, and subsequently they are all required to have a Periodic Inspection and Test to ensure they remain serviceable for use. The date of the last Periodic Inspection and Test is stamp-marked on the neck of the cylinder. Cylinder test rings (two plastic coloured rings) are fitted around the neck of the cylinder to provide a quick, visual reference that shows when the cylinder is next due for a Periodic Inspection and Test (see Part 2, Chapter 3, Annex A).

Note: The cylinder test rings are always to be complete.

2.7.3.03 A transportable gas cylinder past its Periodic Inspection and Test date may continue in use at a static location (subject to its serviceability and any independent life on the gas contents). On expiry of their Periodic Inspection and Test life transportable gas cylinders may be transported only for purposes of returning them back to a place where the Periodic Inspection and Test will be carried out (return to the supplier/contractor). Cylinders do not have to be empty when transporting, the majority are not. As long as there is no obvious defect with the cylinder / valve it can be transported. It is recommended that all cylinders which have past their periodic inspection and test date are returned to the gas cylinder supplier and, as required, replaced with serviceable items.

2.7.3.04 **Life of the gas within a cylinder**. Certain gases are given a life. Depending on the gas type this typically ranges from 2 years to 10 years. This is indicated by the supplier using a label, attached to the shoulder or plastic collar of the cylinder. Once this life has expired the gas is no longer fit-for-purpose and the gas cylinder is to be returned, in accordance with Part 1, Chapter 3.

2.7.3.05 **Corrosive gases**. Cylinders containing corrosive gases are actively controlled by the gas supply company. Each cylinder is allocated an 'expiry' or 'return by' date at the time of filling. Typically this will be three years. All units are to ensure cylinders are returned promptly to the gas supplier when the “return by” date has expired.

SECTION 4 – PRECAUTIONS AND USER PROCEDURES

2.7.4.01 **Safety Precautions when handling / using gas cylinders**. Gas cylinders are only to be used for the transport and storage of gas. Always observe the following safety precautions:

a. Use gas cylinders in a vertical position, unless they are specifically designed to be used otherwise. This is particularly important for liquefied gases such as LPG, carbon dioxide and acetylene.

b. All gas cylinders are to be securely restrained to prevent them from falling over. Gas cylinders, which are left in a gas cylinder trolley, are to be secured to an appropriate strong point to prevent the combined trolley and gas cylinder falling over.

c. If cylinders are leaning over in their pallet or storage bay, do not attempt to straighten them by yourself. Get help and make sure that you know what everyone else is doing to avoid trapping each other’s fingers or being hit by a falling cylinder.

d. Before connecting a gas cylinder to equipment, or pipe-work, make sure that the regulator and pipe-work are suitable for the type of gas and the inlet and outlet pressures being used. Always use an appropriate regulator with the cylinder. Do not connect directly to the cylinder valve.

e. Do not remove valve guards, or any other permanent fittings, on a gas cylinder. If there is a requirement to remove fittings then prior authorisation is to be obtained from the cylinder owner and the responsible Support Authority.

f. Wear the correct personal protective equipment when handling or using gas cylinders (see Part 2, Chapter 2).

g. Gas cylinders are not to be used as rollers or supports.

h. Do not drop, roll or drag gas cylinders. A suitable hand truck, forklift truck or similar material handling device shall be used with the cylinder securely held by the device, especially for large or heavy cylinders. Caution shall be used to guard against dropping or permitting cylinders to violently strike against each other or other surfaces.

i. Do not move the cylinder with the valve open.

j. Cylinder valves are normally protected by a cap, or a guard/shroud. The user shall keep caps on cylinders at all times except when cylinders are connected to dispensing equipment. Replace the cap before returning to stores. Valve guards/shrouds are not to be removed by the user.

Note: Some cylinders have valves that are designed to withstand impact if the cylinder is dropped and therefore do not have guards/shrouds fitted.

k. Keep cylinders away from all sources of contamination, including flammables, corrosives and all fuel and lubricants. Never use oil or grease on a cylinder valve, it is dangerous. If the valve is tight, return the cylinder to the supplier and obtain a replacement. Do not use excessive force to open the valve.

l. Do not use a cylinder found to be leaking. If safe to do so, move the cylinder out-of-doors to a well-ventilated area and take the appropriate action to make the cylinder safe (see Part 1, Chapter 9).

m. Cylinders shall not be placed where they become part of an electrical circuit. When gas cylinders are used in conjunction with electric welding, they shall not be used for earthing (grounding) of electrical equipment. Arc welding near gas cylinders is to be avoided. This precaution will prevent the cylinder from being arc-burned.

n. When using barrier creams, or other types of skin creams, avoid contact with oxygen. In particular do not handle the cylinder valve and cylinder valve outlet, pressure regulator, etc. Use the appropriate clean PPE (see Part 2, Chapter 2).

o. Check the compatibility of the gas against the materials used in the manufacture of the pressure equipment to which it will be connected (e.g. regulators, gauges, hoses, etc). For example, oxygen cylinders are only to be connected to equipment that is specifically designed for oxygen service, acetylene cylinders are only to be connected to equipment that is specifically designed for acetylene service.

p. Never attempt to stop a falling cylinder. Get out of the way until the cylinder comes to rest.

q. Ensure that you read the Safety Data Sheet. Take time to understand the properties and hazards associated with the gas before handling or using it. If in doubt seek appropriate advice. Ensure you know what to do if an emergency situation develops (see Part 1, Chapter 9).

r. Keep all gas cylinders within their safe temperature range. Typically this is between – 20 °C to + 50 °C. Keep cylinders away from excessive heat sources. When gas cylinders, which are not part of the permanent equipment, are being carried in vehicles or aircraft which are likely to be subjected to extremes of temperature e.g. medical cylinders for emergency response teams, those cylinders are to be removed from that platform until actually required for use.

s. Use in a well-ventilated area. Do not smoke or use direct heat on a cylinder. Keep away from any sources of ignition.

t. All valve outlets are to be fitted with blanks at all times when not in use to help prevent the ingress of contamination. This is particularly important for breathing gases, or specialist gases produced to a high specification. Ensure removed blanks are stowed in a safe place for re-use, or to prevent them becoming a hazard e.g. in the aircraft environment.

u. As far as is reasonably practical all gas cylinders are to be protected from potential damage when located in a hostile military environment. Any charged gas cylinder penetrated by a projectile, such as a bullet, will rupture explosively, will release the gas contents into the immediate environment and will project fragments of the cylinder around the local area.

2.7.4.02 **Before use procedure**. Always carry out a before-use inspection on pressure equipment to ensure it is serviceable and appropriate for its intended task. This is to include:

a. A visual examination of the cylinder and its attachments for obvious damage, security of any attachments, contamination and in general, fitness for purpose.

Note: Some gas cylinders, e.g. medical lightweight composite cylinders, have protective plastic liners around the body of the cylinder. Ensure the protective liner is complete, and that there is no obvious damage to the body of the cylinder beneath the protective liner.

b. Always double check that the cylinder/gas is the right one for the intended use. Read the contents label. Check the colour code on the shoulder. (See Part 2, Chapter 3).

c. Where the gas cylinder is installed within equipment ensure that the correct size and type of gas cylinder is fitted, it is secure, it contains the correct gas for that equipment and that it complies in all respects with the appropriate equipment publication.

d. Always read and comply with the appropriate Safety Data Sheet.

e. Ensure the gas outlet connection is compatible with the equipment to which it will be fitted.

f. Check the gas pressure is sufficient for the task. Some gas cylinders incorporate a contents gauge. Alternatively check using an appropriate regulator or pressure gauge.

g. If applicable, ensure that the gas is within its expiry life. Typically this will affect breathing, medical and some specialist gases. See Part 2, Chapter 3.

h. Check the valve outlet is clear of any debris or contamination. Reject if excessively contaminated or there are any signs of oil. As necessary, wipe the cylinder valve outlet with a clean lint-free cloth. If a supply of oil-free compressed air or nitrogen is available this may be used to blow out any loose particles of dirt or residual moisture from the valve sockets. Alternatively, contamination can be removed by purging the valve outlet, through a process of cracking open and immediately closing the valve (sometimes referred to as "snifting"). When purging the valve outlet ensure that

(1) Appropriate PPE including eye protection is worn, see Part 2, Chapter 2.

(2) That there is no source of ignition in the vicinity.

(3) Stand clear of the gas stream and do not deflect the gas stream with the hand or face.

i. Where the gas cylinder is being carried in a purpose built stowage bag, ensure that the bag is fully serviceable, the cylinder is installed within the bag correctly and that the bag and cylinder are secured within the platform. If the stowage bag is contaminated or unserviceable it is to be replaced.

WARNINGS:

1. Do not purge hydrogen as it may ignite spontaneously .

2. Do not purge any toxic gases.

2.7.4.03 **In use procedure**. Where gas cylinders are fitted to dedicated equipment the primary method of operation of the gas cylinder is to be in accordance with the appropriate equipment operating publication. In general, the following procedure is to be followed:

a. Operate the outlet valve using the valve hand-wheel, or using the correct cylinder key. See Part 2, Chapter 17.

b. Cylinder valves are always to be opened and closed slowly. Rapid movement can result in momentarily high pressures.

c. Check that the valve is not blocked and that the system is charging satisfactorily e.g. temperature rise checks of cylinder/system.

d. Monitor the cylinder, valve and pressure system being charged for gas leakage. Ensure that the valve does not leak in the open position e.g. by the use of leak detection fluid.

Note: In the event of any leakage, then charging is to be stopped and the cylinder/ connections vented. The leak is to be rectified before proceeding. Leaks are not to be rectified whilst the system is pressurised.

e. Residual or excess gases are to be vented to a safe location, preferably outdoors in a well-ventilated area.

f. If work is temporarily stopped, always close the cylinder valve.

g. The operator is always to be in attendance when a gas cylinder is open and charging a system.

2.7.4.04 **After use procedure**. The following action is to be taken:

a. Close the outlet valve. Ensure the cylinder is not leaking.

b. Replace any protective covers, where provided, when a gas cylinder is not required for further use. Also securely replace protective covers on all associated equipment once a cylinder has been disconnected. Avoid contamination of the system and the gas cylinder.

c. Remove / disconnect any accessories e.g. regulators.

d. Remove the cylinder key. Do not leave the cylinder key in the valve when the cylinder is not in use.

e. Clean off any contamination that may have occurred during use.

f. If the cylinder is empty, identify it as such and return it. See part 1, Chapter 3.

g. If the cylinder is unserviceable, follow the procedures in Part 1, Chapter 6.

h. Return the cylinder to its correct stowage or store.

i. Where the gas cylinder is being carried in a purpose built stowage bag, ensure that the bag is fully serviceable. If the stowage bag is contaminated or unserviceable it is to be replaced.

2.7.4.05 **Bowman radios**. It has been identified that there is a risk that Bowman radios could generate a spark that might ignite flammable gases, particularly when used in areas of high ambient temperature.

WARNING. Flammable gases are not to be released from their containers unless all BOWMAN radio transmissions have been disabled within the safety distances detailed below.

All Bowman transmissions (except Personal Role Radio (PRR)) are to be disabled in the vicinity of flammable gases within the safety distances detailed below (this includes liquid oxygen storage and operational sites):

a. HF Radios, within 70 m.

b. VHF radios, within 15 m.

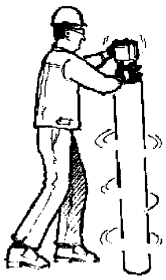
c. UHF radios, within 15 m.

SECTION 5 – HANDLING

2.7.5.01 **Handling and Use**. Manual Handling. Wherever practicable, purpose designed trolleys should be used for moving cylinders. For moving over smooth floors, or for short distances, the 'churning' method may be used.

2.7.5.02 The churning method requires the use of both hands. One supports the cylinder whilst the other rotates the cylinder (away from the body). It requires the cylinder to be tilted slightly (again away from the body). The method takes some practice and if used should only be attempted on a firm, even surface.

Figure 2.7.1: Churning a cylinder.



2.7.5.03 **Manually raising a large cylinder from the horizontal position**. Some cylinders are very heavy and before attempting to raise a cylinder manually, personnel are to ensure they have had appropriate manual handling training, that a valid written risk assessment is in place; and that they are wearing the required PPE. Be aware of your personal limitations before attempting to lift a cylinder. If necessary use appropriate lifting equipment or get assistance. Avoid injury by using the correct lifting method when raising cylinders from the horizontal.

2.7.5.04 The BCGA (Technical Information Sheet 12: 2005) gives the following method:

a. Foot position: hip width apart with one slightly in front of the other, astride the valve end of the cylinder.

b. Bend the knees to lower your body. This will enable your thigh muscles to do most of the lifting.

c. Ensure that the valve guard is secure then take a firm grip using both hands. Only lift using the guard if it has been designed for this purpose, otherwise grip the cylinder neck.

d. Keep your back straight throughout its length. This does not mean it has to be vertical. Doing this will help to prevent a slipped disc. Pull your chin in so that your back is locked in a straight line and look in front rather than at the ground.

e. Lift decisively with a smooth non-jerking motion. It is done initially by straightening the legs then following through with the arms at the same time walking forward until the cylinder is upright.

f. Do not leave the upright cylinder free standing, but move it to a safe storage area.

Figure 2.7.2: Lifting a cylinder from the horizontal.

2.7.5.05 **Loading Pallets**. Pallets are designed to securely hold a load of cylinders for the purpose of distribution or storage. Purpose built pallets have been designed to cater for compressed gas cylinders and globally there are a wide variety of pallet designs and types.

2.7.5.06 Pallets generally have three closed sides and include fork-lift slots in the base to facilitate movement by fork-lift truck. They include features, providing a secure location on vehicles, which are specifically designed to carry pallets. Cylinders are restrained by webbing straps and ratchets or ‘chain and dog’.

2.7.5.07 Small cylinders may be carried horizontally on shelving in pallets generally referred to as ‘wine rack’ types.

2.7.5.08 These guidelines are to be followed:

a. Load cylinders centrally within the pallet.

b. Pallets should preferably be loaded with cylinders of the same size, however if this is not practical:

(1) Ensure the load is stable

(2) Place taller cylinders at the back of the pallet with shorter cylinders placed against the taller cylinders.

(3) Do not place small cylinders amongst larger cylinders. This can result in cylinders becoming dislodged during transit.

c. Cylinders are not to overhang the base of the pallet.

d. Part loads should be loaded, as far as practical, in a central position towards the rear of the pallet for reduced manual handling effort and stability of the pallet.

e. Cylinders are not to be placed on the top of another cylinder's valve as this may cause damage to the valve.

f. Check pallets for serviceability before loading cylinders. Do not load cylinders into a pallet that has defective restraining straps or chains. Ensure the base is clear of debris and is not severely distorted.

g. Round bottom cylinders are not to be loaded into standard pallets. Do not 'hide' round-bottomed or unstable cylinders in the middle of a pallet.

Note: A variety of pallets are available for use. Contact the DFG for further information.

2.7.5.09 **Loading flat pallets**. Best practice dictates that gas cylinders should be secured vertically within specially designed gas pallets using the affixed restraining straps. This is particularly so for cylinders containing liquefied gases, especially those with flammable contents.

2.7.5.10 Exceptionally gas cylinders may be palletised horizontally on wooden pallets. Only wooden pallets which are in a good condition e.g. no protruding nails, and which are free of contamination are to be used e.g. no oil, grease or tar contamination.

2.7.5.11 Gas cylinders that are laid flat on pallets are to be:

a. Smaller than the pallet used. The cylinders are not to overhang the edges of the pallet.

b. Adequately secured using appropriately sized wooden wedges.

c. Banded using metal banding wire, applied through the nearest slats. Insert a protective barrier to avoid metal to metal contact with the cylinder.

d. Spreaders are to be used to avoid cylinder to cylinder contact and to provide extra protection.

e. All cylinder valves are to be protected using a valve-protection device e.g. a collar or a cap.

f. Positioned such that the contents and hazardous goods labels on the cylinders remain visible at all times.

2.7.5.12 **Ships Gas Cylinder Handling Trolley**. Handling and lifting of gas cylinders onboard HM Ships and RFAs can be a hazardous activity involving the manual handling of potentially large, unwieldy, difficult-to-grasp gas cylinders often in confined spaces. A gas cylinder handling trolley which is capable of being lifted is available for use (see Table 2.7.1). Line Managers are to assure that the use of this trolley is considered as part of the control measures when carrying out the Risk Assessment for handling and/or lifting gas cylinders onboard HM Ships and RFAs.

2.7.5.13 Before each ships gas cylinder handling trolley is issued the manufacturer will carry out a load test from the lifting eyeplates which will be recorded on the equipment data plate. The lifting eyes attached to the equipment are subject to examination / test against an examination scheme undertaken by a competent person

a. In the case of lifting equipment (including eyeplates), visual examination at least every 12 months.

b. In accordance with references:

i. The Lifting Operations and Lifting Equipment Regulations (LOLER) 1998

ii. The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2005

iii. BR3027(1), Lifting Equipment Policy

Note: All lifting appliances including 'live' eyeplates are to be load tested at periods not exceeding 5 years.

2.7.5.14 Records of examination and test are to be held within the lifting register.

2.7.5.15 Routine maintenance will consist of before-use and after-use inspections for serviceability for continued use.

2.7.5.16 The cylinder securing straps can be replaced. (see Table 2.7.1) In the event of any other fault which would make the equipment unsafe for further use the equipment is to be scrapped and a replacement obtained.

Table 2.7.1 Equipment details.

Description	NSN
Truck Hand	O443 / 3920-99-7259559
Replacement parts:	
Strap Securing	O443 / 3920-99-7512195

2.7.5.17 **Mechanical Lifting**

a. Use suitable cradles, clamps or other effective means when lifting cylinders with a hoist or crane. Suitable platforms or pallets to hold the cylinders may also be used for lifting.

b. **Do not** use valves, shrouds and caps for lifting cylinders unless they have been designed and manufactured for this purpose.

c. **Do not** lift cylinders having a water capacity over 12 litres by using the valve protection device or magnets.

d. **Do not** use ropes, chains or slings to suspend cylinders unless the manufacturer has installed appropriate lifting attachments such as lugs.

e. Gas cylinders should not be raised or lowered on the forks of lift trucks unless adequate precautions are taken to prevent them from falling, i.e. use of suitable pallets with securing straps.

f. When replacing cylinders in equipment, the cylinder replacement procedures detailed in the equipment publications are to be adhered to.

g. Oil and grease are very hazardous when in contact with certain gases. Lifting devices contaminated with oil and grease are not to be used.

Note: Some smaller cylinders, such as medical cylinders, are designed to have a carrying handle, which also serves as the valve protection device. It is safe to carry such cylinders by such handles/shrouds.

SECTION 6 – DISCHARGING GAS

2.7.6.01 The discharge of contents from any gas cylinder shall not be directed toward any person. Where discharge is necessary it should be carried out in an open environment where the gas cannot accumulate. Corrosive, toxic or very toxic gases shall not be discharged directly to the atmosphere. The user shall return cylinders containing these gases for disposal action by DFG (see Part 1, Chapter 3).

Note: Discharging gas can cause a variety of injuries to the body especially the eyes, from both the pressure and the hazardous nature of the gas. In the event of a release, precautions should be taken to prevent potentially hazardous accumulations, e.g. toxic, asphyxiant, flammable, oxidising, etc.

2.7.6.02 Certain gases (e.g. refrigerants R12, R114, R134a; $SF_{6;}$ Halons 1221, 1301), are controlled gases within environmental legislation. These gases are not to be released to atmosphere. They are to be recovered and returned for disposal action by DFG (see Part 1, Chapter 3).

BIBLIOGRAPHY

1. *Lifting Operations and Lifting Equipment Regulations*, 1998, (LOLER).

2. *The Manual Handling Operations Regulations*, 1992 (as amended)

3. *Provision and Use of Work Equipment Regulations*, 1992, (PUWER).

4. JSP 375 – *Health and Safety Handbook*

5. ISO 11625 – *Gas cylinders – Safe Handling*

6. BCGA – *Guidance Note GN 3, The Application of the Manual Handling Operations Regulations to Gas Cylinders*.

7. BCGA Technical Information Sheet TIS No 12: 2005 – *Handle Gas Cylinders Safely*.

8. The Lifting Operations and Lifting Equipment Regulations (LOLER) 1998.

9. The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2005.

10. BR 3027(1), *Lifting Equipment Policy*.

Part 2

Chapter 8 (Sponsor – FSAT, SAFETY 3)

TRANSPORTATION

SECTION 1 – SCOPE

2.8.1.01 This chapter provides information on the regulations governing the transportation of Class 2 Dangerous Goods, including the military requirements for transportation by road, sea and air.

SECTION 2 – GENERAL

2.8.2.01 All gases and pressure receptacles, including gas cylinders, aerosols, tanks and Multiple Element Gas Containers (MEGC), are classified as dangerous goods and are therefore subject to transport of dangerous goods legislation as detailed within the bibliography. *JSP 800, Defence Movement and Transport Regulations* are always to be consulted when transporting dangerous goods detailed within this publication.

2.8.2.02 The transportation of dangerous goods is regulated in order to prevent, as far as possible, accidents to persons or property and damage to the environment, the means of transport employed or to other goods.

2.8.2.03 Within the *Transport of Dangerous Goods* legislation, gases are classified as Class 2. Substances of Class 2 are assigned to one of three divisions based on the primary hazard of the gas during transport.

a. Division 2.1 Flammable gases.

b. Division 2.2 Non-flammable, non-toxic gases.

c. Division 2.3 Toxic gases.

2.8.2.04 **Empty or partially filled gas containers**. An empty, or partially filled, gas container that has contained a dangerous substance is to be treated the same as a full container and is therefore subject to all the relevant transport dangerous goods regulations. Only if adequate measures have been taken to nullify any hazard may the container be treated as non-hazardous.

2.8.2.05 All empty (non-hazardous) cylinders are to be certified as such by a competent person.

Note: It is expected that, within a military environment, only empty containers that had previously contained a Class 2.2 gas with a gauge pressure containing less than 2 bar at 20 °C may be treated as non-hazardous goods.

2.8.2.06 **Precautions transporting gas containers**

a. Fit suitable protective valve caps and covers to cylinders, when necessary, before transporting. Caps and covers help prevent moisture and dirt from gathering in the valve of the cylinder, in addition to providing protection during transport.

b. Securely stow gas cylinders to prevent them from moving, falling or overturning. This is normally in the vertical position, unless instructions for transport state otherwise. Wherever practical, use suitable pallets, which will assist in loading/unloading and securing the load (see Part 2, Chapter 7).

c. Disconnect regulators and hoses from cylinders whenever practicable.

d. Do **NOT** let gas cylinders project beyond the sides or end of a vehicle (e.g. fork-lift trucks).

e. Ensure gas cylinders are clearly marked to show their contents (including their UN Number) and the danger signs associated with their contents. All gas containers are to have the precautionary label fitted (see Part 2, Chapter 3).

f. All vehicles used to transport gas containers are to be well ventilated. Toxic gases are not to be carried in a closed vehicle unless it is specifically designed for that purpose.

g. It may be necessary to take special measures with certain types and quantities of compressed gases and fluids in order to ensure their safe carriage. Seek advice if at all unsure.

h. Gas cylinders that have been exposed to fire shall not be shipped if they still contain gas under pressure. Seek advice from DFG or the appropriate Support Authority. Attach a suitably annotated Equipment Conditioning Label (e.g. *MOD Form 731*) to the cylinder (see Part 1, Chapter 6 and Chapter 9).

i. If a cylinder or valve is noticeably damaged or corroded, seek advice from DFG or the appropriate Support Authority. Any other damage that might impair the safety of the cylinder during use or transportation shall be called to the attention of the DFG or the appropriate Support Authority before the return of the cylinder. Attach a suitably annotated Equipment Conditioning Label (e.g. *MOD Form 731*) to the cylinder (see Part 2, Chapter 6 and Chapter 7).

2.8.2.07 **Training**. All personnel involved in the transportation of dangerous goods are to have received appropriate training commensurate with their duties (see Part 1, Chapter 8).

2.8.2.08 **Defence Supply Chain Operations and Movements**. Defence Supply Chain Operations and Movements (DSCOM) provides Defence and other authorised users with agreed transport and movements services world-wide in peace, crisis and war in order to support current and future UK military capability. It is operationally focused and has formal responsibility for providing PJHQ with a single DE&S operational focus for mounting and sustaining operations. Within DSCOM the Movement Operations (Mov Ops) Division process, allocate and manage bids for freight movement by road, rail, sea and air to support UK Forces worldwide. The Defence Movements & Transport Policy (DMTP) Branch are responsible for the Defence Policy for Hazardous Materiel & Dangerous Goods.

2.8.2.09 **Nominal Capacity**. When transporting compressed gas cylinders it is sometimes necessary to determine the nominal capacity of the gas within a cylinder. For compressed gas cylinders the nominal capacity shall be equivalent to the water capacity of the cylinder. When determining the net quantity of a cylinder it can be assumed that, for example, if the cylinder has a water capacity of 10 litres the net weight of the gas would be 10 kg.

SECTION 3 – INSPECTION AND TESTING OF GAS CYLINDERS

2.8.3.01 **Periodic inspection and test**. All refillable gas cylinders are subject to a periodic inspection and test. A refillable gas cylinder past its periodic inspection and test date may continue in use at a static location (subject to its serviceability and any independent life on the gas contents). Gas cylinders are not allowed to be filled after they become due for their periodic inspection and test but may be transported after the expiry of the time-limit for purposes of performing inspection or disposal, including the intermediate carriage operations. Units returning expired cylinders are to assess cylinders for any potential risk prior to transportation. Units are to seek advice from DFG if they have any safety concerns.

2.8.3.02 Units that hold deployment stocks are to conduct management checks to ensure cylinders remain in date for the duration of the deployment. UK Depots are not to consign gas cylinder overseas with less than 6 months remaining on the inspection.

2.8.3.03 Cylinders do not have to be empty when transporting, the majority are not. Provided there are no obvious defects which could make it unsafe a cylinder can be transported. If in doubt, consult DFG or the appropriate Support Authority.

SECTION 4 – TRANSPORTATION BY ROAD

2.8.4.01 All military vehicles and their drivers are to comply with the requirement of JSP 800 Vol 4b. All vehicles and their drivers are to comply with ADR, the European agreement concerning the international carriage of dangerous goods by road.

2.8.4.02 JSP 800 Vol 4b and ADR detail specific requirements for all vehicles carrying dangerous goods, including:

a. The suitability of the vehicle.

b. Identification marking.

c. Driver training.

d. The carriage of additional safety equipment.

e. The carriage of documentation relating to the dangerous goods being transported. This includes the:

(1) Safety Data Sheet (SDS).

(2) Instructions in Writing.

Notes:

1. Safety Data Sheets are available for all dangerous substances or dangerous preperations, including gases, within *JSP 515 - MOD Hazardous Stores Information System*.

2. Instructions in writing are provided through the Defence Automated Road Transport System (DARTS-Web).

2.8.4.03 The ADR regulations apply to everyone carrying gas containers in the course of their work. Exemptions are:

a. Loads that are under the exemption limits.

b. When private individuals carry dangerous goods, which are packaged for retail sale and intended for personal use (e.g. transporting a single cylinder of LPG for use on a home barbecue).

2.8.4.04 Details of the exemption limits are at Annex A.

2.8.4.05 **High Consequence Dangerous Goods**. The 2005 edition of *ADR* and the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* imposed new security requirements on the carriage of dangerous goods, covering: consignment; security of sites where they are stored during transit; and training of those involved. More stringent requirements apply to a subclass of dangerous goods known as High Consequence Dangerous Goods. Obvious examples of High Consequence Dangerous Goods are ammunition, explosives and flammable liquids in bulk. This group also includes certain gases in Class 2, Division 2.1 & 2.3. See *JSP 800 Vol 4b* for more detailed information.

SECTION 5 – TRANSPORTATION BY SEA

2.8.5.01 All military vehicles are to comply with the requirement of *JSP 800 Vol 4b*. All dangerous goods transported by sea are to comply with the regulations within the *International Maritime Dangerous Goods (IMDG) Code*.

SECTION 6 – TRANSPORTATION BY AIR

2.8.6.01 All Class 2 dangerous goods transported by air are to comply with the *International Air Transport Association (IATA) Dangerous Goods Regulations*. Where there is a requirement for specific exemptions for military equipment then they are to comply with the requirements of *JSP 800 Vol 4a.*

2.8.6.02 The shipper must specifically verify under *IATA clause 5.2.0.5* that the filled cylinder is not leaking; and under *IATA clause 5.2.0.13* cylinders cannot be offered for air transportation that are:

a. Leaking.

b. Damaged to such an extent that the integrity may be affected.

c. Unless it has been examined and found to be in good working order.

d. Unless the required certification, retest and filling markings are legible.

SECTION 7 – REPORTING ACCIDENTS/INCIDENTS

2.8.7.01 **Accidents / incidents when transporting dangerous goods**. All accidents / incidents involving the transportation of dangerous goods are to be reported. Follow the procedures detailed in *JSP 800 Vol 4a* and *Vol 4b* (see also Part 1, Chapter 7).

BIBLIOGRAPHY

1. ADR: *The European Agreement Concerning the International Carriage of Dangerous Goods by Road*.

2. RID: *Regulations Concerning the International Carriage of Dangerous Goods by Rail*.

3. *The International Air Transport Association (IATA) Dangerous Goods Regulations*.

4. *The International Maritime Dangerous Goods (IMDG) Code*.

5. *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (Amendment) Regulations*, 2005.

6. JSP 800 - *Defence Movement and Transport Regulations*.

7. JSP 515 - *MOD Hazardous Stores Information System*.

ANNEX A

(introduced at paragraph 2.8.4.04)

TRANSPORTATION BY ROAD – ADR LOADS EXEMPTION LIMITS

(*ADR 1.1.3.6* refers)

2.8.A.01 All gas containers have a number of transport units associated with the capacity of the cylinder or the amount of gas they carry. There is a threshold below which certain basic legal safety regulations apply, above this threshold, the full *ADR* legislation applies. All gases have been classified by *ADR* into three of the five transport categories, i.e. categories 1 to 3, relating directly to the hazard diamonds for each product; plus transport category 4 which includes empty uncleaned containers which previously contained dangerous goods.

Note: Only empty containers that had previously contained a Class 2.2 gas groups A and O (see table 2.9.1) and now have a gauge pressure containing less than 2 bar at 15°C may be treated as non-hazardous goods. They count as zero in the load threshold calculation.

2.8.A.02 There are no exemptions for small containers.

2.8.A.03 **How to calculate Transport Units**. The regulations require different sizes to be added together, some in litres of water capacity and some in kilograms. These values are referred to as Transport Units.

2.8.A.04 Compressed gases are measured in litres water capacity (e.g. Oxygen, Nitrogen).

2.8.A.05 Liquefied gases and dissolved compressed gases (such as ACETYLENE, DISSOLVED) are measured in kilograms (e.g. Refrigerant R134a, Acetylene, CO_2).

2.8.A.06 The calculation and threshold limit depends on whether the customer is transporting:

a. A load containing one transport category.

b. A mixed load containing gases with multiple products of different categories.

2.8.A.07 **For loads containing one transport category**:

Table 2.8.A1: The transport calculation and threshold limits

Transport Unit Limit litre / kg	Gas	Classification
20	Toxic gases	Class 2.3
333	Flammable gases	Class 2.1
1000	Asphyxiants and Oxidants	Class 2.2 & 5.1
Unlimited	Empty containers	

Note: For AMMONIA, ANHYDROUS (UN 1005) and CHLORINE (UN 1017) (both Class 2.3) the limit is to 50 Transport Units instead of 20.

2.8.A.08 (Transport units per container) x (number of containers) = Total load Transport Units

2.8.A.09 Example calculation:

Load to be carried

1 x container of R22, weight 12 kg

3 x containers of R134a, weight 65 kg per container

2 x containers of R410A, weight 24 kg per container

All gases are classed as 'Class 2.2' so load is not mixed.

All three types of cylinders are liquefied gases (measure in kg)

R22 12 x 1 = 12 Transport Units

R134a 65 x 3 = 195 Transport Units

R410A 24 x 2 = 48 Transport Units

Total = 255 Transport Units

2.8.A.10 **Conclusion**. This load is less than 1000 Transport Units allowed for a Class 2.2 and is not therefore subject to the full ADR regulations.

2.8.A.11 **For a mixed load containing gases with multiple products of different categories**. Each category of gas carried has an associated calculation. Calculation must be performed for all individual categories of gases; the transport units for each category must then be added together.

2.8.A.12 There are five steps.

a. Calculate the toxic gas Transport Units

(Transport Units per container) x (number of containers) x 50 = **T** Transport Units

For AMMONIA, ANHYDROUS and CHLORINE the calculation is:

(Transport Units per container) x (number of containers) x 20 = ***T*** *Transport Units*

b. Calculate the flammable gas Transport Units

(Transport Units per container) x (number of containers) x 3 = **F** Transport Units

c. Calculate the asphyxiant / oxidant gas Transport Units

(Transport Units per container) x (number of containers) = **A** Transport Units

d. Add the three values together to acquire Transport Units for total load

T Transport Units + **F** Transport Units + **A** Transport Units = Total Transport Units for mixed load.

e. Determine whether your load is above or below the threshold. If the load is above 1000 Transport Units then the ADR regulations must be observed in full.

2.8.A.13 Example calculation:

Load to be carried:

2 x Acetylene containers, liquid weight 10 kg per container

2 x Oxygen containers, water capacity 47 litres per container

Acetylene is a dissolved compressed gas and is measured in kg. (Class 2.1)

Oxygen is a compressed gas and is measured by container water capacity, Litres. (Class 2.2)

As these containers fall into different class categories, this load is mixed.

Acetylene, dissolved (10 kg = 10 Transport Units)

10 Transport Units x 2 containers x 3 = 60 Transport Units

Oxygen (Water Capacity = 47 litres = 47 Transport Units)

47 Transport Units x 2 containers = 94 Transport units

Total = 154 transport Units

2.8.A.14 **Conclusion**. This load is less than 1000 Transport Units allowed for a mixed load and is not therefore subject to the full ADR regulations.

Part 2

Chapter 9 (Sponsor – FSAT, SAFETY 3)

GAS CYLINDER STORAGE

SECTION 1 – SCOPE

2.9.1.01 This chapter provides information on the safe storage of gas cylinders. It discusses the requirements for gas cylinder storage compounds; the management of gas cylinders within the compounds; and highlights the hazards and the potential risks involved in storing gas cylinders. Specific information is provided on the storage of gas cylinders on-board ships; gas cylinders deployed on exercises / operations; and, for units that only have a requirement to store LPG cylinders.

2.9.1.02 This chapter is not intended to be applied to the following:

a. Gas cylinders in use (see Part 2, Chapter 7);

b. Storage of radioactive gases (see *JSP 375* and *JSP 392*);

c. Static gas cylinder storage systems permanently connected for use;

d. Gas cylinders during carriage by road, rail, air and sea (see Part 2, Chapter 8);

e. Cryogenic liquids (see Part 2, Chapter 10);

f. Bulk LPG storage vessels (see Part 3).

SECTION 2 – HEALTH, SAFETY, ENVIRONMENTAL AND SECURITY ARRANGEMENTS

2.9.2.01 Gas cylinders are potential Health, Safety, Environmental and Security risks; as such, gas cylinders are to be accounted for and actively managed whilst in a gas cylinder store.

2.9.2.02 **Main Hazards**. The major hazards associated with the storage of compressed gas cylinders are from a burst; and/or the missile effect likely to occur should the valve be ruptured or broken off a charged cylinder (see Part 2, Chapter 1). This may result from a cylinder overheating in a fire, or as a result of excessive heat radiation from an external source; or during handling, such as impact from a fork lift truck. Personnel (mis)-handling cylinders may receive crush injuries to, e.g. hands and feet; and/or broken bones; and/or eye injuries (see Part 2, Chapter 7).

2.9.2.03 There are also hazards to personnel, property and the environment arising from the hazard classification of any gas released into the local atmosphere, be it: toxic; flammable; corrosive; inert, producing an asphyxiant atmosphere; or an oxidant, producing an enhanced fire hazard (see Part 2, Chapter 1). Gases may have more than one hazard, i.e. a primary hazard and secondary hazard(s), (see *ADR, Volume 1, Part 3*; and JSP 319, Part 2, Chapter 3). This does not affect the requirements for storage, which is based on the primary hazard, but may give rise to additional secondary hazards in the case of an unintended discharge of gas.

2.9.2.04 **Gas Cylinder Failure**. Failure of gas cylinders leading to uncontrolled release of gas is reportable. This will include reporting incidents to the Health and Safety Executive (HSE) under *RIDDOR.* The reporting of incidents/accidents associated with gas cylinders is detailed within Part 1, Chapter 7.

2.9.2.05 **Ozone Depleting Substances / Greenhouse Gases**. Both Ozone Depleting Substances (ODS) and the class of substances known as fluorinated greenhouse gases, or F gases, which includes sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), typically used as refrigerants, require controlled storage conditions and detailed record keeping. See *JSP 418, Volume 2, Leaflets 4, 5 and 11*; and JSP 319 Part 2, Chapter 12.

2.9.2.06 Discharges of Ozone Depleting Substances or F gases may require reporting. Refer to Part 1, Chapter 7.

2.9.2.07 **Risk Assessments**. Sites holding gas cylinders are required by various health and safety regulations to assess risks; provide means of risk prevention and control; and to reduce the risks to levels that are as low as are reasonably practicable (ALARP). The requirements involve the provision of information to employees; ensuring that they are adequately trained; are competent for the tasks they are required to perform; and the provision of periodic refresher training (see Part 1, Chapter 8 – Training; Part 2, Chapter 1 – Introduction to Gases; and, Part 2, Chapter 16 – Liquefied Petroleum Gas (Cylinders)).

2.9.2.08 The scope of the arrangements needed to comply with all the applicable regulations may vary from site to site, but compliance will be required with:

a. *Management of Health and Safety at Work Regulations*, 1999.

b. *Manual Handling Regulations*, 1992.

c. *Control of Substances Hazardous to Health Regulations,* 2002 (as amended) (COSHH).

d. *Dangerous Substances and Explosive Atmospheres Regulations*, 2002 (DSEAR).

e. *Confined Space Regulations*, 1997.

f. *The Registration, Evaluation, Authorisation and Restriction of Chemicals Regulations*, 2006 (REACH).

2.9.2.09 MOD policy on the implementation of these, and other applicable regulations, is detailed within *JSP 375*.

2.9.2.10 **Major Accident Control Regulations (MACR)**. Sites which hold large quantities of gaseous products may require to qualify under *JSP 498* (*MACR*). Individual sites may already be qualified under *JSP* 498 due to their holdings of other substances, such as explosives or bulk fuel storage. Storage of 5 tonnes of hydrogen, 5 tonnes of acetylene, 50 tonnes of LPG, or 200 tonnes of oxygen, for example, will qualify a site at the Lower Tier Threshold (see *JSP 498, Chapter 1, Appendices 1A1* and *1A2* for further details).

2.9.2.11 A fire involving a gas cylinder(s) may have incident reporting implications for MACR qualified sites (see *JSP 498, Chapter 1*).

2.9.2.12 **High Consequence Dangerous Goods**. As a consequence of changes first incorporated in the 2005 editions of *ADR* and the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations*, and in the IATA *Dangerous Goods Regulations*, new security requirements were imposed on the carriage of Dangerous Goods which covers consignment, security of sites where they are stored during transit, and training of those involved. More stringent requirements apply to a subclass of Dangerous Goods known as High Consequence Dangerous Goods. Obvious examples of High Consequence Dangerous Goods are ammunition, explosives and flammable liquids in bulk (see *JSP 800 Volume 4b*).

2.9.2.13 Table 2.9.1 provides an extract from *ADR, Volume I, Table 1.10.5*, of the threshold limits for groups of High Consequence Dangerous Goods that are within the scope of *JSP 319* (see *ADR, Volume I, Chapter 1.10* for the full list). Tighter security arrangements apply to substances carried and stored in quantities in excess of these threshold limits; they include site security, perimeter security and security plans (see JSP 319, Part 2, Chapter 8).

Table 2.9.1: High Consequence Dangerous Goods relevant to JSP 319

Class	Division	Substance / ADR group	Threshold Quantity	
			Tank (litre)	Package (kg)
2	2.1	Flammable gases (classification code F only)	≥ 3,000	N/A
	2.3	Toxic gases (classification codes T, TF, TC, TO, TFC or TOC; excluding aerosols).	All	All

Notes:

Classification codes: C = Corrosive, F = Flammable, O = Oxidant, T = Toxic, TF = Toxic and Flammable, TC = Toxic and Corrosive, etc.

N/A = Not applicable.

(See ADR, Volume I, Table 1.10.5 & Clause 2.2.2.1 for full details).

2.9.2.14 **Protection against Terrorism**. Gas cylinder storage areas are potential terrorist targets. This is a particular concern for gas cylinder storage areas located in Out of Area Operations. Unit management are to take the potential terrorist threat into account when siting gas cylinder stores; the gas cylinder store manager is to ensure the security of the gas cylinders held within; and the safety of the personnel required to work in the local area.

2.9.2.15 **Leak Procedures**. Before a site may be used for storing compressed gas cylinders, written SOPs for dealing with gas leaks and escapes shall be available for all personnel working on the site (see Section 6).

2.9.2.16 **Training**. The storage and handling of gas cylinders is to be carried out only by appropriately trained personnel; and will normally require the provision of suitable handling equipment (see Part 1, Chapter 8 – Training; and Part 2, Chapter 7 – Handling and Use).

2.9.2.17 **PPE**. The appropriate PPE shall be worn when handling gas cylinders or entering a gas cylinder storage area (see Part 2, Chapter 2).

2.9.2.18 **Bowman radios**. It has been identified that there is a risk that Bowman radios could generate a spark that might ignite flammable gases, particularly when used in areas of high ambient temperature (see Annex A).

WARNING. Flammable gases are not to be released from their containers unless all BOWMAN radio transmissions have been disabled within the appropriate safety distances (see Annex A).

2.9.2.19 **Fire / Emergencies**. All gas cylinder storage sites are a potential fire / hazard risk (see Part 1, Chapter 9). The Defence Fire & Rescue Service shall be informed and included in the initial setting up of a gas cylinder store and its future management (see paragraph 2.9.3.33).

2.9.2.20 Storage of the following gases / classes of gases will have consequences in an emergency (see Part 1, Chapter 9); this shall be considered during site selection. Storage of these gases will require a formal risk assessment under DSEAR (see paragraph 2.9.9.05 and *JSP 375, Volume 2, Leaflet 56*).

a. Acetylene. The storage of acetylene cylinders requires careful consideration as any acetylene cylinders involved in a fire should never be approached or moved; and a fire will result in the setting up of an initial 200 m exclusion zone, which will be enforced (see Part 1, Chapter 9). Holdings of this product are to be clearly identified by signage (see paragraph 2.9.3.26).

b. Hydrogen. Hydrogen is lighter than air, it is highly flammable and leaks readily disperse. The flames from burning hydrogen are almost invisible in daylight.

c. LPG Cylinders. The storage of LPG cylinders requires careful consideration as LPG is extremely flammable, is denser than air and forms explosive mixtures with air (see Part 2, Chapter 16; and Part 3, Chapters 2 and 3). LPG cylinders involved in a fire may fail catastrophically, resulting in a Boiling Liquid Expanding Vapour Explosion (BLEVE) (see Part 1, Chapter 9 and Part 2, Chapter 16).

d. Toxic gases. Damaged or leaking gas cylinders containing toxic gases and toxic gas cylinders involved in a fire pose an immediate threat to personnel in the vicinity requiring evacuation of the storage site (see Part 1, Chapter 9). There may also be secondary fire or corrosion hazards (see paragraph 2.9.2.03 and Table 2.9.1). Incidents involving toxic gas cylinders shall be referred to the Defence Fire & Rescue Service, or local unit; as specialist equipment and training is needed (see Part 1, Chapter 9). Holdings of these products are to be clearly identified by signage (see paragraph 2.9.3.23).

e. Pyrophoric gases. Pyrophoric gases, are gases that spontaneously catch fire in air, shall only be stored in external gas cylinder stores. Cylinders shall be protected from heat and other ignition sources, e.g. flames, sparks, etc, to prevent explosion. Escaping gas cannot be extinguished; and extinguished gases may reignite spontaneously / explosively. The gas supply must be shut off.

2.9.2.21 In the case of a gas leak, fire, or other emergency, consideration needs to be given to the effects of the prevailing wind. The provision of an indicator, such as a windsock or other device within the storage area, will provide an indication of which neighbourhood might be exposed to any fumes, smoke and/or plume ground strike arising from the incident.

2.9.2.22 **Corrosive gases**. Gas cylinders containing corrosive gases are actively controlled by the gas supply company. Each gas cylinder is allocated an 'expiry' or 'return by' date at the time of filling. Typically this will be three years. All units are to ensure gas cylinders are returned promptly to the gas supplier when the “return by” date has expired.

2.9.2.23 Certain corrosive gases may be subject to more stringent checks by the gas supply company, involving a physical audit to ensure that there are appropriate stock control and storage procedures in place. Advice on all corrosive gases is available from the DFG (see Part 1, Chapter 3, Annex A).

SECTION 3 – STORAGE COMPOUNDS, SITING, DESIGN AND CONSTRUCTION

2.9.3.01 **General**. It is recognised that each gas cylinder storage facility is different and special circumstances may necessitate a degree of adaptation to the recommendations provided in this document. There shall be no deviation without the authority of the Defence Fuels Group (see Part 1, Chapter 3, Annex A). It is not intended to preclude the use of alternative designs, materials and methods where they provide equivalent standards of safety.

2.9.3.02 **Applicability**. The requirements of this section shall be applied to all new and refurbished facilities designated for the storage of gas cylinders. All gas cylinder storage facilities shall be assessed for risks against this publication. Existing facilities are to be upgraded to comply with these regulations. If there is any outstanding work then a risk assessment is to be carried out; all outstanding work is to be recorded and appropriate procedures put in place to mitigate residual risks until rectification action is complete.

2.9.3.03 **Siting Boards**. All new storage compounds or any significant changes to existing compounds are to be subject to a properly constituted Siting Board. The Siting Board is a mandatory requirement; and it is the responsibility of the sponsor of the project to task the person responsible for all works services at the base or site to convene the Siting Board. The chairman is to assess the level of representation and to take into consideration the requirements of Part 3, Chapter 8 as they relate to gases and the gas cylinders to be stored. It is the responsibility of the Chairman of the Siting Board to ensure that gas cylinder storage facilities comply with all current and foreseeable legislation and MOD regulations relevant to the new gas store. Any existing or intended encroachment must also be examined to ensure that the combined hazard will be manageable. Measures may need to be taken beyond those stated in this document to comply with any applicable legislation.

2.9.3.04 The unit officer responsible for the storage of gas cylinders (see paragraph 2.9.6.01) is to provide the board with local information pertaining to the site, types of gas cylinders and the quantities to be stored*.* Advice may also be sought from DFG (see Part 1, Chapter 3, Annex A). Siting Board members should also consult with one another.

2.9.3.05 **External Storage**. External storage, at ground level, shall be the first consideration when siting a gas cylinder storage facility.

2.9.3.06 **Siting Constraints**. The siting of gas cylinder storage areas are subject to certain constraints, known as separation distances, which require hazardous substances to be separated from other hazards and hazardous substances. This applies to the separation of various gas cylinders within the stores; separation from other hazardous materials such as explosives, fuels and lubricants; separation from other hazardous energy sources, such as radio transmitters and power cables; separation from “vulnerable populations”; and separation from the site boundaries.

2.9.3.07 Annex A summarises a number of separation distances to be applied. It is applicable to the storage of all gas cylinders.

2.9.3.08 Gas cylinder storage areas shall have well defined boundaries; have appropriate ventilation for the type of gases stored and shall be located with due regard to the potential hazards of the particular gases it contains (see the relevant Safety Data Sheets).

2.9.3.09 **Confined Spaces**. The storage locations of liquefied gases and heavier than air compressed gases, e.g. argon, carbon dioxide, LPG, etc, should take into consideration the dangers of gas seepage into drains, basements, manhole covers, cable ducts, etc. Storage of such gas cylinders in low lying areas of land may hinder the safe dispersal of any leakages. Conversely, gas cylinders stored in relatively low lying areas may be susceptible to contamination from adjacent areas, such as run-offs from higher ground, sewage, effluent, fuel and oil spills, etc.

2.9.3.10 Gas cylinders shall not be stored in confined spaces. Any confined spaces adjacent to gas cylinder storage facilities that could be affected by a build-up of gas from leaks, or escapes, may fall with the scope of the *Confined Spaces Regulations 1997*; and shall be subjected to a written risk assessment (see *JSP 375, Volume 2, Leaflet 10*).

2.9.3.11 **Explosives**. Gas cylinders are not to be stored within an explosives area. Exceptionally, should it be necessary for gas cylinders to be stored in the vicinity of explosives, this shall only be within the Outside Quantity Distance (OQD) of the explosives, not within the Inside Quantity Distance (IQD). When they are stored within the OQD of any explosives, an effective traverse is to be provided to protect the compressed gas cylinders from the explosives and the explosives from the gas cylinders (See *JSP 482, Chapter 10*). For detailed information on the storage of explosives refer to *JSP 482*.

2.9.3.12 **Electromagnetic Radiation**. Radio and radar transmitters can produce an explosion hazard when sited close to some compressed or liquefied gas cylinders. However, because of the huge variance in transmitter strengths, frequencies, etc, it is not possible to include specific safety distances in this document. The hazards caused by high-powered radars can extend to several hundred metres and it is the responsibility of the unit Maintenance Management Organisation, with the managers of the radiating source and the gas cylinder storage facility (see paragraph 2.9.6.01), to ensure that sensible safe distances are imposed. Defence Fuels Group may be consulted in cases where units are unable to determine appropriate safety distances (see Part 1, Chapter 3, Annex A).

2.9.3.13 **Overhead Power Cables**. Gas cylinders shall not be located directly beneath electricity power cables, including telephone cables. For cables operating at a voltage less than 1.0 kV, gas cylinders should be sited at least 1.5 m from a line drawn vertically downwards from the power cables. For cables operating at a voltage of 1.0 kV or greater, the distance shall be increased to 10 m. These distances shall be increased where the presence of the overhead cable could constitute a danger to users of the gas cylinder store, loading vehicles, or personnel.

2.9.3.14 **Electrical Wiring / Underground Cables**. Gas cylinder storage areas shall not be built on top of electrical cables; and electrical cables shall not be routed through the area. Where electricity cables are necessary, such as for lighting, they shall be maintained in a good condition and shall be to an appropriate standard (see, for instance, paragraph 2.9.3.39).

2.9.3.15 **Thermal Radiation**. Consideration shall be given to the proximity of the gas cylinder storage area boundaries to other processes and equipment where there is the potential for a fire or explosion hazard. Precautions such as increased separation distances and properly designed fire or thermal radiation barriers are to be employed whenever such risks are high (see Annex A). (See paragraph 2.9.3.48 in respect of protection from thermal radiation from the sun).

2.9.3.16 **Storage Capacity**. When planning the gas cylinder storage facility, adequate handling space must be allowed. The total amount of floor space required will depend on the quantity and the size of the cylinders; and the handling equipment to be used during their movement (see paragraph 2.9.3.18).

2.9.3.17 **Site Boundary and Security**. Access to gas cylinder storage facilities shall be restricted to authorised personnel only. The storage site shall be secured by locked gates or doors appropriate to the location of the site. An industrial security fence, wall, or other impenetrable barrier shall surround the site to prevent trespassing, sabotage, vandalism and other forms of unauthorised access; such barriers are to be at least 1.8 m high. A thermal radiation wall may be considered as part of the enclosure. Any overhanging trees and undergrowth shall be cut back to reduce security and fire risks (see paragraph 2.9.3.37). Appropriate lighting shall be provided to assist in the security of the site (see paragraph 2.9.3.39).

2.9.3.18 **Access and Egress**. Gas cylinder storage facilities shall be designed with adequate access and egress; and to allow unhindered cylinder movement. There shall be good access for delivery vehicles; and for the collection of gas cylinders on cylinder trolleys, etc. Manual handling is to be kept to a minimum, with consideration given to the use of powered mechanical handling aids. Design considerations include:

a. Segregation of vehicle and pedestrian exit and entry routes;

b. Well set out vehicle routes, avoiding sharp corners, blind bends and areas with low headroom (see paragraphs 2.9.3.13 – *overhead power cables* and 2.9.5.16 – *movement within the facility*).

c. Use of the proper equipment, such as cradles or pallets, for lifting and transporting gas cylinders.

2.9.3.19 Clear access for the emergency services shall be maintained at all times.

2.9.3.20 In areas where vehicles have access to, or are in close proximity to, the gas cylinder storage facility, protection shall be provided to prevent damage from vehicles. For example, this may be a low wall, bollards, or a crash barrier.

2.9.3.21 Adequate means of escape shall be provided. Access shall consist of one main entrance, with two doors, with one or more emergency exits provided for persons working in the area, with one door, on the opposite side to the main entrance. All emergency exits are to open in the direction of escape and are to be fitted with panic furniture of a type not requiring a key, card, or code to open. They are to provide an unobstructed means of escape and in operation are not to obstruct any other escape route. These exits shall be properly identified by signage, be unobstructed and maintained in a serviceable condition at all times.

2.9.3.22 **Safety signs and warning notices**. Appropriate and legible warning signs and pictograms shall be displayed and maintained in good condition in accordance with *the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002; The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations*

2007; and the *Health and Safety (Safety Signs and Signals) Regulations 1996.* All signs shall be in English wording. For installations located overseas there is a legal obligation to provide notices in the language relevant to the local civilian population and work force (operator). However, bilingual / multilingual signs may also be necessary within sites based in the United Kingdom.

2.9.3.23 Boundary warning signs and pictograms shall be clearly visible from all angles of approach, preferably sited with the centre of the sign at the average eye level (between 1.5 and 1.7 m above the ground). In exceptional cases, sites may be subject to the imposition of additional requirements by their local authority. All gas storage sites shall display the following signs/pictograms/notices on the access point and boundary fence or wall:

a. Danger – explosive gases.

b. No smoking.

c. No naked flames.

d. No mobile phones.

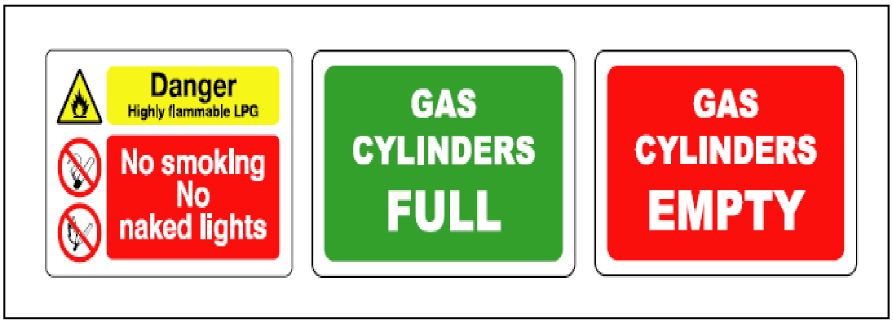
e. No access to unauthorised personnel.

f. No storage of oil, grease or combustible materials.

2.9.3.24 The appropriate diamond hazard labels shall also be displayed. However, if the stored gases would require more than two subsidiary diamond hazard labels, the primary diamond hazard label(s) should be used instead (see Part 2, Chapter 3).

2.9.3.25 If acetylene cylinders are stored within the facility then appropriate signs are to be displayed to alert the emergency services of their presence.

2.9.3.26 The following signs and pictograms are examples only; the same information may be displayed using other authorised signs, pictograms and notices.



In addition, areas classified as Hazardous under DSEAR (see *JSP 375, Volume 2, Leaflet 56*) require an Explosive Atmosphere sign to be displayed at points of entry.

2.9.3.28 At the entrance to the site the appropriate fire signs and notices (e.g. Fire Action Notice) are to be displayed (see *JSP 426, MOD Fire Safety Policy*). A sign shall also be displayed detailing any specific action to be taken in the event of an incident/emergency and showing whom to contact in the event of an incident/emergency, with all appropriate contact details. This is to include the unit's emergency contact details and the contact details for the gas supplier and the gas supplier's 24-hour emergency contact telephone number (see Part 1, Chapter 9). The location of any access keys, as well as the contact details for the authorised key holder shall be displayed.

2.9.3.29 **Construction Materials**. The infrastructure of the gas cylinder storage facility shall be constructed of non-combustible materials. Where uncertainty exists as to the suitability of materials, Defence Estates, DFG (see Part 1, Chapter 3, Annex A), the regional Defence Fire & Rescue Service Fire Safety Officer and the Unit Health and Safety Officer can be consulted.

2.9.3.30 **Floors and drainage**. All gas cylinder storage facilities are to be built on hard standings. Where the construction of hard standings is not appropriate, i.e. on exercises or for operational reasons, the ground must be firm, well-drained and of sufficient strength to support the weight of the gas cylinders / gas cylinder pallets, plus any mechanical aids employed on gas cylinder handling.

2.9.3.31 Within permanent gas cylinder storage facilities the floor shall be flat and constructed of concrete or other non-combustible, non-porous material. All floor surfaces of the gas cylinder storage area shall be constructed so that they can be maintained clean.

The floor shall be laid to a slight fall, and/or provided with suitable drainage, to prevent the accumulation of water.

2.9.3.32 The drainage shall be such that any product spill is directed to a low risk area. The drainage system shall be designed to prevent spills or contaminated water entering surface water drains, or other controlled drainage or watercourses. (See also paragraph 2.9.3.09).

2.9.3.33 **Fire Safety**. Storage areas shall be located away from areas of fire risk. It is imperative that any area identified for storing gas cylinders is acceptable to the regional Defence Fire & Rescue Service Fire Safety Officer, who shall be involved in the planning and siting of the gas cylinder storage facility from the earliest stages, and who is to be consulted on all aspects of fire safety, including the types of cooling and extinguishing systems, and the number of First Aid Fire Appliances required for each gas cylinder storage facility. A Fire Safety Risk Assessment is to be carried out on all storage sites and is to be incorporated into the Site Fire Safety Management Plan (see JSP 426).

2.9.3.34 Consideration shall be given to the use of an automatic fire detection and alarm system, the requirement for fire hydrants, and a water spray system that will operate either automatically or manually.

2.9.3.35 A minimum of two fire extinguishers suitable for use on a Class C (gases or liquefiable gases) fire are to be provided at all gas cylinder storage areas. For flammable gases such as LPG, it is recommended that these extinguishers should be 2 x 9 kg dry powder fire extinguishers. The appropriate number and type of fire extinguishers are to be provided and correctly located in accordance with the assessment made by the regional Defence Fire & Rescue Service Fire Safety Officer. Fire extinguishers shall be positioned in a readily accessible position close to each entrance/exit.

2.9.3.36 Additional safety equipment, such as positive pressure breathing apparatus, a water shower and eye wash bottle, may be required. The quantity of First Aid Fire Appliances and any additional equipment required by the regional Defence Fire & Rescue Service Fire Safety Officer will be considered by the Defence Fuels Group to be the minimum necessary for that site.

2.9.3.37 To reduce the fire hazard to a minimum the area surrounding the cylinders is to be kept clear. Long grass, weeds and any overhanging branches are to be removed. A space of 3 m around the storage area is to be kept clear of all vegetation and combustible material. In addition, the undergrowth is to be kept as short as possible for a total distance of 9 m around the storage area. Chemicals such as sodium chlorate and other oxidising agents which may cause a risk of fire shall not be used as a weed killer.

2.9.3.38 **No Smoking**. Gas cylinder storage facilities shall be designated a “NO SMOKING AREA” (see paragraph 2.9.3.26 for an example of signage), and no smoking shall be permitted within a minimum distance of 3 m of the storage facility boundary (see Annex A).

2.9.3.39 **Lighting and other electrical equipment**. Adequate lighting shall be provided to assist in the security of the site; and in the identification of gas cylinder contents, for maintenance, and for gas cylinder handling. The light source used shall give suitable colour rendering to enable colour labelling to be easily recognised by persons with normal colour vision.

2.9.3.40 To provide suitable protection against the weather, external electrical equipment shall have a minimum rating of IP 54 in compliance with *BS EN 60529*. Within the minimum separation distances detailed at Annex A, unless a specific documented risk assessment has demonstrated the risk to be insignificant, only explosion protected electrical equipment, (i.e. meeting the requirements of *Equipment Group II, Category 3, 'G' of the Equipment and Protective Systems Intended for use in Potentially Explosive Atmosphere Regulations 1996*), shall be installed.

2.9.3.41 Where a gas cylinder storage facility is designated for the storage of oxygen cylinders and/or flammable gases, all fixed, portable and self contained electrical equipment shall be suitably protected (see *BS EN 60079-14*); only electrical equipment certified as suitable for use in a Zone 2 area (or better) and constructed to a recognised standard shall be installed (see *BS EN 60079-10*). This restriction shall be applied within storage areas and outside the storage areas to the distances specified in Annex A. Where applicable the DSEAR Regulations are to be enforced, in particular in the use of Ex-rated equipment (see *JSP 375, Volume 2, Leaflet 56*).

2.9.3.42 **Electrical Hazards**. Precautions shall be taken to ensure that no electrical current can reach the gas cylinders; steel floor inserts, structural members, and metal surfaces that can carry earth-return currents. This may require the provision of earthing rods or plates.

2.9.3.43 All metal fitments in the facility, including fencing, gates, tanks and all pipe work, shall be adequately earthed. This shall be in accordance with *BS 7430*.

2.9.3.44 **Ventilation**. All gas cylinder storage areas shall be constructed so as to provide a high standard of natural ventilation. To ensure that storage areas are afforded sufficient natural ventilation, no more than 50 % of the perimeter shall be obstructed by solid walls. Where practicable, obstructions should not be on adjacent sides.

2.9.3.45 Where there are enclosed or semi-enclosed storage areas which provide protection from the weather, they shall be constructed in such a way as to provide no opportunity for the build-up of gases in enclosed spaces. Low and high level natural ventilation is particularly important since many gases are heavier or lighter than air. Low level openings shall be above the height of any spillage retention sills. The store shall be designed and managed so that gas leaks cannot collect in confined spaces.

2.9.3.46 Open wire mesh of industrial quality, or steel louvers, are suitable materials for use as free venting sides.

2.9.3.47 **Partitions and Barriers**. In some cases, the use of physical partitions or barriers may reduce the required separation distances. However, any cylinders stored adjacent to a partition are to be smaller than the partition (i.e. shorter, so that they are protected by the partition). Such partitions should be rated to provide fire resistance of at least 60 minutes; and shall not measure less than 2 m in height. Normally, partitions will be constructed of unperforated brick or concrete but other materials with equivalent or better properties may be used. However, some structures such as earth banks will require a greater thickness to provide equivalent effectiveness.

2.9.3.48 **Protection against the Elements.** Some gas cylinders, particularly those containing liquefied gases, are susceptible to extremes of temperature, both high and low temperatures; and in these cases they are to be afforded protection from effects of direct sun light. Protection may also be needed from the elements, e.g. in desert conditions driving sand can have an adverse effect on protective finishes, warning labels; and cause contamination to gas cylinder valves and outlets.

2.9.3.49 In external storage areas, where necessary, gas cylinders are to be covered to protect against the effects of strong sunlight and/or to afford some protection against the weather and against corrosion. Any roof shall be designed with vents to prevent the accumulation of lighter-than-air gases in the roof-space.

2.9.3.50 In temperate climates, it is only necessary to protect certain cylinders containing liquefied gases, such as carbon dioxide, anhydrous ammonia and acetylene. In tropical climates all gas cylinders (in particular those containing acetylene and the liquefied gases) should, wherever possible, be protected from direct sunlight with due regard to provision of adequate ventilation over and around the gas cylinders. Where locally made covers are employed they must be manufactured from white fire-resistant material to reduce the temperature produced by the sun's rays.

2.9.3.51 **Lightning protection**. Compressed gas in cylinders and other containers do not normally require special lightning protection. However, this should be identified during the Siting Board. If necessary DFG or the gas supplier will provide details for the safe storage of specific gases and containers (see Part 1, Chapter 3, Annex A).

2.9.3.52 **Telephone(s)**. A telephone to aid emergency response shall be provided. It is to be within 50 m of the store. This is to be located outside the hazardous area (see Annex A). A land-line is the preferred option; however for remote sites, a fixed cell-phone telephone may be provided. In all cases, a copy of the emergency response procedures and the contact details specified at the site entrance (see paragraph 2.9.3.28) shall be provided adjacent to the telephone.

2.9.3.53 **Gas Detection**. Based on foreseeable hazards identified during the Risk Assessments (see paragraph 2.9.2.07), and where it is appropriate, atmospheric monitoring and/or alarm systems should be provided within the gas cylinder store to detect gas leakages. Appropriate conditions include the storage of refrigerant and fluorinated gases (see paragraph 2.9.6.20 and Part 2, Chapter 12); and gas cylinder stores, sited near Vulnerable Populations, that hold significant quantities of flammable and/or toxic gases (see paragraph 2.9.2.20). Advice may be sought from the Defence Fire & Rescue Service Fire Safety Officer and from the DFG (see Part 1, Chapter 3, Annex A).

SECTION 4 – ADDITIONAL REQUIRMENTS FOR STORAGE INSIDE SPECIALLY CONSTRUCTED BUILDINGS

2.9.4.01 Storage areas are to be located in the open air where there is good natural ventilation (see paragraph 2.9.3.05). Storage within buildings is not recommended and shall not be considered for new sites without the authority of DFG (see Part 1, Chapter 3, Annex A).

2.9.4.02 If there are no alternatives to indoor storage of gas cylinders, and where the facility has been authorised by DFG, the storage area shall be a compartment within a single storey building. For all existing locations and any for new facilities, a risk assessment (see paragraph 2.9.2.07) is to be carried out to cover the quantity of cylinders, types of gases, the proposed location and the risks to the other parts of the building (advice can be sought from DFG (see Part 1, Chapter 3, Annex A)).

2.9.4.03 It shall have at least one external wall; and be specifically dedicated and adapted for gas cylinder storage.

2.9.4.04 **Ventilation**. Buildings containing the gas cylinders are to be adequately ventilated to prevent the accumulation of explosive or dangerous concentrations of gas. The rules for ventilation of buildings containing gas cylinders or cryogenic fluids are the same as those prescribed for explosive storehouses (see *JSP 482*, *Part3, Chapter 12*).

2.9.4.05 Humid storage conditions are unsuitable for the storage of gas cylinders. In humid regions, mechanical ventilation systems may be necessary (see paragraph 2.9.3.44).

2.9.4.06 The store shall have thorough ventilation; a minimum of 10 air changes per hour is recommended. Ventilation openings shall be carefully sited in accordance with Annex A. Buildings containing flammable gases are to have openings of not less than 2.5 % of the combined area of the walls and roof of the room or 12 % of the area of one of the external walls, whichever is the greater. Ventilation openings shall not normally be provided in internal walls.

2.9.4.07 If a forced ventilation system is used, it shall be connected to an alarm system to warn of failure.

2.9.4.08 **Gas detection**. Atmospheric monitoring shall be provided within the store to detect gas leakages. Foreseeable hazards will have been identified during Risk assessments (see paragraph 2.9.2.07), e.g. leakage of oxidising, asphyxiating, flammable gases, F-gases (see paragraph 2.9.6.20); and/or fire (see paragraph 2.9.3.34). Based on the risk assessments, suitable gas detectors are to be fitted to warn of any hazardous atmospheres within the store. Alarm warnings, e.g. flashing lights, alarms, etc, are to be provided both outside and inside of the store (see also Part 1, Chapter 9).

2.9.4.09 **Fire and explosion mitigation**. The store shall be constructed of non-combustible materials. Where it forms part of a larger building, it shall be separated from the rest of the building by a firewall constructed of material rated to provide at least 60 minutes fire resistance. Brick and concrete are the preferred materials for firewalls.

2.9.4.10 The store shall have an area equal to at least one wall, or the roof, made of open mesh or lightweight friable material to provide explosion relief. This relief partition should be designed and positioned so that any explosion would vent safely without producing dangerous projectiles.

2.9.4.11 **Electrical equipment**. All electrical equipment is to be provided to the approved classification / specification (see *BS EN 60079-10* and paragraph 2.9.3.39).

2.9.4.12 **Gas Cylinder Handling**. Consideration needs to be given to the use of powered mechanical handling aids such as fork lift trucks within the confined space of an internal store (see paragraph 2.9.3.18).

2.9.4.13 **Safety Management**. Consideration needs to be given to the properties of the gases being stored and the building features which will allow leaks, spillages, fires, etc. to be managed safely (see Section 6).

2.9.4.14 Gas cylinders are not to be stored adjacent to radiators or other sources of heat (see paragraph 2.9.3.48); nor is electric apparatus to be operated in the vicinity of storage buildings containing gases (see Annex A).

2.9.4.15 Combustible stores of any description, i.e. oils, greases, fuels; other dangerous goods; salt, or corrosive chemicals are not to be stored in the same store as gas cylinders (see paragraph 2.9.6.08).

2.9.4.16 Additionally:

a. Cylinders of very toxic or pyrophoric gases **shall not** be stored in internal stores.

b. The number of gas cylinders shall be kept to a minimum.

2.9.4.17 **Safety Signs and Warning Notices**. The building shall be suitable labelled (see paragraph 2.9.3.23) on the outside to assist fire fighting and security operations in identifying the risks inside the building.

SECTION 5 – ORGANISATION OF GAS CYLINDERS WITHIN A STORE

2.9.5.01 **Grouping / Segregation / Identification**. Gas cylinders shall be grouped within the store according to a formal plan. This plan is to take into account the hazards posed by the gases stored; the types of gas cylinders; handling techniques; and the general requirements of good storekeeping.

2.9.5.02 Gas cylinders of the same gas or the same hazard category should be grouped together, e.g. flammable, toxic, oxidising, or corrosive (see Part 2, Chapter 3). Storage areas shall be designed to separate incompatible gases, e.g. gases of different hazard category (see Annex A and Annex B).

2.9.5.03 Where medical gas cylinders are held, they shall be segregated from non-medical gas cylinders. A separate store is recommended. Pathology gases are not classified as medical gases and are to be segregated from medical gases.

2.9.5.04 Cylinders of LPG with a total stored capacity less than 50 kg may be stored with other gas cylinders.

2.9.5.05 Cylinders of LPG with a total stored capacity greater than 50 kg but less than 1000 kg shall be segregated from other gas cylinders (see Annex A).

2.9.5.06 For cylinders of LPG with a total stored capacity greater than 1,000 kg a separate store is required.

2.9.5.07 Full and used gas cylinders are to be segregated.

2.9.5.08 Unserviceable gas cylinders are to be further segregated and separated from serviceable cylinders.

2.9.5.09 Areas within the gas cylinders storage facility are to be clearly identified by signage to show the condition, ownership and contents of gas cylinders. See para 2.9.3.22.

2.9.5.10 **Cylinder orientation**. Gas cylinders should be stored in accordance with the supplier's guidance and maximum use should be made of specially designed pallets.

2.9.5.11 Gas cylinder pallets are available from the DFG contractor.

2.9.5.12 Generally, unless the gas supplier provides contrary guidance, all gas cylinders are to be stored vertically. This can be in cradles, pallets, trolleys or other specifically designed stowages. Gas cylinders stored in a vertical position are to be stored no more than one cylinder high.

2.9.5.13 All gas cylinders are to be securely restrained to prevent them from falling over. Gas cylinders, which are stored in a gas cylinder trolley, are to be secured to an appropriate strong point to prevent the combined trolley and gas cylinder falling over.

2.9.5.14 Certain compressed gases are supplied in gas cylinders with rounded bottoms. Where these are stored vertically, special stowages specifically designed to accommodate round-bottom cylinders shall be used.

2.9.5.15 Where gas cylinders are stored horizontally, special arrangements will be required to secure them. They shall be suitably restrained on dunnage. Horizontally stored gas cylinders are not to rest directly on the floor. Particular care is to be taken to prevent the onset of external corrosion (e.g. by ensuring gas cylinders do not rest in pools of water).

Note: Horizontal gas cylinder storage can allow any water, or other contaminants, inside the gas cylinder to corrode the wall along the parallel section where it is thinnest and most highly stressed.

2.9.5.16 **Movement within the Facility**. For housekeeping and stock control purposes, aisles shall be provided in storage areas to enable access to groups of gas cylinders. Typically, aisles should not be less than 0.6 m wide and shall, in all cases, provide sufficient manoeuvring space for the types of mechanical handling equipment used at that site (see Annex B and Annex C).

2.9.5.17 The storage area shall be maintained in a condition that affords the unhindered safe movement of gas cylinders by trolley, forklift truck, etc, and to prevent damage to cylinders during manual handling, as well as trolleys, fork lift truck and other vehicular use. Clear access for the emergency services is to be maintained at all times. Store gas cylinders where they are not vulnerable to hazards caused by impact, e.g. from vehicles such as fork-lift trucks (see paragraph 2.9.3.20).

2.9.5.18 **Material Handling Equipment.** Where flammable gas cylinders are stored, Material Handling Equipment, e.g. a counter-balanced forklift truck, should be suitably protected so that its operation within a gas cylinder storage area should not introduce additional hazards due to the presence of flammable gases or vapours (see *JSP 317, Part 3 Chapter 13 - Mechanical Handling Equipment*).

2.9.5.19 **Very Toxic and Toxic Gases**. In all cases, full and nominally empty gas cylinders of very toxic gases shall be kept in a suitably ventilated, locked enclosure. Access shall be restricted to trained and authorised personnel only.

2.9.5.20 Gas cylinders containing toxic gases are supplied with a valve outlet sealing plug or cap-nut which acts as a secondary seal. Slight leakage or the inadvertent opening of the valve can be hazardous if these seals are incorrectly fitted. Potentially, this hazard can also exist when gas cylinders are nominally empty. Whenever practicable, toxic gases are to be stored separately. Full and unhindered access to gas cylinders containing toxic gases will assist their routine checks, and reduce the risk of accidental exposure should an incident occur.

2.9.5.21 **Pyrophoric Gases**. In all cases, full and nominally empty gas cylinders of pyrophoric gases shall be kept in a suitably ventilated, locked enclosure. Access shall be restricted to trained and authorised personnel only. They should not be stored within a building (see paragraph 2.9.2.20).

2.9.5.22 **Small Quantity Stores**. A suitably ventilated, marked and labelled, lockable cabinet may provide effective security for small quantities of gas cylinders / containers (see Section 14).

2.9.5.23 **Fire extinguishers**. Where fire extinguishers are stored in a gas store they are to be segregated from all other gas cylinders. Specifically, powder fire extinguishers are not to be stored with other gas cylinders. There is the potential for certain powders within these extinguishers to form a corrosive mixture when mixed with water which could affect the integrity of gas cylinders.

SECTION 6 – MANAGEMENT OF GAS CYLINDERS AND THEIR STORES

2.9.6.01 **Gas cylinder store manager**. A single person shall be appointed as the gas cylinder store manager. The manager must have the minimum competencies (for training see Part 1, Chapter 8) to carry out the duties as detailed in paragraph 2.9.6.02.

2.9.6.02 The gas cylinder store manager shall ensure that the receipt, storage and issue of gas cylinders are carried out in accordance with all external and internal regulations, such as JSP 319. The list below provides, as a generic guide, the minimum responsibilities of the gas cylinder stores manager:

a. The security of the gas cylinder store and the safe keeping of the gas cylinders within. Ensuring there is management control of the access keys to each gas cylinder store and that there is an up-to-date list of authorised persons who may draw those access keys.

b. Providing a focal point for the store and ensuring compliance with all external and internal rules and regulations.

c. Providing a focal point for the identification of hazards and risks within the gas cylinder store. Ensuring a Fire Safety Risk Assessment has been carried out on all storage sites and is incorporated into the Site Fire Safety Management Plan (see paragraph 2.9.3.33).

d. Ownership of Emergency Plans (see paragraph 2.9.6.03) and SOPs, such as leak procedures (see paragraph 2.9.6.09).

e. Liaison with the unit emergency response organisation, as appropriate, to provide access to the gas cylinder store by the Emergency Services during any incident.

f. Accounting for all gas cylinders in the designated manner; and ensuring that receipt and issue checks are carried out (see paragraph 2.9.6.05).

g. Ensuring that the weekly gas cylinder store inspection is carried out (see paragraph 2.9.6.06).

h. Liaise with the Maintenance Management Organisation (MMO) and other contractors to ensure upkeep of the infrastructure; and compliance with the rules and regulations concerning safe working procedures, for example, within any confined spaces affected by the gas cylinder store (see paragraph 2.9.3.10).

i. Where controlled gases are stored, e.g. 'F' gases (see paragraph 2.9.6.21), maintaining a record of all holdings and any leakages.

j. Ensuring that only persons who are trained and competent to carry out their duties within the gas cylinder store are permitted access.

k. When gas cylinders are moved from the holding unit to another unit, ensuring that DFG Supply Chain Manager (see Part 1, Chapter 3, Annex A) is informed: information on the products, quantities and the relevant UINs is required.

2.9.6.03 **Emergency Plans**. A plan of the gas cylinder storage facility's layout, identifying gas classifications, full and nominally empty gas cylinder locations, etc, especially the confirmed presence or confirmed absence of acetylene cylinders, will assist the emergency services when dealing with incidents in or around the storage site.

2.9.6.04 The gas cylinder store manager is to provide an appropriate emergency plan. This plan is to be made available to the emergency services via the unit Safety, Health, Environmental and Fire Officer as appropriate.

2.9.6.05 **Receipt and Issue Checks**. Following all deliveries, and prior to all issues, checks are to be carried out to ensure all products are in a serviceable condition and the appropriate documentation is complete. All non-conformities are to be reported to the gas cylinder store manager. The checks are to include:

a. The gas cylinder contents are correctly identified (see Part 2, Chapter 3).

b. The gas cylinder is in-date for its periodic inspection and test dates (see Part 2, Chapter 3).

c. A lifed gas is in-date for use (see Part 2, Chapter 3).

d. There is no obvious damage to the gas cylinder body.

e. There is no obvious damage to the valve.

f. Gas cylinder accessories, e.g. valve guard, protective cap, valve outlet protection, as appropriate are fitted, secure and serviceable (see Part 2, Chapter 17).

g. There is no gas leakage.

h. Any certification necessary e.g. certificate of conformity, is provided (see Part 2, Chapter 6).

i. Safety Data Sheets are available for all products.

j. All gas cylinders are accounted for in accordance with unit stores procedures.

k. Unless required for use, all gas cylinders are kept in an authorised gas cylinder store.

2.9.6.06 **Inspection of Gas Cylinders and Gas Cylinder Stores**. The gas cylinders and their storage area shall be inspected by a competent person, at least weekly, under the authorisation of the gas cylinder store manager. All non-conformities are to be reported to the gas cylinder store manager. This inspection is to be recorded and records kept.

2.9.6.07 The inspector is to ensure that:

a. There are no leaks.

b. There are no obvious unserviceabilities.

c. All gas cylinders are correctly segregated and grouped as appropriate (see Section 5).

d. All gas cylinders are correctly orientated and are secure in their storage.

e. All gas cylinders are within their periodic inspection and test life, and all lifed gases are within date for use (see Part 2, Chapter 3).

f. All gas cylinders are correctly marked and identified (see Part 2, Chapter 3).

g. Safety Data Sheets and any other certification (e.g. Certificates of Conformity) are available (see Part 2, Chapter 6).

h. There are sufficient gas cylinders to meet unit demands. All excess gas cylinders are to be returned.

i. Empty, unserviceable or unwanted gas cylinders are returned at the earliest opportunity.

j. The gas cylinder store is clean, with no obvious fire risks.

k. Access and egress routes are clear.

l. The gas cylinder store is secure.

m. The gas cylinder store is not being used to store other items / dangerous goods (see paragraph 2.9.6.08).

2.9.6.08 **Storage of Goods within a Storage Compound**. The only items to be stored in a gas cylinder storage compound are gas cylinders; their associated fittings, such as cylinder keys, valve caps, etc; and associated mechanical handling aids, such as cylinder trolleys. Combustible stores of any description, e.g. oils, greases, paints, fuels; other classes of Dangerous Goods; salt, or corrosive chemicals shall not be stored in the same storage compound / building as gas cylinders. The storage compound is not to be used as a lay-apart store or as a convenient storage area for other items.

2.9.6.09 **Leak Procedures**. All units are to have written standard operating procedures for managing leaking gas cylinders. These SOPs are to be available for all personnel working on the site. Any leaking gas cylinders are to be made safe and returned as unserviceable (see Part 1, Chapter 6).

2.9.6.10 **Considerations of High or Low Temperature Storage**. Gas cylinders exposed to high levels of radiant heat have the potential to explode due to an increase in pressure. To prevent explosion under normal conditions, the gas cylinder supplier is required to carefully control the gas cylinder's charge, in accordance with *BCGA CP 35*, to ensure that excessive pressure cannot develop under the highest ambient temperature range in the climactic area of use. Gas cylinders shall not be deliberately heated or knowingly stored where they are likely to become excessively heated.

2.9.6.11 Aluminium gas cylinders that are subjected to temperatures above 150 °C will soften permanently and present a potential hazard even after the heat source has been removed.

2.9.6.12 Some steel gas cylinders and their fittings may become brittle when subjected to temperatures below –20 °C.

WARNING. Cold-soaked gas cylinders are to be handled with care. Avoid subjecting the gas cylinders to any impact or sudden shock.

2.9.6.13 Storage at low temperatures may affect the homogeneity of certain gas mixtures and this may inhibit the immediate bringing into service of a limited number of gas mixtures. For example, the medical gas mixture Entonox™ will separate out at temperatures below – 6 °C and will require conditioning before use (see Entonox ™ Safety Data Sheet); and calibration gas mixtures will need to be conditioned at room temperature before use.

2.9.6.14 LPG cylinders, especially butane cylinders, may not be useable at low temperatures due to lack of developed pressure (see Part 3, Chapter 2).

2.9.6.15 Whenever a gas cylinder's normal operating temperature limits are exceeded it is to be made safe and separated from serviceable stock. The gas supplier, or the Support Authority responsible for the gas cylinder, is to be informed and advice sought. If deemed unserviceable the gas cylinder is to be returned as unserviceable (see paragraph 1.9.4.06 for gas cylinders subjected to excessive heat) detailing the reason for the unserviceability (see Part 1, Chapter 6).

2.9.6.16 **Stock Rotation**. Gas cylinders are not to be stored for excessive periods of time. Only demand sufficient quantities of gas to cover actual unit requirements. Stock rotation should be practised in line with normal stock control procedures, i.e. to ensure that wherever possible first-in is first-used. This is particularly important when the gas cylinders are exposed to the elements. However, it shall be borne in mind that certain gases are lifed; and that all gas cylinders are subject to periodic inspection and test requirements.

2.9.6.17 Gas cylinders containing corrosive gases shall be returned promptly to the supplier by the expiry date; and these gas cylinders may be subject to audits by the supplier (see paragraph 2.9.2.23).

2.9.6.18 Gas cylinders containing a gas that is time expired shall be returned to the cylinder owner (see Part 1, Chapter 3). Gas cylinders past their periodic inspection and test date may be issued for use within the unit (provided the contents are in-life), but the gas cylinder must not be refilled (see Part 2, Chapter 5), or transported on the public highway (see Part 2, Chapter 8). It is recommended that all gas cylinders which are past their periodic inspection and test date are returned to the gas cylinder supplier and, as required, replaced with serviceable items.

2.9.6.19 It is particularly important that units who store gas cylinders for use on operations, exercises, or detachments maintain their stock within the stated gas life and periodic inspection and test life. Gas cylinders within six months of the end of their gas life or periodic inspection and test date shall not be released for overseas deployment.

2.9.6.20 **Fluorinated Greenhouse Gases and Ozone Depleting Substances**. Fluorinated Greenhouse gases ('F' gases) and Ozone Depleting Substances are subject to regulation. Regulation includes: the containment, use, recovery, disposal, destruction and labelling of both the gases themselves and products and equipment containing these gases (see Part 2, Chapter 12 and *JSP 418, Volume 2, Leaflets 5 & 11*).

2.9.6.21 Units holding gas cylinders in stores are required to keep records, prevent leakages and to promptly repair any detected leakages. Record keeping is to include:

a. The quantity of Ozone Depleting Substances and 'F' gases held.

b. Quantities recovered from maintenance and service activities.

c. Quantities disposed of or returned.

d. Details of leakages, including quantity (see Paragraph 2.9.2.06 and Part 2, Chapter 12).

2.9.6.22 The regulations require the installation of leak detection systems that will warn of leakages. These can be calibrated mechanical, electrical or electronic devices. At units where these gases are used, cylinders containing these gases are likely to be regularly rotated through a gas cylinder store. Any gas cylinder store holding these gas cylinders is to have a leak detection system fitted that will alarm when a leak is detected.

2.9.6.23 All units holding these gas cylinders are to have written standard operating procedures for the storage of these gases and instructions to deal with leaking gas cylinders (see Paragraph 2.9.6.09). Any leaking gas cylinders shall be promptly identified. If the leak cannot be contained then, if safe to do so, the contents of the leaking gas cylinder are to be transferred into a recovery cylinder (see Part 1, Chapter 3, Annex B, Table 6).

2.9.6.24 Maintenance activities are only to be carried out by authorised, competent personnel (see Part 1, Chapter 8, Section 6; and Part 2, Chapter 12).

2.9.6.25 **Gas Cylinder Maintenance**. No gas cylinder maintenance should be necessary in-service. If military units identify a requirement for maintenance they are to declare the gas cylinder unserviceable and:

a. Separate the gas cylinder from serviceable stock.

b. Return the gas cylinder in accordance with Part 1, Chapter 6.

SECTION 7 – GAS CYLINDER STORAGE ON OPERATIONS AND EXERCISES

2.9.7.01 **General**. Where it is necessary to provide temporary facilities for the storage of gas cylinders on military operations and exercises the requirements of JSP 319 are to be followed. However, where it may be impracticable to fully comply with the requirements detailed in JSP 319, the following procedures are to be followed.

2.9.7.02 A written assessment of the site is to be carried out by the senior person responsible for the storage site. The assessment is to identify and to include mitigation against all potential hazards (see paragraph 2.9.2.07). The risk assessment is to be approved by the senior officer responsible for the operation / exercise.

2.9.7.03 Where available, an existing dedicated facility is to be used.

2.9.7.04 **Operations**. Where practicable, storage of all gases on operations shall be as for non-operational storage. Those elements that can not be achieved without compromising operational effectiveness may instead be risk assessed (see paragraph 2.9.7.02) and the risks mitigated as far as possible. Only when assessing the risk in an operational theatre, may the risk to operational effectiveness be given higher priority to the risk of life; when this is done, the operational commander shall give explicit authorisation.

2.9.7.05 **Exercises**. The storage of all gases on exercises should be as for non-exercise storage. Those elements that can not be achieved may instead be risk assessed (see paragraph 2.9.7.02) and the risks mitigated as far as possible. Advice may be sought from DFG, during the exercise planning stage (see Part 1, Chapter 3, Annex A).

2.9.7.06 As part of the unit exercise administration instruction, guidelines are to be included concerning the safe storage and use of all gas cylinders.

2.9.7.07 **LPG Cylinders**. The storage of LPG cylinders on operations and exercises is to follow the policy laid out in the preceding paragraphs.

2.9.7.08 On major operations and exercises detailed instructions concerning LPG cylinder storage and supply will be provided by the nominated HQ. Where LPG is procured overseas, any deviations from the standard gas cylinder markings as detailed in Part 2, Chapter 16, are to be notified within the operation / exercise order.

2.9.7.09 An aide memoir to assist in the siting of LPG cylinders in the field is at Part 2, Chapter 16, Annex A.

SECTION 8 – ADDITIONAL REQUIREMENTS FOR GAS CYLINDER STORAGE ON HM SHIPS AND OTHER VESSELS

2.9.8.01 Storage details are to be approved for HM ships by Director General Ships and for other Service vessels by the appropriate authority. Reference is to be made to *DBR 1754*.

2.9.8.02 **General**. All gas cylinders are to be stowed in a designated location within an authorised and approved gas cylinder stowage. They are to be secured in the stowage.

2.9.8.03 It is recommended that gas cylinders are stored in the vertical position. They are to be located in such a manner that they are at all times accessible for inspection; and located such that the valve is protected from accidental damage. In addition, consideration is to be given to the easy removal of the cylinder, e.g. in the case of a suspected leakage or a fire.

2.9.8.04 Externally, gas cylinders must be stored under cover protected from the direct rays of the sun. In all cases, gas cylinders are not to be stored in any position in which they may be subjected to undue heat (e.g. in the vicinity of steam pipes, boilers, radiators), or in proximity to corrosive or highly flammable substances (see paragraph 2.9.3.48).

2.9.8.04 All electrical equipment in the stowage compartment is to be designated Zone 1. Electrical fittings, including outlets, fittings, switches and lighting, etc, fitted in the interior of flammable gas stowages are not to be located below 1.5 m from floor level. The general requirements of *DBR 1754, Chapter 3,* are to apply.

2.9.8.05 As cylinders are to have their valves closed even though they may be nominally empty. When empty the internal pressure is approximately atmospheric and, should the valve be leaking or left open, air can diffuse into the gas cylinder and within a flammable gas cylinder may form a flammable mixture. Closing the valve also assists in preventing internal contamination of the gas cylinder.

2.9.8.06 Care is to be taken that all threads of gas cylinders, valves and seatings are kept free from dirt and foreign matter to enable gas-tight joints to be made. No oil or grease is to be used to lubricate the gas cylinder valves or equipment and jointing compounds are not to be used for making connections.

2.9.8.09 A water spray system is to be fitted in confined space stowages and also over the top of all the gas cylinders where located on a weather deck stowage. The water spray system to each of these stowage positions is to be fitted with a remotely controlled operating valve. The water spray system should be connected into vessel's atmospheric monitoring and detection system. In the case of service vessels where a water spray system is impracticable, a fire hose fitted with a spray nozzle is to be specifically installed at an appropriate fire fighting position to provide fire / cooling water cover for the stowage.

2.9.8.10 Appropriate signage warning of the hazards of the gas, including a warning notice indicating that 'NO SMOKING OR NAKED LIGHTS' are permissible, is to be displayed within or near compartment stowages where gas cylinders are stowed (see paragraph 2.9.3.22).

2.9.8.11 Gas cylinders are to be subject to regular inspection (see Section 6). A particular concern is to ensure that gas cylinders remain within their periodic inspection and test life.

2.9.8.12 Safety Data Sheets shall be held for all the gases stored on board the vessel.

2.9.8.13 Compartments containing flammable gas cylinders / cartridges are to be; provided with adequate floor level ventilation, thoroughly ventilated before entry is permitted and have their doors clearly marked indicating the nature of their contents (see, for example, paragraph 2.9.3.26). Fan exhausts are to be based on 12 compartment air changes per hour. Fans are to be sited outside the compartment and are to be of the continuously rated (single speed) type. Flame arrestors are to be fitted at suitable points in the supply and exhaust system to ensure that the fan motor cannot be a source of ignition, e.g. on the exhaust line, the inlet line and the suction side of the suction fan. Consideration needs to be given to appropriate ventilation systems for gases of the other primary hazard categories, e.g. asphyxiants and oxidants.

2.9.8.14 **Gaseous Welding and Cutting Equipment**. Oxygen/propane and oxygen/acetylene welding and cutting equipment sets approved for damage control and emergencies on sea vessels, and their spare gas cylinders, shall be stowed in a secure, sheltered from the elements and well ventilated position in a weather deck superstructure, protected from the direct rays of the sun. They should be stowed where an exploding gas cylinder would produce the least danger to personnel and the vessel's structure.

2.9.8.15 Associated welding equipment (regulators, flashback arrestors, hoses etc.) are always to be removed from cylinders when not in use. It is recommended that they are stowed in a purpose-built storage box kept in an accessible location close to the cylinders.

2.9.8.16 **LPG Cartridges.** When cartridges of LPG are transported in HM ships or other Service vessels, each stowage is to be classified as a dangerous area and is subject to the general regulations laid down in *JSP* 319 and *DBR 1754.*

SECTION 9 – STORAGE OF LPG CYLINDERS / CARTRIDGES, GENERAL

2.9.9.01 This section deals with the various methods of storage of LPG cylinders / cartridges; the requirements of earlier Sections, i.e. Sections 1 to 8, shall apply unless otherwise stated. The main source document is the *UKLPG COP 7*, modified where required due to service constraints.

2.9.9.02 The outside storage of LPG cylinders/ cartridges is the preferred option and should always be considered in the first instance. All permanent fixed storage sites for LPG cylinders/ cartridges are to be the subject of a properly constituted Siting Board (see paragraph 2.9.3.03 and Part 3, Chapter 8).

2.9.9.03 Areas designated for LPG gas cylinder stowage (> 1,000 kg) are not to contain other flammable liquids or gases. Specific guidance on the storage provisions of bulk LPG is given in Part 3.

2.9.9.04 **Separation Distances**. Where LPG has to be stored near explosives, advice from the appropriate ammunition technical authority is to be sought (see paragraph 2.9.3.11).

2.9.9.05 **DSEAR**. As a flammable gas, a documented risk assessment of the LPG storage area and its surroundings is required under DSEAR; and all workplaces where an explosive atmosphere may occur must be classified into hazardous and non-hazardous areas. Hazardous areas must be classified into zones by a Competent Person (see *JSP 375, Volume 2, Leaflet 56*).

2.9.9.06 Strict controls on the access of vehicles and other mechanical handling equipment into the storage area shall be exercised, in accordance with guidance given in Section 3. Only vehicles and other mechanical handling equipment associated with transfer and handling operations should be allowed in. Transport vehicles should have their engines and auxiliary equipment, e.g. radios, turned off when cylinders/ cartridges are being loaded or unloaded.

2.9.9.07 Where non-explosion protected mechanical handling equipment is used (see Paragraph 2.9.5.17), special precautions need to be taken in respect of design of pallets and operator training. Such vehicles shall be removed from storage areas when the activity is completed.

SECTION 10 – EXTERNAL STORAGE OF LPG CYLINDERS ≤ 20 kg INDIVIDUAL SIZE

2.9.10.01 The *UKLPG COP 7* allows for less stringent procedures where the individual cylinder size does not exceed 20 kg and the total storage of LPG does not exceed 400 kg. Examples of this type of storage are included in Annex C; but it is re-iterated that authority from the Defence Fire & Rescue Service must be sought in the first instance when this type of storage is being considered. Additionally, a risk assessment (see paragraph 2.9.2.07) must be made of the proposed site to ensure that the LPG storage does not pose an unacceptable risk to human life and property.

2.9.10.02 Pictorial examples of the various options indicated in this section are shown at Annex C.

2.9.10.03 Where LPG cylinders are stored against a boundary wall it must be with the owner's consent. The wall is to be at least 2 m high and provide at least 60 minutes fire resistance.

2.9.10.04 The wall must be imperforate for a distance of 1 m either side of the storage area. The LPG cylinders are to be at least 2 m from any building opening and at least 3m from other flammable materials. The height of the stack is not to exceed the height of the wall (see paragraph 2.9.3.47).

2.9.10.05 If LPG cylinders are stored against a building wall, the area up to 2 m either side of the storage area and up to 9 m above ground should have no openings and be of 60 minutes fire resisting construction. Any overhanging roof should also be constructed of 60 minutes fire resisting construction.

2.9.10.06 A building that houses vulnerable populations is not to be considered for the storage of LPG cylinders.

2.9.10.07 There should be no overhanging eaves or similar projections made of combustible materials above any cylinder. No external stairway or fire escape is to be positioned above stored LPG cylinders and no access or escape route should be compromised by the storage area.

2.9.10.08 Passageways are not suitable as storage areas.

2.9.10.09 LPG cylinders may be stored in a corner between two walls (see Figure 2.9.C2).

2.9.10.10 If the storage area has 3 walls at least one should not exceed 3 m in height.

2.9.10.11 LPG cylinders may be stored between two wing walls (see Figure 2.9.C4). If the wings are less than 2 m high they should be discounted for separation purposes and the area considered as if it were located against a single wall. If the wing walls are 2 m or higher, separation distances may be calculated by measuring along and around the perimeter. To ensure adequate ventilation the wing wall should not extend outwards more than 1 m beyond the storage area.

SECTION 11 – EXTERNAL STORAGE OF LPG CYLINDERS > 50 kg

2.9.11.01 The chosen site should be well ventilated to allow for dispersal of gas from small leaks, level and the base must be sufficient to support the weight of the gas cylinders. Examples of typical outside storage layout are at Annex C.

2.9.11.02 Whenever possible, LPG cylinders are to be stored in open areas on hardstandings (see paragraph 2.9.3.30).

2.9.11.03 Unless the storage area is contained within a larger protected area or where 400 kg or less of LPG is stored, the storage compound is to in accordance with the requirements given in Section 3. However, the requirements of paragraph 2.9.3.18, *Access and Egress*, may be relaxed in respect of the provision of a single door, provided that the maximum escape distance from any part of the storage area to the exit measured around the LPG cylinders does not exceed 9 m.

2.9.11.04 In temperate climates it is not usually necessary to provide overhead cover to reduce the effects of direct radiation. In tropical climates the requirement for overhead cover should be the subject of a risk assessment. Where overhead protection is deemed necessary it should be high enough above the cylinders not to impede the natural ventilation and should reflect the sun's rays (see paragraph 2.9.3.48). The store is to be constructed from non-combustible material (see paragraph 2.9.3.29).

2.9.11.05 The separation distances that apply to the outside storage of LPG cylinders are given at Table 2.9.A2. This also includes the reduced distances permissible when a fire-wall is incorporated. Irrespective of the separation distances given in Table 2.9.A2, the minimum distance from the storage perimeter fence to the nearest LPG cylinder is to be 1 m for nominally empty cylinders and 1.5 m for full cylinders.

2.9.11.06 Where vulnerable populations are housed, the minimum separation distance for LPG stored in excess of 400 kg is 8 m or that given in Table 2.9.A2, whichever is the greater distance. Where a fire-wall or other fire resisting separation is incorporated this minimum distance may be reduced in consultation and on the authority of the regional Defence Fire & Rescue Service Fire Safety Officer.

2.9.11.07 There should be no opening into buildings, cellars or pits within 2 m of an LPG storage area or the separation distance given in Table 2.9.A2 whichever is the greater. In exceptional circumstances where a gully or drain is unavoidable within 2 m the opening should be securely covered or fitted with a suitable seal to prevent the entry of vapour.

2.9.11.08 **Zoning**. A documented risk assessment of the LPG cylinders/ cartridges storage area and its surroundings is required under DSEAR (see paragraph 2.9.9.05). For outdoor storage, hazardous areas are only presumed to exist immediately around and above the LPG cylinders/ cartridges; and this area is deemed to be Zone 2: i.e. a place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of a gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

2.9.11.09 The storage area and up to a height of 1.5 m above the top of the highest LPG cylinder/ cartridge or beneath any roof whichever is the greater is deemed to be a Zone 2 area. Areas within the separation distance for a fixed source of ignition (Table 2.9.A2) but outside the immediate storage area up to a height of 1.5 m are also classified as Zone 2. Where a roof is fitted above the storage area the distance should be measured from the edge of the roof.

2.9.11.10 **Safety Signs and Warning Notices**. The LPG warning sign as depicted in Section 3 is to be displayed on each side of the fenced storage area that represents an approach route. All other relevant signs and pictograms detailed in paragraph 2.9.3.22 are to be displayed.

2.9.11.11 **Fire Precautions**. Each storage location is to be provided with a minimum of two fire extinguishers suitable for use on a Class C (gases or liquefiable gases) fire. Additional fire cover may be required and is to be provided on the authority of the regional Defence Fire & Rescue Service Fire Safety Officer (see paragraph 2.9.3.35).

SECTION 12 – ADDITIONAL REQUIREMENTS FOR INTERNAL STORAGE OF LPG CYLINDERS, PURPOSE BUILT

2.9.12.01 The preferred method of storage of LPG cylinders is in the open (see Paragraph 2.9.3.05). Where for security or climatic reasons LPG cylinders are to be stored in buildings the preferred option is within a purpose built structure.

2.9.12.02 Examples of typical purpose built LPG cylinder stores are shown at Annex C.

2.9.12.03 The following conditions will apply to LPG cylinder storage within specially constructed buildings:

2.9.12.04 The permissible quantity of LPG to be stored is detailed at Table 2.9.A3.

2.9.12.05 No part of the building is to be below ground level.

2.9.12.06 **Zoning**. A documented risk assessment of the LPG cylinders/ cartridges storage area and its surroundings is required under DSEAR (see paragraph 2.9.9.05). For the remainder of this section, it presumes that hazardous areas are classified as Zone 2: i.e. a place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of a gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

2.9.12.07 The whole of the inside of a building used solely for storage of LPG cylinders/ cartridges is deemed to be a Zone 2 area for hazardous area classification corresponding to the area in which a flammable cloud of gas may form in the event of a leaking cylinder (see *BS EN 60079-10*).

2.9.12.08 **Lighting**. If required, internal and building located external lighting shall be to Zone 2 and give an average luminance of 350 lux in the horizontal plane 0.8 m Above Finished Floor Level. Emergency lighting shall be to the requirements of *BS 5266-1* to give a luminance of approximately 2 lux with 3 hours duration.

2.9.12.09 **Separation Distances**. The separation distance from the store to the boundary, other buildings or fixed sources of ignition is determined by the capacity of LPG stored and is to be in accordance with that detailed at Table 2.9.A2.

2.9.12.10 Where the minimum separation distance to the boundary as detailed at Table 2.9.A2 (other than a building or fixed source of ignition) cannot be met, the appropriate external and internal walls are to provide a minimum of 60 minutes fire resistance; and internal walls are to have no ventilation openings.

2.9.12.11 **Construction**. The building is to be mainly constructed from non-combustible materials. Roof supports (including load bearing capacity) are to provide a minimum of 60 minutes fire resistance.

2.9.12.12 At least half of the longest wall or half of the roof area is to be constructed from open mesh or lightweight materials to act as explosion relief. The relief should ensure that any explosion is safely vented and that parts of the building do not present a subsequent hazard.

2.9.12.13 The building is to be provided with dispersed ventilation openings totalling a minimum of 2.5 % of the combined area of the walls and roof. Ventilation openings must not be placed in those parts of the building within the separation distances at Table 2.9.A2.

2.9.12.14 The floor of the storage room must be level and able to support the weight of the cylinders (see Paragraphs 2.9.3.30 and 2.9.3.31). There must be no drains, ducts or sumps (see Paragraph 2.9.3.32).

2.9.12.15 The number of doors is dependant on the layout of the building. The requirements of paragraph 2.9.3.21 may be relaxed in respect of the provision of a single door, providing the maximum escape distance from any part of the storage area to the exit measured around the containers does not exceed 9 m.

2.9.12.16 All relevant safety signs and warning notices detailed in paragraph 2.9.3.22 shall be displayed. Specifically the LPG warning sign (i.e. an LPG warning sign together with a No Smoking sign and a Highly Flammable sign) is to be displayed on each side of the building that represents an approach route.

2.9.12.17 Full and nominally empty LPG cylinders may be stored together in the same building although they are to be segregated and marked by the use of suitable signs such as those depicted in Section 3. Nominally empty gas cylinders are to be treated as full cylinders with respect to hazardous zoning and in calculating separation distances.

2.9.12.18 **Fire Precautions**. Each storage location is to be provided with a minimum of 2 x 9 kg Dry Powder Extinguishers. Additional fire cover may be required and is to be provided on the authority of the regional Defence Fire & Rescue Service Fire Safety Officer (see paragraph 2.9.3.35).

2.9.12.19 Access to the building is to be restricted to authorised persons only.

SECTION 13 – ADDITIONAL REQUIREMENTS FOR INTERNAL STORAGE OF LPG CYLINDERS IN AN EXISTING BUILDING

2.9.13.01 Where it is not practicable to store LPG cylinders / cartridges in the open air or in a purpose built building, exceptionally they may be stored in specially designed storage areas in buildings subject to the following conditions.

2.9.13.02 The quantity of LPG cylinders / cartridges stored is not to exceed that stated in Table 2.9.A3.

2.9.13.03 The building should be one storey and not used for sleeping accommodation. At least one side of the store should be an external wall of the building.

2.9.13.04 The doorway into the store should be located in an outside wall. Alternatively a ramp or sill of at least 250 mm should bridge the doorway in order to prevent LPG vapours entering other parts of the building.

2.9.13.05 There are to be no drains or other openings in the floor (see paragraph 2.9.3.09).

2.9.13.06 Well dispersed natural high and low level ventilation is to be provided in the form of permanent openings in the outside wall equal to a minimum of 12 % of the area of one of the outside walls or 2.5 % of the total area of the walls and roof whichever is the greater.

2.9.13.07 Ventilation should not discharge directly onto accommodation or office areas, areas where people accommodate, onto a pavement, or compromise any escape route; and the separation distances for apertures and other points is to be in accordance with Table 2.9.A2. Ventilation discharge areas shall be designed as “No Smoking” areas.

2.9.13.08 Explosion relief is to be provided equivalent to half the area of the longest wall. The explosion relief should be located in an outside wall or roof and vent to a safe place. The relief area may be left open or covered with wire mesh or lightweight panels.

2.9.13.09 Any part of the front of the building, including any overhanging roof, up to a height of 9 m and extending horizontally for a distance of 2 m on either side of any opening into the storage area should be imperforate and of 60 minutes fire resistance. Any openings in the fire resisting section should be fixed shut and appropriately protected.

2.9.13.10 **Safety Signs and Warning Notices**. The external walls of the building and adjoining internal walls shall be suitably labelled (see paragraph 2.9.3.22) to assist fire fighting and security operations in identifying the hazards and risks inside the building.

2.9.13.11 The use of this area of the building for the storage of gas cylinders shall be included in the building safety plans.

2.9.13.12 Appropriate controls are to be enforced to minimise any hazard to adjoining rooms, with an assessment of the use of electrical equipment, naked lights and a 'No Smoking' policy.

SECTION 14 – ADDITIONAL REQUIREMENTS FOR INTERNAL STORAGE OF GAS CYLINDERS WITHIN CABINETS

2.9.14.01 Any gas cylinders or cartridges stored internally are to be kept to the minimum necessary. Limited quantities of gas cylinders / cartridges may be stored inside a buiding within a dedicated cabinet(s). Each cabinet may store up to a maximum volume of 220 litres of gas. A maximum quantity of 400 kg of LPG cylinders / cartridges may be stored inside a building. The building and all cabinets located inside that building are to meet the following requirements.

2.9.14.02 The building is to be of single story construction and is not to house vulnerable populations.

2.9.14.03 The cabinet shall be located either at or above ground level. It shall not be located where it could prejudice any escape route.

2.9.14.04 The cabinet is to comply with BS EN 14470-2. It is to be constructed of non-combustible materials. It is to provide a minimum of 60 minutes fire-resistance. It is to be secured in position and have a lockable door which is to be kept locked when not in use.

2.9.14.05 It is to be ventilated at high and low levels to a safe place outside the building.

2.9.14.06 If it has an internal volume greater than 0.5 m^3 it is to be fitted with explosion relief equal to at least half the area of the back or side of the unit which discharges to a safe place outside the building.

2.9.14.07 All relevant safety signs and warning notices detailed in paragraph 2.9.3.22 shall be displayed, including the emergency actions and contact details (see paragraph 2.9.3.28).

2.9.14.08 The use of this area of the building for the storage of gas cylinders shall be included in the building safety plans. An appropriate Fire Safety Risk Assessment of the site shall be carried out and is to incorporated into the site Fire safety Management Plan (sse JSP 426).

2.9.14.09 Appropriate controls are to be enforced to minimise any hazard within the room or within adjoining rooms, with an assessment of the use of electrical equipment, naked lights and a 'No Smoking' policy. The area around the cabinet is to be is to be kept free of combustible materials. Refer to Annex A.

SECTION 15 – STORAGE OF GASES WITHIN A MTFI

2.9.15.1 Within Motor Transport Fuelling Installations (MTFI) it is acceptable to store small quantities of LPG cylinders where an alternative gas cylinder storage compound is not available. The hazards associated with locating cylinders at a fuel site are to be assessed and as necessary any risks mitigated. Reference is to be made to JSP 317 (see 4.12.27).

Note: The storage of LPG in a cage is to be included within the fuel site safety case and is auditable as part of the Fuel and Gas Safety Assurance programme.

2.9.15.2 Cylinders are to be stored in a dedicated wire cylinder cage. The mesh on the cage is to be small enough to prevent any unauthorised tampering, especially with the valves. The cage is to be kept secured.

2.9.15.3 The maximum quantity of LPG to be stored is 400 kg.

Note: Nominally empty or part used cylinders are to be treated as full for the purpose of storage in this cage.

2.9.15.4 The cage is to be located in a well ventilated position. It is to be protected from, or not to be located where it can be struck by, vehicle movements. It is not to be located where it can become immersed in fuel following a spill. The location is to comply with the minimum safety separation distances within Annex A. A minimum separation distance of 4.3 m from fuel pumps and fuel storage tank manlids is required. There are to be no openings into buildings, cellars, pits or confined spaces within 2 m.

2.9.15.5 There is to be no parking of vehicles with 3 m of the cage.

2.9.15.6 The cage is to be maintained in a serviceable condition and it is to be regularly inspected for continued fitness for use.

2.9.15.7 All relevant safety signs and warning notices detailed in Paragraph 2.9.3.22 shall be displayed, including the emergency actions and contact details (see paragraph 2.9.3.28).

BIBLIOGRAPHY

1. EC Regulation No 842/2006 on *Certain Fluorinated Greenhouse Gases*.

2. *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations, 2007.*

3. *Chemicals (Hazard Information and Packaging for Supply) Regulations*, 2002.

4. HSE L136. *Control and mitigation measures: Dangerous Substances and Explosive Atmospheres Regulations 2002.* Approved Code of Practice and Guidance.

5. *Confined Space Regulations*, 1997.

6. *Control of Substances Hazardous to Health Regulations, 2002 (as amended)*. (COSHH).

7. *The Dangerous Substances and Explosive Atmospheres Regulations*, 2002. (DSEAR).

8. *Equipment and Protective Systems Intended for use in Potentially Explosive Atmosphere Regulations 1996.*

9. United Nations, Economic Commission for Europe Committee on Inland Transport. *European Agreement Concerning the International Carriage of Dangerous Goods by Road*. (ADR).

10. *Health and Safety (Safety Signs and Signals) Regulations*, 1996.

11. *Management of Health and Safety at Work Regulations*, 1999.

12. *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations*,1995 (as amended). (RIDDOR).

13. HSE L135. *Storage of dangerous substances: Dangerous Substances and Explosive Atmospheres Regulations 2002.* Approved Code of Practice and Guidance.

14. BCGA Guidance Note 2 - *Guidance for the Storage of Transportable Gas Cylinders for Industrial Use*.

15. BCGA Code of Practice 35 - *Filling gas cylinders with liquefiable gases for transport within the United Kingdom*.

16. LPGA Code of Practice 7 - *Storage of Full and Empty LPG Cylinders and Cartridges*.

17. BS EN 14470-2, *Fire storage cabinets. Safety cabinets for pressurised gas cylinders.*

18. BS EN 60079-10 - *Electrical Apparatus for Explosive Gas Atmospheres. Part 10: Classification of Hazardous Areas*.

19. BS EN 60079-14 - *Electrical Apparatus for Explosive Gas Atmospheres. Part 14: Electrical Installations in Hazardous Areas (other than mines)*.

20. BS EN 60529 - *Specification for Degrees of Protection Provided by Enclosures (IP Code)*.

21. BS 5266 - *Emergency Lighting*.

22. BS 5266-1:2005 - *Emergency lighting. Code of Practice for the Emergency Lighting of Premises*.

23. BS 5378 - *Safety Signs and Colours*.

24. BS 5499 - *Graphical Symbols and Signs. Safety Signs, Including Fire Safety Signs*.

25. BS 7430 – *Code of practice for Earthing*.

26. JSP 317 - *Joint Service Safety Regulations for the Storage and Handling of Fuels & Lubricants*.

27. JSP 375 - *MOD Health & Safety Handbook*.

28. JSP 392 - *Radiation Safety Handbook***.**

29. JSP 418 - *MOD Sustainable Development and Environment Manual*.

30. JSP 426 - *MOD Fire Safety Policy*.

31. JSP 482 – *MOD Explosives Regulations.*

32. JSP 498 - *Major Accident Control Regulations*. (MACR)

33. JSP 800 Volume 4b - *Defence Movement and Transport Regulations*.

34. DBR 1754 - *Safety Regulations for Storing and Handling Petroleum, Oils and Lubricants & Certain Other Hazardous Stores on HM Ships*.

35. Defence Works Functional Standard, Design and Maintenance Guide 03 – *Storage of Dangerous Substances*.

36. Health Technical Memorandum (HTM) 02 – Medical Gas Pipeline Systems

ANNEX A

(Introduced at paragraph 2.9.2.18)

2.9.A1 MINIMUM RECOMMENDED SAFETY SEPARATION DISTANCES FOR GASES

Table 2.9.A1

(Table continued on next page)

Serial	Typical Type of Exposure	Separate from:	Min. separation distance (m)
1	Smoking, naked flames, sources of ignition and heat sources;	Storage area	3
2	Combustible materials, e.g. paper, wood.	Storage area	3
3	Bulk storage of flammable gases and liquids (Note 1).	Storage area	5
4	Unprotected electrical equipment	Flammable gases and LPG (see Notes 2 and 3)	3
5	Bowman radios (Note 4)	Flammable gases	HF radios: 70 VHF radios: 15 UHF radios: 15
6	Site boundaries (Note 5)	Toxic and Flammable gases; LPG (Note 2) and other liquefied flammable gases	5
7	Air compressors and ventilator intakes (Note 6)		
8	Roadways (other than those required for access)		
9	Bulk storage of cryogenic liquids (Note 7).		
10	Transportable cryogenic containers		
11	Building openings		
12	Pyrophoric gases in external store		

(Table continued from last page)

Serial	Typical Type of Exposure	Separate from:	Min. separation distance (m)
13	Site boundaries	Other gases	3
14	Air compressors and ventilator intakes (Note 6)		
15	Roadways (other than those required for access)		
16	Bulk storage of cryogenic liquids and transportable cryogenic containers (Note 1).		
17	Building openings, Pyrophoric gases in external store	Other gas containers	2
18	Pyrophoric gases connected for use	Other gas containers	2

Notes:

1. Bulk storage is defined as static vessels of capacity greater than 1,000 litres, in to which the produced is delivered.

2. Refers to LPG of between 50 – 1,000 kg; not required for less than 50 kg LPG.

3. A documented risk assessment is to identify if there is a need for protected electrical equipment (see paragraph 2.9.3.40).

4. All Bowman transmissions (except Personal Role Radio (PRR)) are to be disabled in the vicinity of flammable gases within the safety distances detailed below (this includes gas cylinder stores as well as liquid oxygen storage and operational sites) (see paragraph 2.9.2.18).

5. This should be increased to 8 m where the site boundary forms the boundary with vulnerable populations.

6. The Storage area shall not be directly below an air intake.

7. Bulk storage is defined as static vessels of capacity greater than 1,000 litres, in to which the produced is delivered. For bulk storage between 1,000 litres and 200 tonnes capacity, the separation distance shall be increased to 8 m from flammable gases and LPG cylinders above 50 kg total capacity.

Minimum separation distances for LPG storage in cylinders and cartridges

Table 2.9.A2

Total Qty of LPG Storage (kg)	Size of Largest Stack (kg)	Minimum distance from nearest cylinder to boundary, building or fixed ignition source where:	
		No fire wall is provided (m)	A fire wall is provided (m)
15 – 400	< 1,000	1	Nil
401 – 1000	≤ 1,000	3	1
1,001 – 4,000	≤ 1,000	4	1
4,001 – 6,000	≤ 3,000	5	1.5
6,001 – 12,000	≤ 3,000	6	2
12,001 – 20,000	≤ 5,000	7	2.5
20,001 – 30,000	≤ 7,000	8	3
30,001 – 50,000	≤ 9,000	9	3.5
50,001 – 60,000	≤ 10,000	10	4
60,001 – 100,000	≤ 10,000	11	4.5
100,000 – 150,000	≤ 20,000	12	5
150,001 – 250,000	≤ 30,000	15	6
> 250,000	≤ 30,000	20	7

2.9.A.01 UKLPG Code of Practice 24, Part 1 and BS 5482 specify a distance from LPG cylinders and "readily ignitable materials" which should not be less than 1 m. "Readily ignitable" in terms of oil tankers means those containing products having a flash point of 65 °c or less. This includes most domestic heating oils. The separation distance of 1 m is to be maintained even if the flash point may be above 65 °C.

2.9.A.2 Quantity of LPG storage within a building

Table 2.9.A3

Type	Max quantity of LPG per compartment (kg)	Max number of compartments	Max total quantity of LPG in building (kg)
Specially designed single storey building			
Cylinders & Cartridges	5,000	5	25,000
Cartridges only	50,000	5	250,000
Specially designed storage space within an existing building			
Cylinders & Cartridges	1,000	1	1,000
Cartridges only	5,000	1	1,000

2.9.A.02 Where storage buildings do not fall within a larger adequately secured area, the separation distances in Table 2.9.A3 should be enclosed by an industrial type security fence at least 1.8 m in height. Fire walls or other buildings may form part of this separation distance.

2.9.A.3 Additional minimum safety distances for cylinders at a MTFI

Table 2.9.A4

Event	Safety Distances
Fuel tank vents and fill points	7.5 m
Fuel dispensers	7.5 m
Flammable liquid bunds	3 m
Parked vehicles	6 m
Vehicle being fuelled	3 m

ANNEX B

(introduced at paragraph 2.9.5.02)

DESIGN AND LAYOUT FOR MIXED GAS CYLINDER STORAGE AREAS

2.9.B.1This Annex is intended to provide guidance on best practice for the design and layout of storage areas for compressed and liquefied gases. The layouts have been chosen to illustrate the factors that must be taken into account to achieve good stock management and effective access. These include:

a. Gas cylinders segregated according to product - hazard type (see paragraph 2.9.5.01).

b. Full and empty gas cylinders stored separately (see paragraph 2.9.5.07).

c. Where medical gas cylinders are held, they shall be segregated from non-medical gas cylinders (see paragraph 2.9.5.03).

d. Walkways of sufficient width to enable handling of gas cylinders (see paragraph 2.9.5.15).

e. Adequate access for emergency use (see paragraph 2.9.3.19).

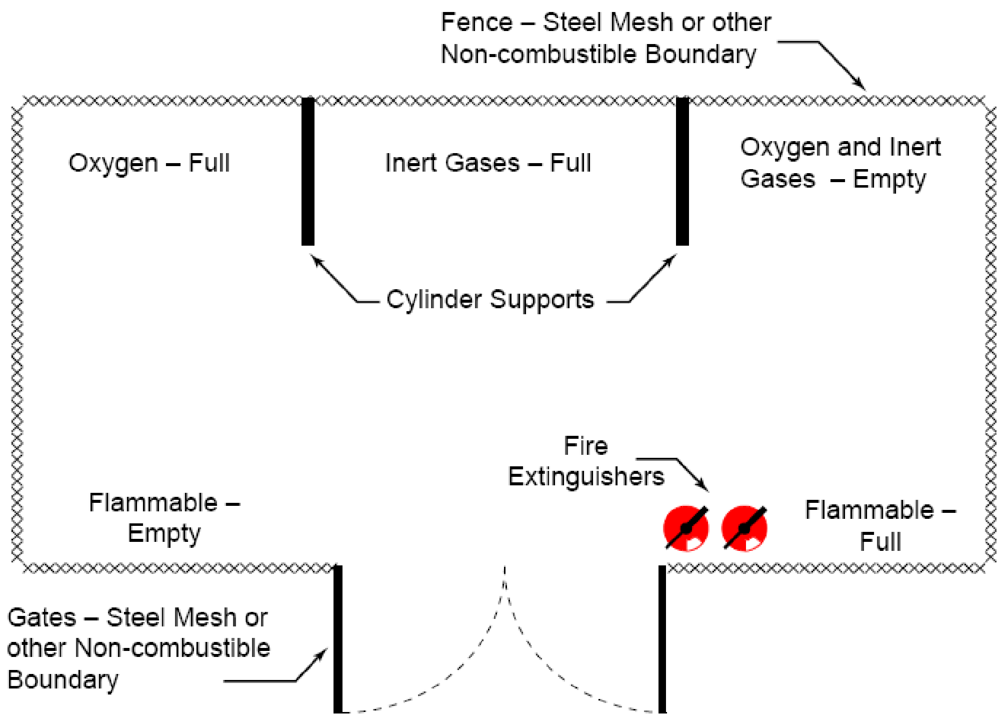
f. Provision for cylinders to be properly secured in an upright position (see paragraphs 2.9.5.10 to 2.9.5.14).

g. Provision of fire-fighting equipment (see paragraphs 2.9.3.33 to 2.9.3.36).

h. Appropriate signage (see paragraphs 2.9.3.22 to 2.9.3.28).

2.9.B.2 These layouts are not intended to be used as the definitive solutions to the design and layout of all sites. They are reproduced to provide guidance. All new and refurbished sites are to be subjected to a Siting Board (see paragraph 2.9.3.03). All gas cylinder storage facilities shall be assessed for compliance with this publication (see paragraph 2.9.3.02). Advice can be sought from the Defence Fuels Group (see Part 1, Chapter 3, Annex A).

Figure 2.9.B1: Example 1: Layout of a Typical Storage Compound



Notes:

1. Fencing shall be steel mesh construction.

2. LPG cylinders should not be placed within 1 m of the fence.

3. Appropriate warning signs shall be displayed (see paragraph 2.9.3.22).

4. Only quantities of LPG less than 50 kg (total) may be stored with other gases.

5. Where medical gas cylinders are held, they shall be segregated from non-medical gas cylinders (see paragraph 2.9.5.03).

6. A minimum of two fire extinguishers are to be provided at all gas cylinder storage areas (see paragraph 2.9.3.35).

Figure 2.9.B2: Example of a Typical Storage for Small Quantities of Different Gases

Note: Typically, a storage area for 'small' quantities of gas would contain 3 – 5 gas cylinders of industrial gases, and may also contain cylinders of LPG which total less than 50 kg.

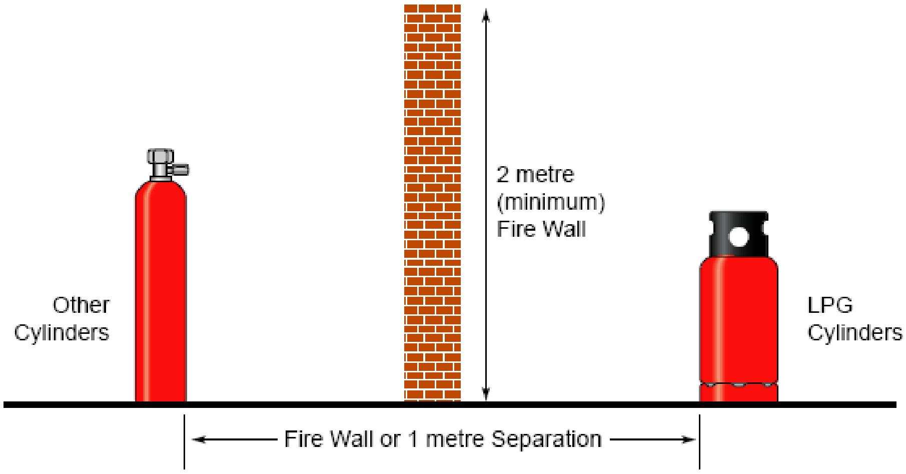
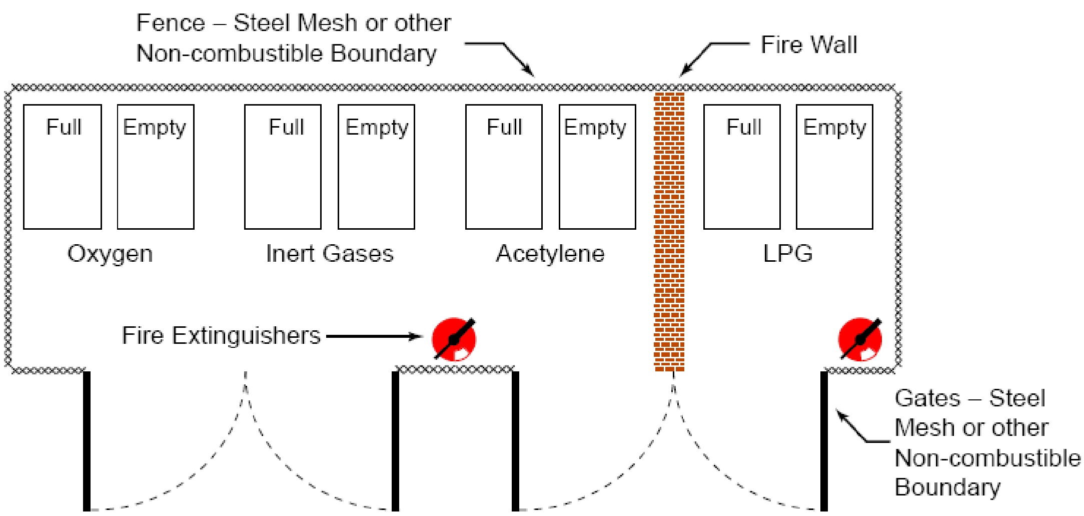


Figure 2.9.B3: Example of a Layout of Storage for Small Quantities of Different Gases



Notes:

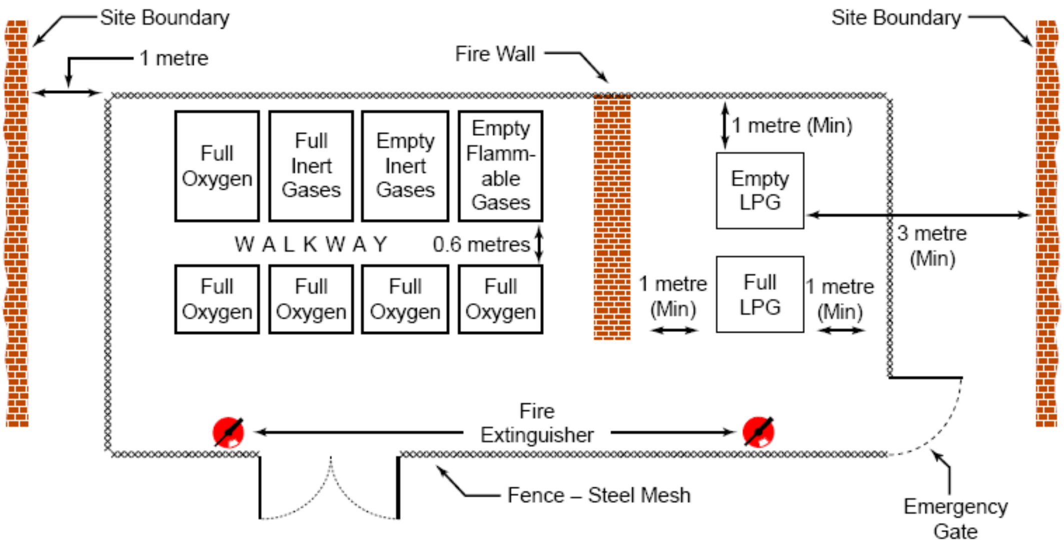
1. The minimum distance from a firewall separating LPG cylinders and industrial gases shall be 1 m.

2. A minimum of two fire extinguishers shall be provided at all gas cylinder storage areas (see paragraph 2.9.3.35).

3. The appropriate warning signs and safety notices shall be displayed (see paragraph 2.9.3.22).

4. If the total quantity of LPG is between 50 kg and 1,000 kg then the LPG cylinders are to be segregated or a fire wall is to be provided.

Figure 2.9.B3: Example of a plan for Gas Cylinders Storage Compound Containing Different Gases



Notes:

1. For quantities of 50 to 1,000 kg the minimum distance from a firewall separating LPG cylinders and industrial gas cylinders shall be 1 m; without a fire wall it is 3 m.

2. The height of thermal radiation barriers should not normally be less than 2 m (see paragraph 2.9.3.47).

3. The appropriate warning signs and safety notices shall be displayed (see paragraph 2.9.3.22).

4. Where medical gas cylinders are held, they shall be segregated from non-medical gas cylinders (see paragraph 2.9.5.03).

5. A minimum of two fire extinguishers shall be provided at all gas cylinder storage locations (see paragraph 2.9.3.35).

ANNEX C

(Introduced at paragraph 2.9.10.02)

LPG STORAGE OF 400 kg OR LESS

Figure 2.9.C1: Storage of 400 kg or less against a building

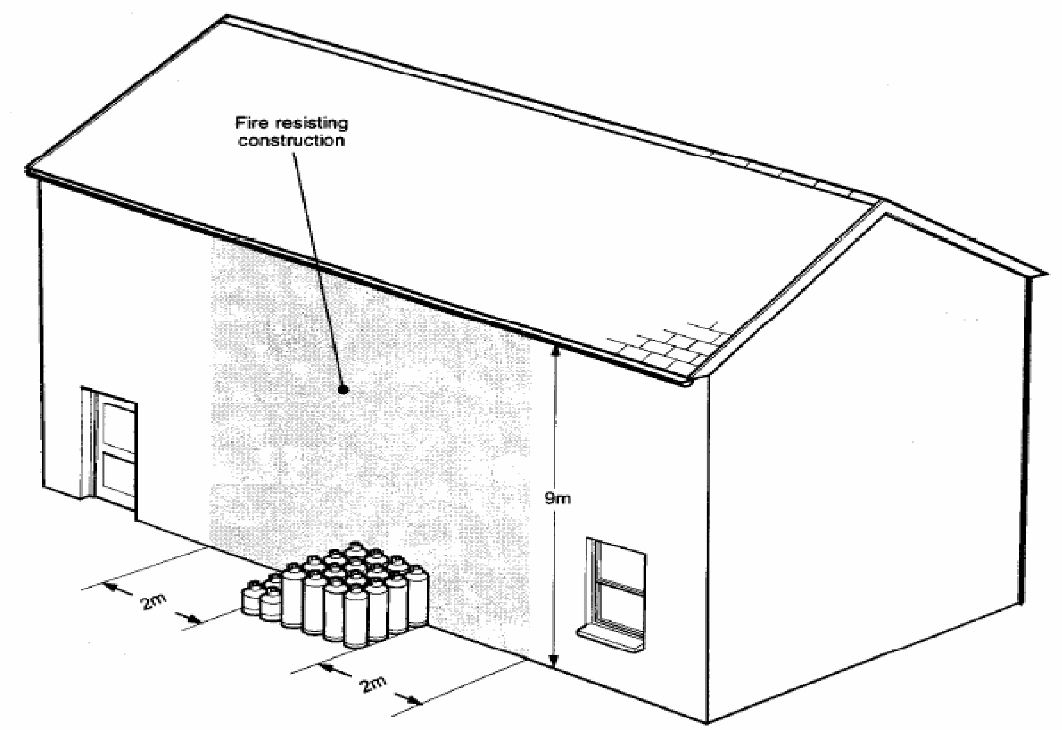


Figure 2.9.C2: Storage of 400 kg or less of LPG in a corner

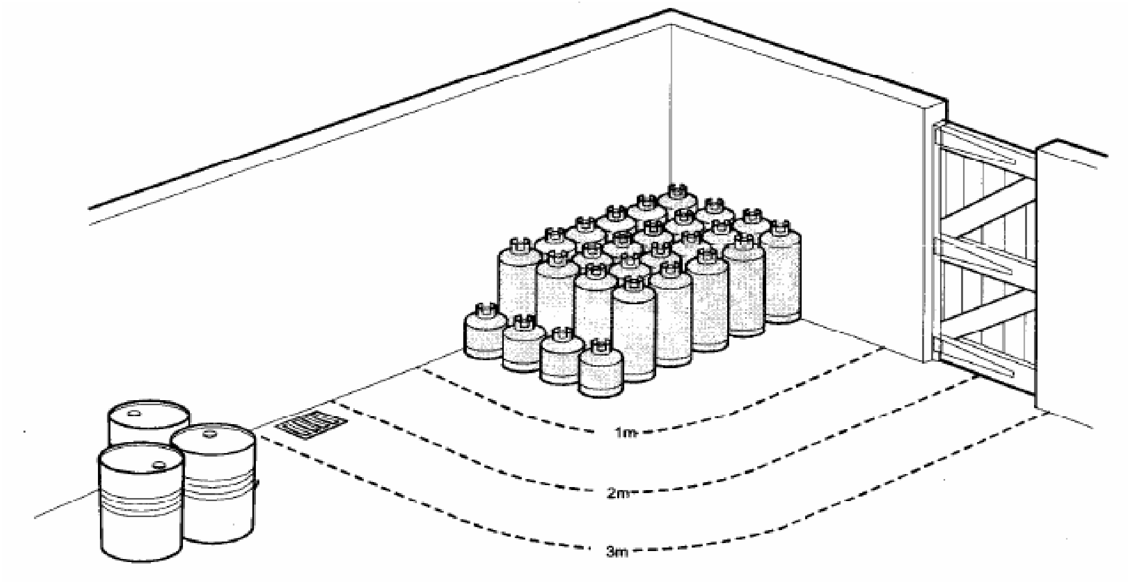


Figure 2.9.C3: Storage of 400 kg or less of LPG against a boundary wall

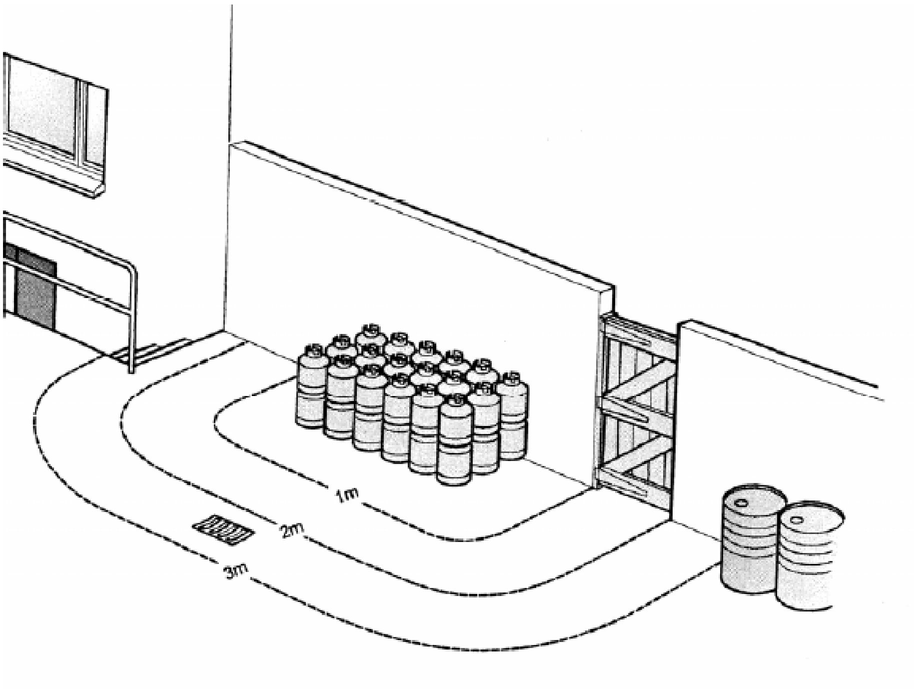


Figure 2.9.C4: Storage of 400 kg or less of LPG between 2 wing walls

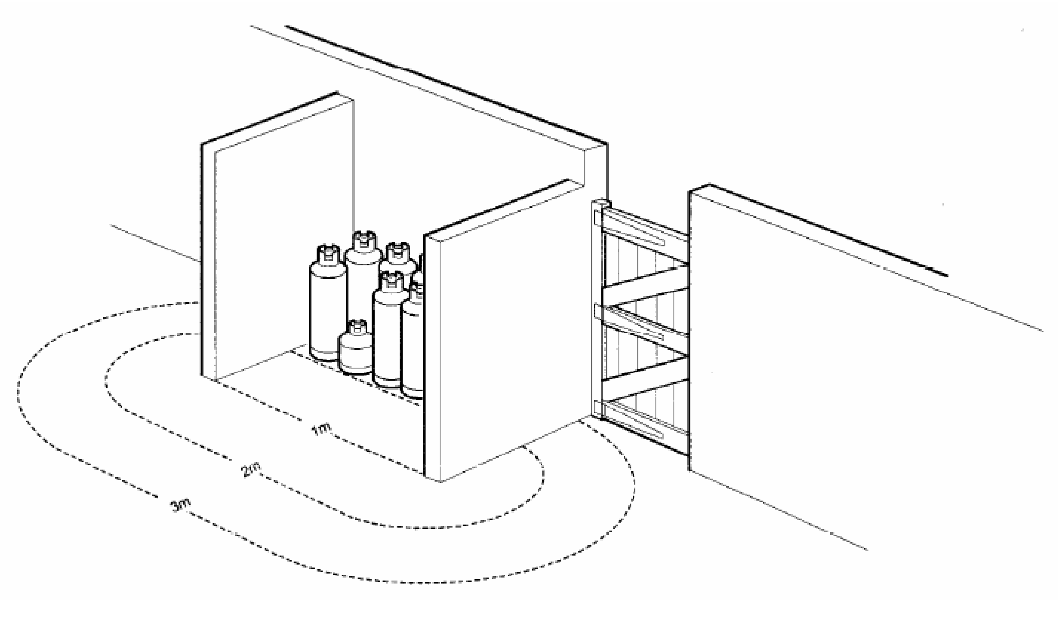


Figure 2.9.C5: Typical outdoor LPG cylinder store (within a site to which access to LPG is not otherwise controlled.

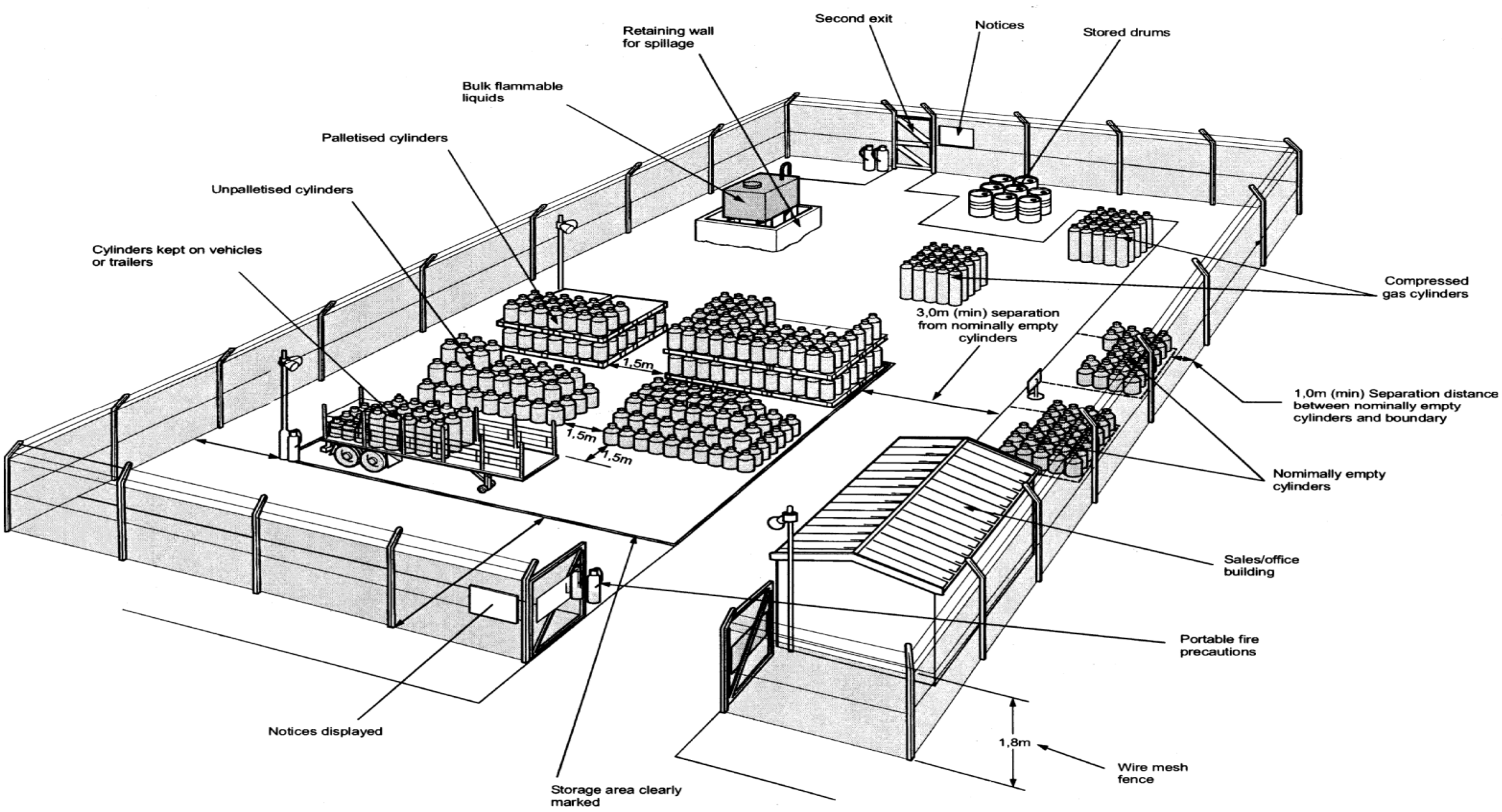
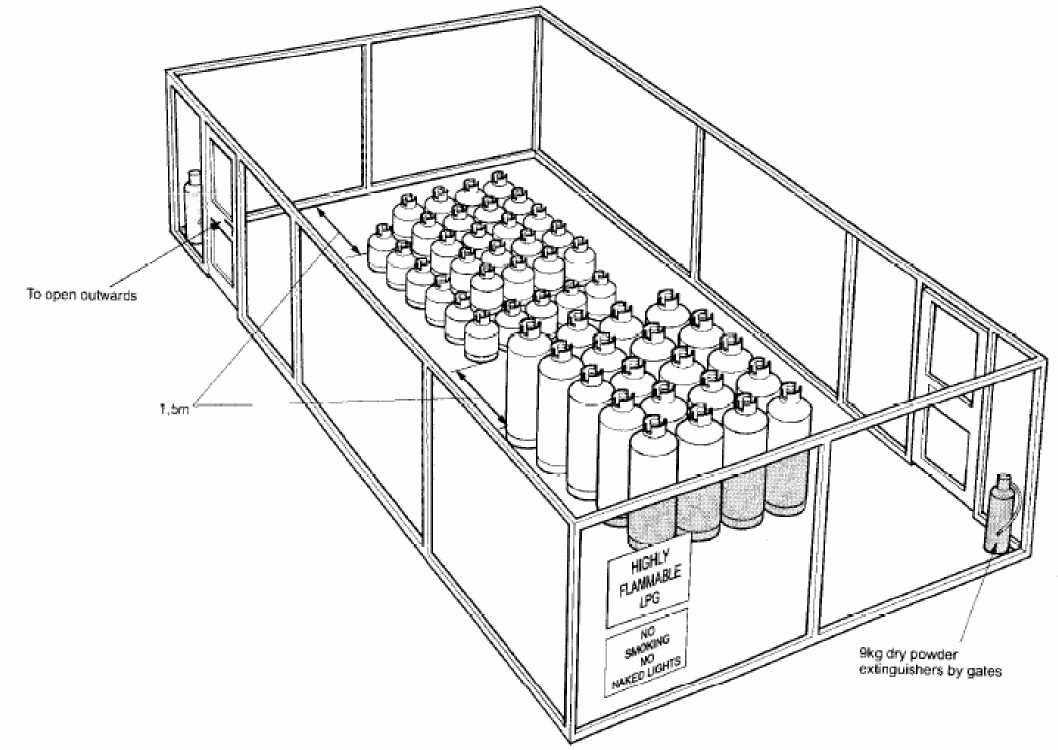


Figure 2.9.C6: Typical compound for storage of LPG cylinders



Note: For minimum distances from any gas cylinder to buildings, boundaries and sources of ignition see Annex A.

Figure 2.9.C7: Indoor LPG Cylinder Storage within a specially designed storage room within a building.

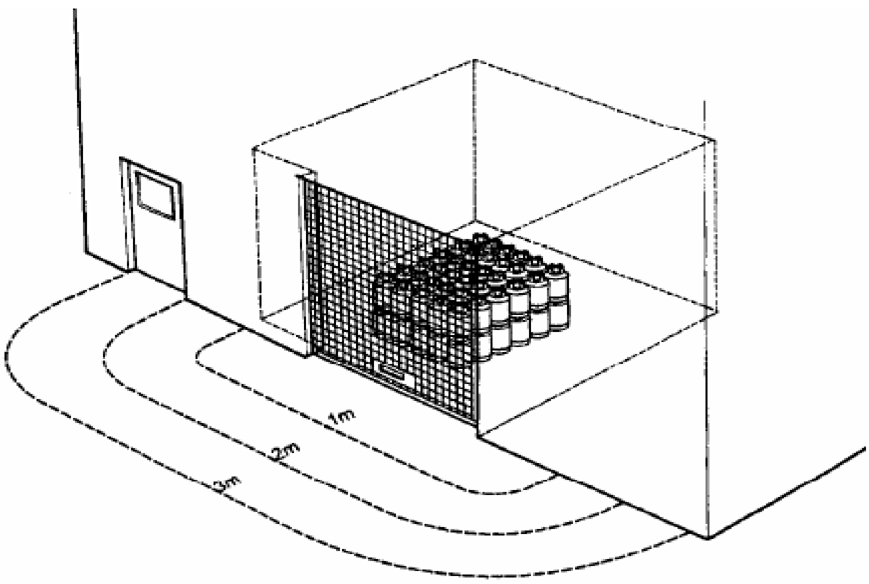
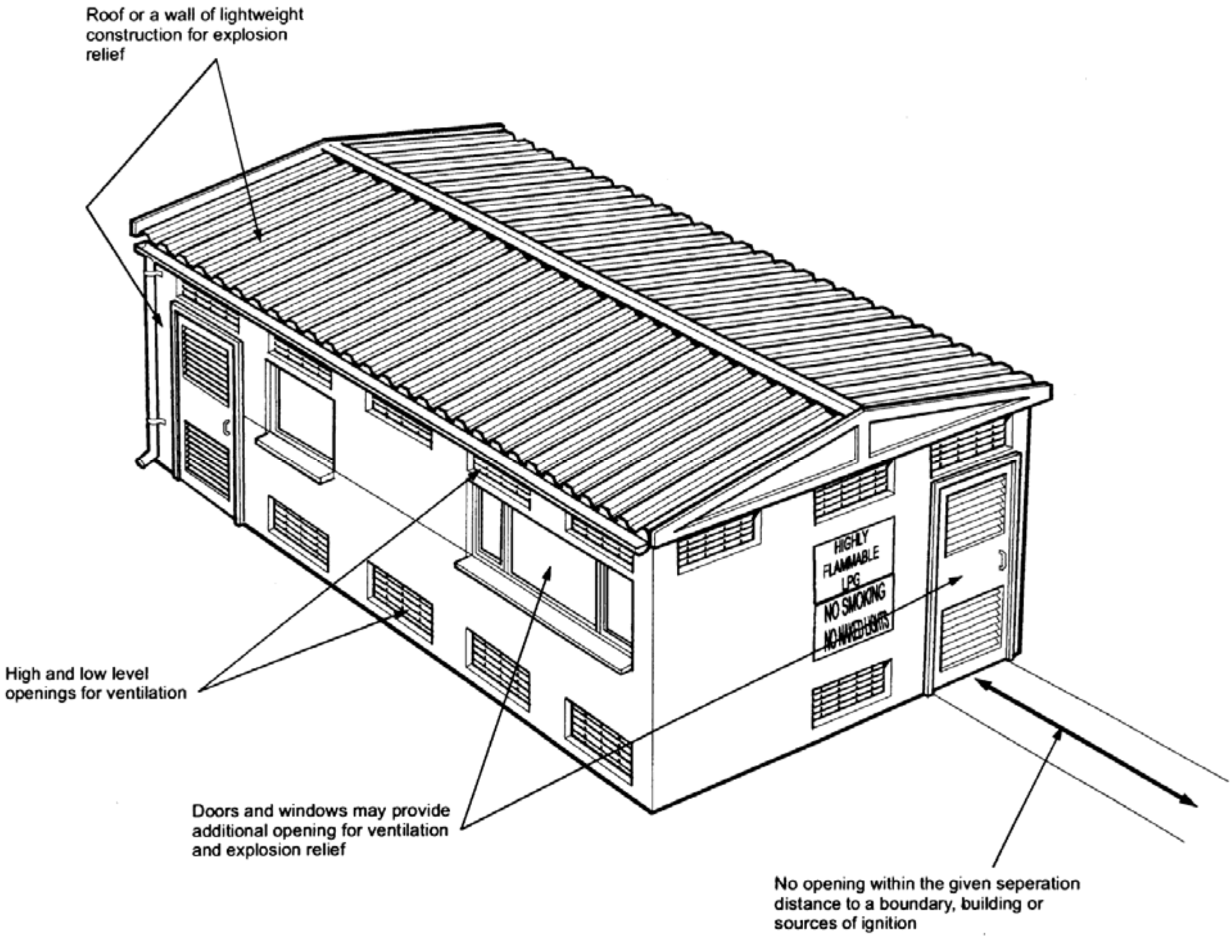


Figure 2.9.C8: Indoor LPG Cylinder Storage within a specially constructed building



Part 2

Chapter 10 (Sponsor – FSAT, SAFETY3)

CRYOGENIC LIQUIDS

SECTION 1 – SCOPE

2.10.1.01 This chapter is concerned with cryogenic liquids. It discusses the properties of and the hazards associated with the storage and use of cryogenic liquids; the properties of cryogenic storage vessels, both pressurised and non-pressurised; and, it outlines the general requirements of a cryogenic liquids and gases workshop.

2.10.1.02 In line with the general trend to move away from MOD-owned equipment towards Contractor-owned equipment, this chapter also considers the demarcation of responsibilities between MOD and the Contractor in respect of contractor-owned cryogenic storage vessels.

SECTION 2 – PROPERTIES AND HAZARDS OF CRYOGENIC LIQUIDS, GENERAL

2.10.2.01 Bulk gases are purchased in units of cubic metres, or in 'HCM's, referenced to standard conditions. In the UK these standard conditions are 15 °C and 1013.25 millibar pressure. A HCM is one hundred cubic metres (100 m^3) of gas: equivalent to 100,000 litres of gas. The corresponding volume, in litres, of one HCM of a particular cryogenic liquid is therefore 100,000 divided by the volume of gas to volume of liquid ratio (see Table 2.10.1). For example: 1.0 HCM of gaseous oxygen Ξ 118.76 litres of LOx; and 1.0 HCM of gaseous nitrogen Ξ 146.62 litres of LiN.

2.10.2.02 **General Safety Precautions**. Before carrying out any work with cryogenic gases, Users must be aware of:

a. The Hazards and the Safety Requirements associated with the storage, transfer and use of cryogenic gases.

b. The selection and use of necessary Personal Protective Equipment, (PPE), (see Part 2, Chapter 2);

Notes:

1. The general properties of and the class-hazards associated with the storage, transfer and use of cryogenic gases are discussed in paragraph 2.10.2.03 and paragraphs 2.10.2.05 – 2.10.2.17; and, the specific properties of and the hazards associated with individual cryogenic gases, such as liquid argon, liquid oxygen, liquid nitrogen and liquid and solid carbon dioxide, are discussed at Sections 3 (liquid oxygen), 4 (liquid nitrogen), 5 (liquid argon) and 6 (carbon dioxide). Those paragraphs together provide a summary of the hazards associated with the storage and use of those cryogenic gases employed within the MOD.

2. General information on aircraft oxygen equipment is given in AP107D-0001-1.

General Properties of Cryogenic liquids

2.10.2.03 **Critical Temperature**. All gases can be liquefied if cooled to a sufficiently low temperature. Liquid argon, liquid nitrogen and liquid oxygen are obtained by separating the constituents of atmospheric air liquefied in this way. Above a certain temperature, the Critical Temperature, a gas cannot be condensed or exist as a liquid regardless of the pressure applied (see Table 2.10.1).

2.10.2.04 **Evaporation rate**. Heat is required to evaporate liquefied gases; the rate of evaporation being governed by the rate of heat transfer. Thus a liquefied gas in an uninsulated vessel will boil briskly as heat is absorbed from the atmosphere and all the liquid may be evaporated within an hour; whereas, when the liquid is contained in a vacuum-insulated container (VIE: = evaporator; VIT: = tank; VIV: = vessel) it will simmer gently and, according to the capacity of the container, may take many days or weeks to evaporate completely. When spilled on the ground the rate of heat absorption is so great that the liquid evaporates in a few minutes.

General Class Hazards of Cryogenic liquids

2.10.2.05 **Principal Hazards**. The nature of cryogenic liquids gives rise to two principal hazards: low-temperature effects; and, excessive pressure generation in storage vessels and pipelines. Procedures for managing these risks are given in the remainder of this chapter.

2.10.2.06 Low air temperatures caused by the proximity of liquefied gases and discharges of these gases to atmosphere may cause hypothermia, and people at risk shall be suitably clothed to provide protection against this (see Table 2.10.1 and paragraphs 2.10.7.44 to 2.10.7.48).

2.10.2.07 In addition, the properties of the particular cryogenic liquid must also be considered in respect of the effect of its gaseous product upon respiration, in confined surroundings, as a result of leakage or spillage (see Table 2.10.1 and for the properties of particular cryogenic liquids), Sections 3 (liquid oxygen), 4 (liquid nitrogen), 5 (liquid argon) and 6 (carbon dioxide).

2.10.2.08 **Respiration Hazards**. Respiration of the gaseous products may give rise to asphyxia in the case of oxygen-deficient atmospheres (see Table 2.10.1). Carbon dioxide, as well as having the potential to produce oxygen-deficient atmospheres, is toxic once its concentration exceeds a few per cent by volume (see Table 2.10.2).

2.10.2.09 The body cannot detect oxygen-deficient atmospheres by smell, or other means; and a person entering such an area will be seen by onlookers to simply collapse; hence the former use of canaries in mines.

Table 2.10.1: Properties of cryogenic liquids (and associated gas)

Property	**Oxygen (O_2)**	**Nitrogen (N_2)**	**Argon (Ar)**	**Carbon Dioxide (CO_2)**
Molecular Weight.	32	28	40	44
(Colour of Gas)	None	None	None	None
Colour of Cryogenic liquid.	Light Blue	None	None	None
Paramagnetic	Yes	No	No	No
Normal Boiling Point at atmospheric pressure. (ºC)	–183	–196	–186	–78.5 (Sublimes)
Critical Temperature. (ºC)	–118.4	–147	–122	+ 30.1
Ratio: Volume of Gas to Volume of Liquid, measured at + 15 ºC and 101.3 kPa (absolute).	842	682	822	845 (solid)
(Relative Density of Gas, at 101.3 kPa.) (Air = 1).	1.105 @ 25 ºC	0.967 @ 25 ºC	1.380 @ 25 ºC	1.48 @ 25 ºC
Liquid Density, at 101.3 kPa (absolute). (kg/m^3)	1141	807	1394	1030
Latent Heat of Evaporation. (kJ/kg)	213	199	161	573 (Sublimes)
Respiration difficulties due to vapour inhalation	Yes	Yes	Yes	Yes
Asphyxiant	No	Yes	Yes	Yes
Toxic	No	No	No	Yes
Supports Life	Yes	No	No	No

Table 2.10.2: Effects of Carbon dioxide inhalation

Carbon dioxide Concentration (Volume %)	Effects and Symptoms
1	Slight and unnoticeable increase in breathing rate.
2	Breathing becomes deeper, rate increases to 50% above normal. Prolonged exposure (several hours) may cause headache and feeling of exhaustion.
3	Breathing becomes laboured, rate increases to twice the normal. Hearing ability reduced, headache experienced with increase in blood pressure and pulse rate.
4 - 5	Breathing laboured at four times the normal. Symptoms as above, with signs of intoxication after ½ hour exposure and slight choking feeling.
5 - 10	Characteristic pungent odour noticeable. Breathing very laboured, leading to physical exhaustion. Headache, visual disturbance, ringing in ears, confusion probably leading to loss of consciousness within minutes. **Immediately Dangerous to Life.**
Above 10	Loss of consciousness more rapid, with risk of death from respiratory failure. Hazard to life increased with concentration, even if no oxygen depletion. **Immediately Dangerous to Life.**
Note: It should be appreciated that the reactions of some individuals may be very different from those shown in this table.	

2.10.2.10 Respiration of an oxygen-enriched atmosphere is potentially less safe than breathing clean air; and breathing pure oxygen at atmospheric pressure for several hours may produce hallucinatory effects and intoxication of the central nervous system. The most significant hazard, however, for oxygen-enriched atmospheres is the considerable increase in fire risk. Sparks or smoking, which might be regarded as normally harmless, can cause fires that can burn vigorously or explosively in oxygen-enriched atmospheres.

2.10.2.11 Transient exposure to a very cold gas may produce discomfort in breathing and may provoke an asthma attack in susceptible people.

2.10.2.12 Prolonged exposure to cold gas can produce serious effects on the lungs.

2.10.2.13 **Heat Transfer Processes**. Cryogenic liquids, by reason of their extremely low temperatures (see Table 2.10.1), continuously attract heat from their surroundings, there being no perfect heat insulating medium available. This inflow of heat cannot be entirely prevented and in consequence cryogenic liquids must evaporate continuously at a greater or lesser rate according to the heat transfer permitted.

2.10.2.14 If there is no outlet or safety release provided for the gas, the pressure will rise as evaporation proceeds and a closed container, unless constructed to withstand the ultimate pressure, will eventually rupture. The effect of rupture even at comparatively low pressures could be serious.

Note: It is possible by employing special refrigeration equipment to re-condense the gas evaporated from cryogenic liquid containers, and so to maintain supplies without loss. This does not mean that evaporation, as a result of heat flow, can be prevented.

2.10.2.15 **Affect on Materials, including Skin**. Cryogenic liquids rapidly extract heat from their immediate surroundings until the temperature is reduced to that of the liquid (see Table 2.10.1). At these temperatures ductile metals, rubbers and plastics become brittle and may fail under loading or impact.

2.10.2.16 If allowed to remain in contact with the skin longer than momentarily, cryogenic liquids cause severe burning or “frostbite”. This can arise through contact with uninsulated surfaces of equipment, which in use become chilled to near cryogenic gas temperatures (see Table 2.10.1). The presence of frost may give an indication of chilling, but in a relatively dry atmosphere this takes time, and a dangerous condition may exist unnoticed.

2.10.2.17 If a chilled object is accidentally grasped with bare hands the skin will adhere (“freeze”) to the surface and may be torn on removal, so aggravating the injury received.

Note: Droplets of cryogenic liquids projected against the skin causes only slight temporary discomfort comparable to that experienced from similar droplets of boiling water or sparks from a fire. More prolonged contact causes painful blistering, of the nature of a heat burn, requiring medical attention.

SECTION 3 – PROPERTIES AND HAZARDS OF LIQUID OXYGEN

2.10.3.01 **Properties**. Liquid oxygen is clear, pale blue in colour, slightly heavier than water, and has no smell. At atmospheric pressure it boils at –183 ºC, the gaseous oxygen given off occupying about 840 times the volume of the liquid (at +15 ºC). The gas is slightly heavier than air at the same temperature. In the pure state liquid oxygen is stable. The liquid cannot be detonated by disturbance or shock.

2.10.3.02 **Toxicity**. Oxygen is non-toxic at atmospheric pressure, but sustained breathing of pure, neat, oxygen at atmospheric temperature for several hours may produce hallucinatory effects and intoxication of the central nervous system.

2.10.3.03 The toxicological effects of breathing pure, neat, oxygen under pressure must be considered, particularly in respect of diving and hyperbaric applications.

2.10.3.04 **Fire Hazards**. In addition to the general class hazards discussed at paragraph 2.10.2.05 the principal hazard associated with both liquid and gaseous oxygen is fire. A dangerous concentration of gaseous oxygen in the atmosphere can exist undetected.

2.10.3.05 Being heavier than air, especially when cold, as when evaporated from a liquid, the gas has a tendency to linger near floor level and may remain in a pit or a confined space for a considerable time. Combustible material, such as clothing, could be ignited in such an atmosphere. It is conceivable that a strand of material could be ignited by a static electrical discharge for which it formed a path, and thus precipitate combustion of the mass.

2.10.3.06 Ignition may occur through the inclusion of traces of oil or grease in oxygen systems. While not liable to ignite spontaneously at atmospheric pressure, these substances, if present in the vicinity, could contaminate equipment, such as valve outlets and liquid hose couplings, and later give rise to ignition when conditions become favourable.

2.10.3.07 Materials, including hair and skin, which burn in air will burn fiercely in oxygen. Some materials, such as metals, which do not burn in air, will burn in oxygen.

2.10.3.08 Although a necessary constituent of combustion, oxygen is not, in the accepted sense, itself combustible. Once started, combustion in oxygen proceeds until all of the material or all of the oxygen is consumed.

2.10.3.09 If readily combustible material in finely divided form, e.g. cotton or wool fabric, charcoal, sawdust, etc, is ignited in oxygen, combustion is extremely rapid. If sufficient oxygen is present, a violent explosion will result.

2.10.3.10 Hydrocarbon based oils and greases are combustible materials which have a high affinity for oxygen. They may ignite spontaneously in gaseous oxygen under high pressure. Even if only a trace of oil or grease is present sufficient heat may be generated under these circumstances to ignite other, less combustible, substances in the surroundings, including the metal of the containing vessel itself.

2.10.3.11 **Explosion**. Oils, greases and some other organic materials are liable to spontaneous combustion or explosion in the presence of gaseous oxygen; liquid oxygen is less hazardous in this respect. Its low temperature implies low intrinsic physical energy for spontaneous effects, but certain organic materials soaked in liquid oxygen are prone to detonation by the energy of impact. This is considered to result from the formation of unstable compounds which release explosive energy on impact. Inorganic materials such as aluminium, carbon and iron in finely divided form, are also known to explode when soaked in certain proportions of liquid oxygen.

2.10.3.12 Liquid oxygen falls within the scope of *DSEAR (Dangerous Substances and Explosive Atmospheres Regulations, SI 2776: 2002)* therefore a risk assessment shall be carried out to ensure that all equipment used with liquid oxygen is in compliance with DSEAR. A drawing is to be produced showing the hazardous areas. JSP 375, Volume 2, Leaflet 56 refers. A copy of the DSEAR Risk Assessment and the drawing showing the hazardous areas is to be kept on-site and made available for any persons requiring access.

2.10.3.13 **Confined Spaces**. Inspection pits, wells, or other Confined Spaces adjacent to an installation holding oxygen shall not be entered without a suitable and sufficient, written, Risk Assessment and/or Permit to Work, to assess whether the work can be done without the need for people to enter the confined space, identify the hazards present, assess the risks and determine what precautions are to be taken (see the *Confined Space Regulations* and *JSP 375, Volume 2, Leaflet 10*).

SECTION 4 – PROPERTIES AND HAZARDS OF LIQUID NITROGEN

2.10.4.01 **Properties**. Liquid nitrogen is clear and colourless, slightly lightly than water, and has no smell or taste. At atmospheric pressure it boils at –196 ºC, the gaseous nitrogen given off occupying about 680 times the volume of the liquid (at +15 ºC). The gas is slightly lighter than air at the same temperature.

2.10.4.02 **Toxicity**. Liquid nitrogen is chemically inert. It is incombustible and for this reason is an effective fire extinguisher. The gas is non-toxic but is incapable of supporting respiration.

2.10.4.03 In addition to the general class hazards discussed in paragraphs 2.10.2.05 – 2.10.2.17, the principal hazard associated with both liquid and gaseous nitrogen is its inability to support respiration and the production of local oxygen-deficient atmospheres, which will produce asphyxia if breathed.

2.10.4.04 Free entrance is only permissible if the oxygen concentration is between 20 and 22%. Atmospheres containing less than 18% oxygen are potentially dangerous; and, atmospheres containing less than 10% oxygen can cause brain damage and death (see Table 2.10.A1 in Annex A).

2.10.4.05 Asphyxia due to oxygen deficiency is often rapid with no prior warning to the victim. The body cannot detect oxygen-deficient atmospheres by smell, or other means; and a person entering such an area will be seen by onlookers to simply collapse.

2.10.4.06 **Oxygen-Enrichment of Air**. The low-temperatures of bulk liquid nitrogen (and liquid helium) are such that adjacent atmospheric air may become liquefied, giving rise to preferential oxygen-enrichment.

2.10.4.07 Thermal insulation around liquid nitrogen (and liquid helium) storage tanks and pipe work may become saturated with oxygen-enriched air and possess an enhanced fire hazard. All such thermal insulation shall be oxygen compatible.

2.10.4.08 For the same reasons, grease and oil contamination shall be prevented; and, where the use of these products is necessary, only approved oxygen-compatible products shall be used.

2.10.4.09 **Confined Spaces**. Inspection pits, wells, or other Confined Spaces adjacent to an installation holding liquid nitrogen shall not be entered without a suitable and sufficient, written, Risk Assessment and/or Permit to Work, to assess whether the work can be done without the need for people to enter the confined space, identify the hazards present, assess the risks and determine what precautions are to be taken (see Annex A, the *Confined Space Regulations* and *JSP 375, Volume 2, Leaflet 10 and Leaflet 18*).

SECTION 5 – PROPERTIES AND HAZARDS OF LIQUID ARGON

2.10.5.01 **Properties**. Liquid argon is clear and colourless, it is heavier than water, and has no smell or taste. At atmospheric pressure it boils at –186 ºC, the gaseous argon given off occupying about 822 times the volume of the liquid (at +15 ºC). The gas is heavier than air at the same temperature.

2.10.5.02 **Toxicity**. Liquid argon is chemically inert. It is incombustible and for this reason is an effective fire extinguisher. The gas is non-toxic but is incapable of supporting respiration. Being heavier than air, especially when cold, as when evaporated from a liquid, the gas has a tendency to linger near floor level and may remain in a pit or a confined space for a considerable time.

2.10.5.03 In addition to the general class hazards discussed in paragraphs 2.10.2.05 – 2.10.2.17, the principal hazard associated with both liquid and gaseous argon is its inability to support respiration and the production of local oxygen-deficient atmospheres, which will produce asphyxia if breathed.

2.10.5.04 Free entrance is only permissible if the oxygen concentration is between 20 and 22%. Atmospheres containing less than 18% oxygen are potentially dangerous; and, atmospheres containing less than 10% oxygen can cause brain damage and death (see Annex A, Table 2.10.A1).

2.10.5.05 Asphyxia due to oxygen deficiency is often rapid with no prior warning to the victim. The body cannot detect oxygen-deficient atmospheres by smell, or other means; and a person entering such an area will be seen by onlookers to simply collapse.

2.10.5.06 **Confined Spaces**. Inspection pits, wells, or other Confined Spaces adjacent to an installation holding liquid argon shall not be entered without a suitable and sufficient, written, Risk Assessment and/or Permit to Work, to assess whether the work can be done without the need for people to enter the confined space, identify the hazards present, assess the risks and determine what precautions are to be taken (see Annex A, the *Confined Space Regulations* and *JSP 375, Volume 2, Leaflet 10 and Leaflet 18*).

SECTION 6 – PROPERTIES AND HAZARDS OF CARBON DIOXIDE

2.10.6.01 **Properties**. At normal ambient temperature and pressure, carbon dioxide is a colourless gas which is toxic with a slightly pungent odour at high concentrations (see Table 2.10.2). It does not support life or combustion and is heavier than air. It is an effective fire extinguisher. Carbon dioxide will dissolve in water to a limited extent to form a weak acid.

2.10.6.02 Carbon dioxide is naturally present in the atmosphere at about 0.03% (300 ppm), by volume; this concentration may be higher due to the effects of respiration in confined spaces, combustion processes and the effects of internal combustion engines, such as vehicles.

2.10.6.03 **"Dry Ice"**. Solid carbon dioxide is available commercially; it is sometimes known as "Dry Ice". It sublimes at pressures below 20 bar, i.e. on warming it changes directly from a solid to a gas.

2.10.6.04 It cannot be overemphasised that the physical properties of "Dry Ice" differ significantly from those of ice, i.e. frozen water. "Dry Ice" has a temperature of –78.5 ºC, which is low enough to inflict cold "burns"; it has a volume of gas to volume of solid ratio of 845 (at +15 ºC), which may led to rupture of closed containers; at atmospheric pressure it sublimes to produce gaseous carbon dioxide, which is an asphyxiant and is toxic at concentrations above a few percent by volume (see Table 2.10.1); whereas, ice has a normal temperature of 0 ºC and a volume of solid to volume of liquid ratio of nearly 1.0.

WARNING: **"Dry Ice" shall not be used as a direct substitute for ice.**

2.10.6.05 **Liquid Carbon Dioxide**. Carbon dioxide is usually transported and stored in bulk as a liquefied gas, at a temperature of about –17 ºC and a pressure of 20 bar. It cannot exist as a liquid at atmospheric pressure.

2.10.6.06 When liquid carbon dioxide under pressure is released to the atmosphere, a dense white cloud is formed containing the cold gas, solid carbon dioxide particles and condensed moisture from the air. The solid carbon dioxide particles, at –78.5 ºC, may settle on adjacent surfaces before subliming to produce more cold gas.

2.10.6.07 Liquid carbon dioxide will change to a solid when the pressure falls below 5.18 bar, and may give rise to a risk of a system blockage.

2.10.6.08 Being heavier than air, especially when cold, as when evaporated from a liquid, the gas has a tendency to linger near floor level and may remain in a pit or a confined space for a considerable time.

2.10.6.09 **Toxicity**. In addition to the general class hazards discussed in paragraphs 2.10.2.05 – 2.10.2.17, the principal hazard associated with carbon dioxide is its toxicity; and, its ability to produce local oxygen-deficient atmospheres, which will produce asphyxia if breathed. Table 2.10.2 provides a summary of the effects of inhaling varying concentrations of carbon dioxide; but it should be appreciated that the reactions of some individuals may be very different from those shown in Table 2.10.2.

2.10.6.10 The Health and Safety Executive (HSE) have set Workplace Exposure Limits for carbon dioxide of: 5000 parts per million by volume (ppm), (0.5%), Long-term Exposure Limit (eight-hour reference period); and 15000 ppm, (1.5%), Short-term Exposure Limit (15-minute reference period). (See *EH40* for further details).

2.10.6.11 Free entrance is only permissible if the oxygen concentration is between 20 and 22% and the carbon dioxide concentration is below its Workplace Exposure Limits. Atmospheres containing less than 18% oxygen or more than 5% carbon dioxide are potentially dangerous; and atmospheres containing less than 10% oxygen, or more than 5% carbon dioxide, can cause brain damage and death (see Table 2.10.A1).

2.10.6.12 Asphyxia due to oxygen deficiency is often rapid with no prior warning to the victim. The body cannot detect oxygen-deficient atmospheres by smell, or other means, although high concentrations of carbon dioxide may be detected by its odour; and a person entering such an area will be seen by onlookers to simply collapse.

2.10.6.13 **Confined Spaces**. Inspection pits, wells, or other confined spaces adjacent to an installation holding carbon dioxide shall not be entered without a suitable and sufficient, written, Risk Assessment and/or Permit to Work, to assess whether the work can be done without the need for people to enter the confined space, identify the hazards present, assess the risks and determine what precautions are to be taken (see Annex A, the *Confined Space Regulations* and *JSP 375, Volume 2, Leaflet 10 and leaflet 18*).

SECTION 7 – CRYOGENIC LIQUIDS, SAFETY PRECAUTIONS

2.10.7.01 **Ventilation**. The provision of ample uncontaminated through-ventilation is essential to prevent the formation of undue concentrations of gases in the atmosphere of buildings housing cryogenic liquids. Temporary high concentrations may result from accidental spillage of the liquid, but these occurrences will themselves draw attention to the accompanying hazard. The creation of a dangerous atmosphere out of doors is unlikely except in the case of accidental discharge of the liquid in quantity.

2.10.7.02 **Confined Spaces**. Inspection pits, cable ducts, wells, or other Confined Spaces adjacent to an installation holding cryogenic liquids shall not be entered without a suitable and sufficient, written, Risk Assessment and/or Permit to Work, to assess whether the work can be done without the need for people to enter the confined space, identify the hazards present, assess the risks and determine what precautions are to be taken (see Annex A, the *Confined Space Regulations* and *JSP 375, Volume 2, Leaflet 10*).

2.10.7.03 No person shall be permitted to enter any cryogenic liquid receiver, gasholder, or storage tank for the purpose of inspection or repair without a suitable and sufficient, written, Risk Assessment and/or Permit to Work (see the *Confined Space Regulations* and *JSP 375, Volume 2, Leaflet 10*). These documents shall record safe working procedures covering:

a. An assessment of whether the work can be done without the need for people to enter the confined space.

b. Preventing further entry of gas or liquid.
Note: In addition to closing off the inlet valve(s), this may necessitate the removal of a section of pipe, or the insertion of a solid plate or spade into a pipe joint to physically isolate the inlet(s).

c. Purging of the interior with clean breathable air and verification by tests that the internal atmosphere is safe to breathe.

d. Suitable PPE is to be provided and worn (see Part 2, Chapter 2).

e. Personal continuous oxygen level alarms are worn.

f. Suitable rescue equipment is to be put in place and used in conjunction with a "Safety Man" who remains outside of the confined space. and

g. In the case of work inside metallic enclosures, extra-low voltage (25 volt or less) lighting and power shall be used (possibly in conjunction with earth-leakage or residual-current circuit breakers) to reduce the risk of electric shock.

2.10.7.04 The discharge of cryogenic liquids shall always be directed out of doors to a safe point, such as a dedicated boil-off pit, and shall be prevented from entering drains, sewers, cable ducts, buried earthing plates/electrodes and bunded areas.

2.10.7.05 **Cryogenic liquids boil-off pit**. The boil-off pit is a dedicated area provided to facilitate the safe evaporation of a spillage of cryogenic liquid. It is not intended to contain the contents of a bulk storage tank that has failed catastrophically; and it is not constrained to hold 110% of the cryogenic tank capacity. It should, however, be of sufficient surface area to accommodate any foreseeable spills.

2.10.7.06 The boil-off pit shall be constructed from oxygen-compatible non-porous materials that will not shatter due to brittle-fracture, such as concrete or coarse gravels, to provide a shallow high-surface-area "pit" to allow heat exchange and evaporation of the cryogenic liquid. Bitumen, tar, asphalt, or other incompatible materials shall not be used (see paragraphs 2.10.7.11 – 2.10.7.15).

2.10.7.07 The boil-off pit shall be sited where it will not cause a hazard to people in adjacent buildings; and be located away from windows and doors, especially emergency exits.

2.10.7.08 The boil-off pit is to be subjected to regular inspection / maintenance to ensure it is free from contaminants. It shall be kept clear of carbonaceous materials, such as fallen leaves, oils, fuels, or greases, etc. There is the potential for a build up of water within the boil-off pit. An appropriate means of draining water from the boil-off pit is to be installed.

2.10.7.09 The boil-off pit shall be totally independent of all soakaways intended for intercepting fuel spillages and surface run-off from aircraft aprons and runways.

2.10.7.10 This boil-off pit is potentially hazardous when in use (see Section 2), and may fall within the scope of a Confined Space (see Annex A and *JSP 375, Volume 2, Leaflet 10*). Dependant upon foreseeable spillages, access may need to be restricted by means of barriers, such as chain link fencing and/or the provision of suitable safety signs and warning notices.

Note: As this, the boil-off pit could be used for both liquid oxygen and other liquefied gases, such as nitrogen, argon, or carbon dioxide, the main hazard may vary, depending on which cryogenic liquid was previously discharged, the quantity discharged and the time when it was discharged. The hazard may vary from no hazard, to a vigorous fire hazard, to an asphyxiation hazard, and both an asphyxiation and a toxic gas hazard.

Materials

2.10.7.11 **Material Compatibility**. In the case of oxygen producing plants, liquid oxygen and liquid nitrogen storage tanks, or cryogenics workshops, no combustible material in significant quantity shall be permitted in the construction of buildings or for permanent fittings or furniture.

2.10.7.12 Wooden flooring, roofing or partitioning shall not be used. Wood absorbs oxygen and over time the concentration of oxygen held within wood can increase beyond safe limits. Wooden fittings, e.g. workbenches and cupboards, are not to be used. To assist with fire retardency the use of plasterboard walls in the construction of buildings is not recommended. Walls are to be of solid construction. Internal rough brick/block walls are to be coated with a gypsum or lime-based plaster finished to a smooth surface. Repairs to damaged plasterwork with proprietary cellulose fillers is not recommended.

2.10.7.13 Any hydrocarbon oil is hazardous in the presence of oxygen, as it is likely to burn spontaneously and with excessive violence. Asphalt, or similar tar-based materials (e.g. bitumen), shall not be used for flooring as these materials, once exposed to liquid oxygen spillages, may detonate on impact.

2.10.7.14 Only inert, inorganic, non-porous materials approved for the purpose shall be used for thermal insulation, even temporarily, of liquid oxygen and liquid nitrogen equipment.

2.10.7.15 All materials in direct contact with cryogenic liquids are to be approved for use with that cryogenic liquid and shall be ‘oxygen compatible’.

2.10.7.16 **Jointing Materials**. Joints in cryogenic liquid systems should preferably be made metal to metal.

2.10.7.17 The use of plastic or fibre, but not asbestos, sheet jointing material is permissible for liquids other than oxygen and nitrogen.

2.10.7.18 Only oxygen compatible polytetrafluoroethylene (PTFE) tape, to BS 7786, may be used for cryogenic liquid systems. The use of PTFE tape is to be kept to the minimum necessary. Approved PTFE tape is detailed in Table 2.10.3.

Table 2.10.3

Description	Support Authority	NSN
Tape, anti-seizing	AC PT	71A/8030-99-5624616

2.10.7.19 Sealing compounds are unnecessary and shall not be used.

2.10.7.20 **Pressure Gauges**. All pressure gauges used with liquid or gaseous oxygen equipment shall have dials inscribed ‘OXYGEN’ and ‘Tested without Oil’ or ‘Oil Free’. No other gauges shall be used.

2.10.7.21 Equipment associated with the transfer of gaseous or liquid oxygen shall be kept scrupulously clean and completely free from oil or grease.

2.10.7.22 Parts accidentally contaminated shall not be used until cleaned by an approved process and certified safe by a competent person.

2.10.7.23 Pressure gauges cannot be effectively cleaned and if contaminated they shall be removed and replaced with serviceable items.

2.10.7.24 **Hoses and Hose Couplings**. A hammer shall not be used on hose couplings or fittings when cold. The correct ‘C’ spanner is to be used. If further force is required a mallet may be used to strike the ‘C’ spanner. This method avoids fracture of the metal due to temporary embrittlement.

2.10.7.25 Joints shall not be tightened unduly when the parts are cold in an endeavour to rectify leakage of liquid.

2.10.7.26 Oil, grease or lubricants shall not be used with any equipment which comes into contact with liquid oxygen or liquid nitrogen. Storage and transfer equipment used for liquid oxygen is identical to that used for liquid nitrogen, apart from the end couplings, and a hazard would be created by the use of these substances.

2.10.7.27 On completion of use, all independent hoses are to be emptied of cryogenic fluid, vented and blanked. They are to be hung up and stored in a dry environment. All reasonable action is to be taken to prevent contamination.

2.10.7.28 Before use, carry out an inspection of the hose/couplings for their serviceability, in particular, ensure the hose/couplings are free from contamination.

2.10.7.29 **Storage and Transport**. Cryogenic liquid tanks, with the exception of carbon dioxide, are normally maintained freely vented to the atmosphere (or to a gasholder if provided) except when liquid is being discharged.

2.10.7.30 Liquefied gases cannot be conserved by preventing escape of the evaporated gas since evaporation is controlled by the rate of heat absorption.

2.10.7.31 When cryogenic liquid tanks are being transported in enclosed vehicles or aircraft, means shall be provided for the safe venting of the evaporated gas, either by adequate ventilation or by directing the vent discharge to the outside of the vehicle or aircraft. When being transported, cryogenic liquids are classified as Dangerous Goods and the containers and the cryogenic liquid are only to be transported in accordance with the *Dangerous Goods Regulations* (see Part 2, Chapter 8).

2.10.7.32 Cryogenic tanks or vessels shall not be transported in lifts unless a suitable and sufficient, written, Risk Assessment has been carried out and precautions are put in place to reduce, as low as is reasonably practicable, the risks to personnel and to equipment. Where carriage in a lift is unavoidable, the use of a remotely controlled, unmanned, goods-only lift is the primary choice; otherwise the lift shall be operated strictly as a confined space (see Annex A, the *Confined Space Regulations* and *JSP 375, Volume 2, Leaflet 10*). Any spillages of cryogenic liquids may endanger the life of any personnel inside the lift and compromise the structural integrity of the floor.

2.10.7.33 For further information regarding transportation (see Part 2, Chapter 8).

2.10.7.34 **Pressure Release**. Attempts shall never be made to confine cryogenic liquids in a vessel or pipe not provided with automatic pressure release equipment, such as a pressure relief valve or bursting disc.

2.10.7.35 Hoses used to transfer cryogenic liquids between storage and transport tanks shall be vented to atmosphere immediately after the liquid valves of both tanks are closed, to prevent damage by over-pressure. If a manually operated vent valve is not provided, the hose shall be uncoupled; it is not good practice to depend on automatic pressure relief devices which may become temporarily inoperative through icing. The hose shall be drained of liquid before blanks are fitted.

2.10.7.36 Aircraft servicing hoses shall always be vented when the tank liquid valve is closed between transfer operations by parking the filling connector on the special fixture provide on the trolley.

2.10.7.37 Automatic pressure relief devices shall be provided on all fixed pipeline installations used for conveyance of cryogenic liquids where sections can be isolated by operation of control valves.

2.10.7.38 Pressure relief valves shall not on any account be adjusted or tampered with while under pressure in order to rectify leakage. Defective valves shall be removed from equipment for servicing and testing immediately. They are to be replaced with serviceable items.

2.10.7.39 **Fire Precautions**. Smoking, sparks, welding/flame cutting, or naked lights shall not be permitted in the vicinity of oxygen producing or compressing plants, liquid oxygen storage tanks or any activity involving the transfer of gaseous oxygen or liquefied oxygen or nitrogen.

2.10.7.40 Loose materials, combustible or otherwise, shall not be permitted to remain on liquid oxygen / nitrogen producing or storage sites.

2.10.7.41 Ready means of entry and exit shall be provided throughout (see paragraphs 2.10.9.20 to 2.10.9.21).

2.10.7.42 In the event of fire involving oxygen equipment any conventional extinguishing medium may be freely used (see Part 1, Chapter 9).

2.10.7.43 **Leak Detection**. The method of leak detecting shall be in accordance with instructions given in Part 2, Chapter 17, Section 3. Leakages of liquid involving spillage can be readily located by inspection, i.e. the presence of frost and/or ice at the point(s) of leakage.

Hygiene, personal safety precautions and PPE

2.10.7.44 **Protective Clothing**. Part 2, Chapter 2 details appropriate PPE to be used in a cryogenic environment. This protective clothing is intended to provide a number of functions: e.g. shed accidental spillages of cryogenic liquids and thus protect the skin from cold “burns”; provide protection to normal everyday clothing; minimise the risk of hypothermia; and, protect the body from fire. In order to carry out these functions it shall be maintained in a state that is fit for purpose.

2.10.7.45 All protective clothing shall be maintained clean and free from oil or grease; and only be used in an Oxygen Bay environment. Such clothing shall be marked for oxygen bay use only.

2.10.7.46 *Not used.*

2.10.7.47 *Not used.*

2.10.7.48 Items which have the potential to cause a spark are forbidden in close proximity to cryogenic liquids. This includes Personal Electronic Devices, such as cameras, computers, radios and mobile phones, as well as matches, cigarette lighters, smoking materials, etc. These shall not be carried on the person or placed in the pockets of any protective clothing.

2.10.7.49 **Safety Man**. To ensure that prompt first aid can be rendered or assistance given in the event of an accident during cryogenic liquid transfer, a ‘Safety Man’ shall be present at all times and wearing full protective clothing during transfer operations.

2.10.7.50 The safety man is to have had appropriate training in the following areas:

a. Handling of cryogenic liquids.

b. Hazards of cryogenic liquids.

c. First aid (for cryogenic liquids).

d. Local emergency procedures and actions.

e. Operation of the equipment.

f. The use of fire-fighting equipment.

2.10.7.51 The training provided is to include the actions to be taken (when safe to do so) to stop the flow of cryogenic liquid from a cryogenic storage tank or cryogenic delivery tanker. Where fitted this includes the operation of the 'Emergency Stop' button.

2.10.7.52 For details of the protective clothing to be worn (see Part 2, Chapter 2).

2.10.7.53 **Barrier Creams**. The use of skin barrier creams is undesirable; as such creams are often hydrocarbon-based, they may lead to contamination of oxygen equipment and they represent an increased fire hazard to personnel.

2.10.7.54 **Gloves**. Direct skin contact with the oxygen-wetted parts of the system is undesirable, particularly in the case of high-pressure oxygen systems; these systems shall be protected from contamination by the User / Maintainer wearing approved, lint-free, clean gloves.

2.10.7.55 For similar reasons, the use of thin gloves that are internally "dusted" with talc, or other powder, is undesirable in respect of risks to the system.

2.10.7.56 Approved gloves are essential to protect the hands from the cold when handling valves or metal parts through which cryogenic liquids flow.

2.10.7.57 Where skin protection is needed for other tasks, such as equipment cleaning operations, reference should be made to the relevant equipment publication, the Safety Data Sheet (SDS); and Part 2, Chapter 2.

2.10.7.58 **NBC Equipment**. It is recommended that, wherever practicable, NBC equipment is not worn in a cryogenic liquids environment, as there are increased fire hazards when NBC equipment and oxygen are brought into contact; it is also cumbersome and there are other safety considerations involved, such as reduced mobility and reduced visibility.

2.10.7.59 Pure carbon (in the form of charcoal or activated-carbon) is shock sensitive when contaminated with liquid or gaseous oxygen; and, if ignited, burns explosively. Layers of carbon-impregnated cloth may be found within NBC clothing; carbon may also be present in NBC filters.

2.10.7.60 When there is a requirement to wear NBC equipment, oxygen bay protective clothing is to be worn over the top of the NBC equipment. The wearing of NBC equipment in a cryogenic liquid environment is to be specifically addressed when carrying out the documented Risk Assessment (see Part 2, Chapter 2).

2.10.7.61 **Spillages**. Avoid spillage of cryogenic liquids:

a. It may become trapped in pockets, shoes, etc.

b. Do not tread in spilled cryogenic liquids.

c. Do not allow vehicles to drive through spilled cryogenic liquids, as this may lead to embrittlement and bursting of tyres.

2.10.7.62 As spillage of liquid oxygen within a Confined Space will readily lead to an oxygen-enriched atmosphere, clothing will absorb a higher level of oxygen than normal and will burn fiercely if ignited.

2.10.7.63 Personnel who have worked in such an atmosphere are not to smoke, go near heat sources or naked flames until they have ventilated their clothing by walking about in a normal atmosphere for at least 15 minutes.

2.10.7.64 Conversely, spillage of liquid nitrogen, liquid argon or liquid carbon dioxide within a Confined Space may lead to the production of local oxygen-deficient atmospheres, which will produce asphyxia if breathed. Asphyxia due to oxygen deficiency is often rapid with no prior warning to the victim. The body cannot detect oxygen-deficient atmospheres by smell, or other means; and a person entering such an area will be seen by onlookers to simply collapse (see Annex A).

2.10.7.65 **Medical First Aid**. In all cases of injury from a cryogenic liquid qualified medical assistance is to be called immediately. All cases of injury through contact with cryogenic liquids shall be given medical attention without delay.

2.10.7.66 All units who use, store or transport cryogenic liquids are to have Standard Operating Procedures in place for dealing with cases of injury through contact with cryogenic liquid. These are to be endorsed by the senior medical officer on the unit. The unit is to carry out a First Aid Assessment with emphasis on the hazard from cryogenic liquid (see JSP 375, Volume 2, Leaflet 27). Any equipment identified in the First Aid Assessment is to be provided and maintained in a serviceable condition. Signage across the site is to clearly identify First Aid equipment locations, the emergency shower and the nominated First Aiders.

2.10.7.67 The particular cryogenic liquids discussed in this Chapter have no corrosive properties and the injurious effects upon the body are due to their very low temperatures. Specific advice is available in the product Safety Data Sheet.

2.10.7.68 Cryogenic liquids can cause the following problems:

a. Cold burns (frostbite) will result from skin/eye contact with liquid, prolonged contact may also induce hypothermia.

b.Liquid release or vapour pressure jets present a risk of serious damage to the eyes.

2.10.7.69 Cold water is a simple and effective means of rapidly conveying heat to parts of the person affected by contact with cryogenic liquid. All workshop / storage facilities have an emergency shower (see paragraph 2.10.9.72).

2.10.7.70 In the case of splashed eyes, the recommended treatment is to irrigate continuously with cold water.

2.10.7.71 Where possible, clothing contaminated with cryogenic liquids should be removed to lessen the time of contact with the skin. However, no attempt shall be made to remove any clothing that has "frozen" onto the skin.

2.10.7.72 Cover affected area with clean, dry, sterile dressing, bulk protective dressings should not be too tightly applied.

2.10.7.73 Alcoholic beverage and smoking is not to be permitted. In the case of liquid oxygen, any degree of personal contamination with oxygen constitutes a grave fire risk to both the injured person and those giving First Aid; and the No Smoking Rule shall be observed as long as the contamination remains."

SECTION 8 – CRYOGENIC VESSELS

2.10.8.01 **MOD owned bulk cryogenic storage tanks**. Details regarding the storage capacities and the associated reference publications for, MOD-owned, liquid oxygen (LOx) and liquid nitrogen (LiN) bulk storage tanks are given in Table 2.10.4.

Table 2.10.4: MOD owned LOx/LiN storage tanks

Storage Tank	Mk. No.	Publication No.
2400 litre	MK 1	AP 119L-0507-135F
2400 litre	MK 2	AP 119L-0508-1235F
4000 litre	-	AP 119L-0503-16A
9000 litre	-	AP 119L-0505-1
18000 litre	-	AP 119L-0505-1

Note: The Support Authority for this equipment is the AC PT.

2.10.8.02 **Dedication of Storage Tanks to Particular Products**. A particular bulk storage tank shall be dedicated to one particular cryogenic product and shall be clearly labelled to show the contents and the hazards associated with that product (see paragraph 2.10.9.28).

2.10.8.03 It shall not be used for the storage of another cryogenic product, unless the tank has been specifically designed to hold the other product, specific authorisation has been obtained from the relevant Support Authority, and the tank is correctly labelled to identify the contents. In this case a full written Risk Assessment by a Competent Person, to include purging, flushing, cleaning, re-testing and re-labelling shall be carried out before it is put back into service.

2.10.8.04 **Site and Access Requirements**. Bulk storage tanks are usually filled directly from a delivery tanker managed and operated by a MOD contractor (for further details contact DF. See Part 1, Chapter 3, Annex A.); thus, adequate provision shall be made for road access and egress of these delivery tankers (see paragraphs 2.10.9.23 to 2.10.9.27).

2.10.8.05 Detailed guidance is given in *BCGA Codes of Practice 26* and *36* in respect of the site requirements for the bulk storage of cryogenic liquids. These BCGA Codes of Practice cover: site layout, location, electrical installations, safety features, access control, road access, parking, escape, and warning signs and labels. Access and escape shall never be blocked by aircraft movements. MOD installations are required to comply with these Codes of Practice, as a minimum.

2.10.8.06 The siting requirements for fixed bulk cryogenic storage tanks are discussed in more detail in Section 9.

2.10.8.07 **Contractor Owned Cryogenic Bulk Storage Vessels**. DFG is working with its contractor to supply a range of bulk storage vessels; these are available from 25 litre capacity, upwards. Further details may be obtained from DFG Technical Team Manager (see Part 1, Chapter 3, Annex A).

2.10.8.08 Where Contractor Owned Cryogenic Bulk Storage Vessels are located at a Unit the responsibility for maintenance, periodic examination, replenishment and the quality of the product will remain with the contractor. The contractor is required to provide comprehensive identification of the product and its hazards.

2.10.8.09 The contractor is required to provide the unit with:

a. A set of Standard Operating Procedures, detailing the operation of the vessel and a step-by-step procedure for withdrawing the product.

b. Instructions on the actions to be taken in the event of an emergency or an incident.

c. Full contact details of a responsible person(s) within the contractors organisation.

d. Initial training on the operation of the vessel.

e. Certification of the quality of the product.

f. Provision of technical advice, as required.

g. Identification of the exact point at which the contractor's responsibility ends and the MOD / Defence Estates responsibility begins.

Note: For aviation/missile supplied cryogenic fluids the contractor is to sample the product and provide a Certificate of Conformity on a monthly basis (see Part 2, Chapter 6).

2.10.8.10 The unit is responsible for managing the vessel on a day-to-day basis and ensuring compliance with the contractors Standard Operating Procedures.

2.10.8.11 **Sampling and Testing of Product**. The sampling, testing and purging requirements for liquid oxygen, used for breathing, and liquid nitrogen, used for aircraft and missile systems, are given in Part 2, Chapter 6.

2.10.8.12 Users' shall obtain Certificates of Conformity for liquid oxygen used for breathing against *Defence Standard 68-284*; and for liquid nitrogen, used for aircraft and missile systems, against *Defence Standard 58-96*.

2.10.8.13 These Certificates of Conformity shall be kept as evidence of quality control of these products.

2.10.8.14 **Replenishment of Bulk Storage vessels**. Some contractor-owned bulk storage vessels are being supplied with an approved solar-powered mobile phone permanently fitted to the bulk cryogenic storage vessel to monitor the tank's contents, on a daily basis; thereby passing responsibility for replenishment to the contractor. Where the provision of such devices are not acceptable, due to Tempest or phone frequency concerns, the unit will be responsible for ordering replenishment stocks. However, whilst this system should maintain tank levels under normal usage, the unit will remain responsible for placing demands with the supplier to cover ad hoc surge demands.

2.10.8.15 Unless periodic maintenance is due the contents of in-use bulk storage tanks are to be maintained to at least 25% of the tank capacity. This will help to prevent a build up of contamination and reduce the need for purging. If a tank capacity falls below 25% then the actions detailed in Part 2, Chapter 6, are to be followed.

2.10.8.16 All units who replenish bulk storage vessels for cryogenic liquids are to have Standard Operating Procedures in place for the receipt of the cryogenic liquid. This is to include a responsible person who can complete the appropriate paperwork and account for the delivery.

2.10.8.17 Delivery of cryogenic liquid shall only be received from approved MOD Contractor's. Advice on approved contractors is available from DFG, Supply Chain Manager (see Part 1, Chapter 3, Annex A). The contractors driver is to make contact with the unit Fuel & Lubricants (F&L) section prior to any delivery taking place.

2.10.8.18 There are always to be a minimum of two persons present during a replenishment. Normally this is the vehicle driver/operator and a MOD person. The MOD person normally acts in multiple roles e.g. as a safety person, security host, accounting for the product. All persons involved in a replenishment are to be competent to do so, they are to have had suitable training and they are to wear the appropriate Personal Protective Equipment. Appropriate safety/warning signs are to be displayed during the replenishment.

2.10.8.19 As a result of investigations by the European Industrial Gases Association industry has fitted electrically operated safety valves to their LiN storage tanks which, when connected to a road delivery vehicle, prevent a tank being filled from over-pressurising. The safety valve is connected to the replenishing delivery vehicle by means of a "flying lead" and should over-pressurising occur, the safety valve will cut the power to the replenishing tanker motor.

2.10.8.20. Due to the high costs involved, and the age of MOD owned storage tanks, it has been decided not to fit these valves to MoD owned tanks. However, in order to replenish a LiN tank from a contractor's delivery vehicle a "High Pressure Dummy Socket" (HPDS) must be fitted to the delivery vehicle's "flying-lead" in order for the delivery vehicle to deliver liquid. The possibility of the tank over pressurising is negated by the use of a "safety-man" who as part of the receipts process is to monitor the storage tank gauges.

2.10.8.21 Before delivery, check the cryogenic liquid is the correct product and it is to the specification and standard required. Refer to the Certificate of Conformity.

2.10.8.22 Ensure that the tank to be filled is an approved vessel for storing cryogenic liquid, and that the vessel is serviceable.

2.10.8.23 Ensure that the delivery vehicle is correctly positioned. Check that the coupling end of the delivery hose is free from contamination. Ensure that the delivery vehicle, the supply hoses, and the receiving vessel are all earthed. There are to be no activities taking place within 25 m of the replenishment which have the potential to cause sparks or initiate a fire.

2.10.8.24 Open control valves slowly to prevent rapid pressure rises downstream that could lead to adiabatic heating and ignition.

2.10.8.25 All delivery vehicles should be fitted with an Emergency Stop button. All persons involved in a replenishment are to be familiar with the location of this button and the actions to be taken if an emergency situation arises. Establish an agreed code of signals and /or verbal communications with the driver to ensure the delivery process can be halted immediately should any incident jeopardise the safety of personnel or equipment.

2.10.8.26 At the end of the replenishment, check the quantity of product delivered. Receive a Certificate of Conformity for the product. Complete the delivery note and sign the *MOD Form 640* as appropriate.

Small Vessels (Dewars)

2.10.8.27 **Product range**. A standardised range of small, stainless steel, open neck, cryogenic storage vessels (Dewars) are available (see Table 2.10.5 and Figure 2.10.1). These smaller vessels, 1 to 6 litre capacity, are available as consumable items.

2.10.8.28 DFG is working with its contractor to supply a range of other sized of Dewars. Further details may be obtained from DFG HQ, IGAPM or FHE3 (see Part 1, Chapter 3, Annex A).

Table 2.10.5: Stainless steel, open neck, Dewars.

Manufacturers Product Code	Capacity (litres)	Internal Diameter (mm)	External Diameter (mm)	Internal Height (mm)	External. Height (mm)	Weight Empty (kg)	Weight Full (kg)
11858846	0.9	85	107	206	232	0.9	1.0
11880462	1.8	100	122	285	312	1.3	2.8
11858848	2.6	185	200	160	190	1.8	3.9
19308083	5.25	150	217	297	432	4.7	9.0
19308084	5.5	185	200	270	300	2.4	6.8
Note: These Dewars are supplied with lids and handles.							

Figure 2.10.1: Stainless steel, open neck, Dewars

2.10.8.29 **Intended Application**. Open neck Dewars are intended for the short term immersion and storage of engineering materials that are being cooled down with liquid nitrogen; and are User filled from bulk storage tanks.

2.10.8.30 These operations shall be subjected to both a written Risk Assessment and a written COSHH Assessment; and the Users' shall be adequately trained in the handling of liquid nitrogen and the Dewars. Appropriate Personnel Protective Equipment is to be worn (see Part 2, Chapter 2).

WARNING: Liquid oxygen shall not be used in place of liquid nitrogen for cooling down engineering materials.

2.10.8.31 **Putting into Service**. Unless labelled by the manufacturer, before first putting into service, each Dewar shall be labelled in accordance with the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations, 2004*, to indicate its contents and the Hazards associated with that product. Where space does not allow this, as a minimum they shall be labelled in accordance with the *Health & Safety (Safety Signs and Signals) Regulations, 1996*. This may be accomplished by attaching a plastic, self-adhesive, Diamond Hazard label to the outside of the Dewar. See Part 2, Chapter 3.

2.10.8.32 **Storage and Use**. Before each use they shall be examined for serviceability and cleanliness.

2.10.8.33 Empty Dewars at ambient temperature, due to the temperature difference, will induce vigorous boil-off of any cryogenic liquids decanted into them. It is recommended, therefore, that they are should be filled with cryogenic liquid and allowed to reach a balanced temperature, and are refilled as necessary, before they are used to cool down engineering materials.

2.108.34 They shall be cleaned after use to remove any oils, greases, or other contamination. They are to be stored, if practicable in sealed plastic bags, in a clean dry environment away from any flammable materials, oils, greases, or lubricants.

2.10.8.35 Any unserviceable containers shall be destroyed and replaced.

2.10.8.36 **Owner's responsibilities for Cryogenic Storage Vessels**. In line with the general trend to move away from MOD-owned equipment towards Contractor-owned equipment; this clause considers the demarcation of responsibilities between MOD and the Contractor in respect of contractor-owned cryogenic storage vessels.

2.10.8.37 Storage vessels, with the exception of those operating below 0.5 barg, or having a pressure-volume product below 250 bar.litre, are subject to the *Pressure Systems Safety Regulations, 2000*, and/or the *Transportable Pressure Vessels Regulations, 2001*.

2.10.8.38 These regulations place responsibilities on the user of an installed system or on the owner of mobile equipment. An exception is made in respect of equipment that is leased or hired to a user; in this case the supplier of the hired equipment is allowed to take on some of the duties of the user, for the period of the lease (see *BCGA CP 23*).

2.10.8.39 The cryogenic bulk storage tanks listed in Table 2.10.4 are MOD owned; and they are maintained by the MOD in accordance with the relevant publication. Further information can be obtained from the relevant Support Authority.

2.10.8.40 Other bulk storage vessels not listed in Table 2.10.4 may be either rented or owned by a Support Authority.

2.10.8.41 The stainless steel open neck Dewars listed in Table 2.10.5 are MOD owned and responsibility for their serviceability lies with the user; however these are consumable items and they may be disposed off when they become unserviceable.

2.10.8.42 **General responsibility for cryogenic storage vessels**. All users, operators and fillers of cryogenic storage tanks have a duty of care to ensure that the equipment is operated safely. Routine checks are to be carried out to ensure that the equipment remains in a safe condition and is fit for further use. These checks are to include:

a. A check for any damage to the tank or installation.

b. Relief valves are not continually venting.

c. A check for abnormal frosting on the tank surface.

d. That gas is not venting from any part of the tank surface or from any connections to it.

e. The pressure and contents indicating devices are functioning correctly.

2.10.8.43 Any concerns over the safety of a storage tank, or any defects identified, are to be reported to the owner of the storage tank or the support authority responsible for that tank.

SECTION 9 – CRYOGENIC LIQUID STORAGE TANK COMPOUNDS AND CRYOGENIC LIQUIDS AND GASES WORKSHOPS

2.10.9.01 Cryogenic liquid storage tank compounds & cryogenic liquids and gases workshops are to be inspected regularly to ensure that they are maintained in a proper condition and that safety distances are enforced (see Part 2, Chapter 1).

2.10.9.02 All personnel involved in the operation and maintenance of liquid cryogenic storage systems are to be fully informed regarding the hazards associated with cryogenic gases and properly trained as applicable to operate or maintain that equipment (see Part 1, Chapter 8).

2.10.9.03 Safety Data Sheets for the individual cryogenic liquids and gases in-use are to be held within each facility (refer to JSP 515).

2.10.9.04 Emergency procedures are to be prepared to cover the event of a spillage of liquid cryogenic gases. Local emergency services are to be included in these procedures. Practical exercises are to be carried out to ensure the suitability of the procedures and to provide familiarity with the procedures (see Part 1, Chapter 9).

2.10.9.05 Site Location of Cryogenic Storage Tank Compounds and Cryogenic Liquids and Gases Workshops. The following factors are to be observed when determining the site location of a bulk cryogenic liquid storage tank compound and/or cryogenic liquids and gases workshop. They are to be included in the risk assessment for that site. For existing tank compounds and workshops that may not conform to these requirements a risk assessment is to be carried out, any risk is to be assessed and recorded and appropriate safety procedures put in place until rectification action is taken.

2.10.9.06 These factors specifically apply to the storage of liquid oxygen, however many of them have equal relevance to other cryogenic liquids.

a. All breathing oxygen facilities are to have a constant source of fresh 'uncontaminated' ambient air. The necessary separation from threats to/from the site may well exceed the safety distances given in Table 2.10.6. Consideration needs to be given to the main prevailing wind direction; and the operating site should not be located in areas where there are likely to be regular contaminations from, e.g. aircraft jet engine exhaust fumes. The use of an indicator, such as a windsock or other device, may provide a warning of an "unusual" wind direction and forewarning of new potential threats to the facility.

b. Sites should be located away from public roads and housing areas, but should provide easy access for gas suppliers and rescue vehicles.

c. Direct access to the aircraft parking platform area needs to be ensured.

d. Consideration needs to be given to the main prevailing wind direction and the possibility of the movement of vapour clouds from cryogenic liquid spillages or venting; these are generally low-lying and may give rise to hazards such as poor visibility, oxygen-enrichment, oxygen-depletion, etc. The use of an indicator, such as a windsock or other device, to provide in the early stages of any spillage or discharge an indication of which neighbourhood might be exposed to plumes and/or plume ground strike is recommended.

e. The location of the site shall be chosen so that damage by electrical arcing from overhead electrical or other cables cannot occur.

f. Protection against lightning is not normally required. However the risk should be evaluated and protection may be necessary to comply with local conditions or site regulations. Any necessary lightning protection should be installed in accordance with *BS 6651 (Code of Practice for protection of structures against lightning)*.

g. Consideration shall also be given to the location of any underground cables and the effect that a major spillage may have on these cables.

h. Operating sites shall be fitted with electrical grounding straps to ground oxygen equipment for discharge of static electricity. Fixed bulk cryogenic storage shall also be bonded to earth (see paragraphs 2.10.9.94 – 2.10.9.97).

i. The site shall not be established in areas that could be exposed to flammable or combustible liquids or any kind of gases in the event of a piping rupture.

j. Storage sites for liquid breathing oxygen shall neither be located on the top of structures, nor underground or in basements.

k. Containers for liquid oxygen shall not be located in the vicinity of oil lines or areas in which hydrocarbons or other combustible materials can accumulate.

l. If an oxygen storage area is established at a place which is located below an adjacent storage area for flammable or combustible liquids, appropriate measures, e.g. the construction of embankments, diversion dams, or steps, etc, shall be taken to prevent liquids from accumulating below the storage tanks.

m. The floor shall be of solid construction and consist of non-combustible materials (see paragraphs 2.10.7.11 – 2.10.7.15). It shall have a gradient (a recommended slope of between 1:80 and 1:100) sloping away from the storage tanks and the compound entrance. Any spillages are to be directed towards a non-hazardous area, towards a drainage channel, or boil-off pit (see paragraphs 2.10.7.04 – 2.10.7.10) located at a safe location. The floor shall be free of oils and greases and other combustible materials. Asphalted surfaces and joints containing asphalt shall not be admissible (see paragraphs 2.10.7.11 – 2.10.7.28). A clean non-porous concrete surface with joints containing a silicone filling will be suitable.

n. Drains. To control spillage of cryogenic liquids only dedicated drains allowing cryogenic liquid to flow towards a cryogenic liquid boil-off pit are allowed.

o. Non-combustible partition walls or barriers are to be erected to prevent cryogenic liquid running off the site or entering storm drains, sewers, cable ducts, buried earthing rods/plates/electrodes, or bunded areas for other chemicals/products.

p. When operating aircraft in the vicinity, consideration needs to be given to the hazards associated with oil and grease contamination; fuel use and spillage; weapons systems; and the possibility of an ignition source from electrical equipment and radio/radar transmitters.

q. Similar hazards shall be assessed from operating aviation Ground Support Equipment in the vicinity.

2.10.9.07 Further guidance on the location of bulk cryogenic liquid storage tanks is given, in respect of Safety Zones and Minimum Separation Distances, in *STANAG 7175* and in *BCGA Codes of Practice 26 and 36.*

2.10.9.08 Safety distances, according to *BCGA Codes of Practice 26 and 36* are based on experience and calculations of minor releases; not catastrophic failures. Table 2.10.6 provides a summary of some of the safety distances for LOx given in *STANAG 7175* and/or *BCGA Code of Practice 36* (the most conservative distance is given). LOx storage tanks and plant shall be located at a site which will minimise any risk to personnel, the local population, equipment and property. They shall not be close to areas where other hazardous materials are stored. For all new installations a minimum safety distance of 1500 m from any areas of risk is to be applied. If this is not practical, local protection around the site to prevent unauthorised access, any unwanted projectiles or contamination entering the area, whilst allowing thorough ventilation is necessary. A siting board for the installation would be expected to take this into consideration.

2.10.9.09 When assessing the risk from a cryogenic liquid or its vapour, the hazard produced may well exceed the safety distance determined from a fixed point. Liquid will travel until it settles at the lowest point and subsequently evaporates. Vapour clouds will be blown by the wind and, if in sufficient quantity, have the potential to travel far beyond the minimum safety distance quoted. This dynamic movement of cryogenic liquid and vapour is always to be taken into account when conducting siting boards for new / replacement facilities or when carrying out assessments of existing facilities.

Table 2.10.6: Safety Distances from LOx storage tanks

Activity	Minimum Safety Distance (m)
Public road and railways	50
Flammable liquid / gases storage	25
Aircraft parking, refuelling & defuelling	25
Parked vehicles	15
Traffic routes	15
Combustible solid materials	15
Any inlet to the public sewerage system	15
Buildings	15
Aircraft Taxiways	15
Asphalt surface	15
Meadow	15
Property boundary	15
Non-intrinsic mobile phones & other electrical devices fitted with batteries (see note)	15
Fire, open flame, light, smoking areas	15
Operation of Bowman radio: HF Radios VHF & UHF Radios	 70 15
Note: This excludes approved solar-powered mobile phones permanently fitted to the bulk cryogenic storage, by the tank owner, to monitor the tank's contents.	

2.10.9.10 Where a cryogenic liquid tank is sited close to a public road or traffic route, it is advisable to mitigate the risk by:

a. The use of signs to warn passing traffic of the hazard within the storage area.

b. Including information about the storage area and the associated hazard in Unit induction briefing.

c. Providing information about the storage area and the associated hazard when issuing Unit driving licences and permits (e.g. Airfield Driving Permits).

d. Carry out local control of traffic, e.g. when carrying out replenishment or maintenance operations on tanks, when there is an increased risk of a spillage.

e. Ensure there are Standard Operating Procedures in place to deal with spillages, fires etc. that have been fully agreed between the site operators and the emergency services.

2.10.9.11 **Construction of storage areas**. Existing MOD cryogenic storage tank areas are situated in a variety of locations, these include open compounds; buildings with open sides that are partially enclosed (Dutch Barns); or, totally enclosed (blast-proof shelters). Any new / replacement tanks are not to be situated in an enclosed storage area. New / replacement tanks are to be installed in accordance with the relevant BCGA Codes of Practice.

2.10.9.12 A Risk Assessment is to be carried out on all cryogenic tank storage areas. Where the unit has an existing tank in an enclosed or semi-enclosed space, it is to include an assessment of the risk from having a cryogenic storage tank in that space, and it is to ensure appropriate procedures are in place to minimise that risk.

2.10.9.13 The floor material is to be concrete, and any surface treatment shall be non-oxidising and capable of withstanding the low temperatures resulting from cryogenic liquid spillages. Materials such as asphalt or other tar based substances shall not be used (see paragraphs 2.10.7.11 – 2.10.7.15).

2.10.9.14 The design of the flooring shall be more than sufficient to withstand the loading of full cryogenic storage tanks and any machinery or delivery tankers likely to be used for installation or charging. Consideration shall be given to the weight of additional equipment which may also be located on the plinth and the effects of volatile substances such as snow, ice etc. or loading from the wind.

2.10.9.15 The floor shall have a gradient (a slope of between 1:80 and 1:100 is recommended) sloping away from the storage tanks and the compound entrance. The design will allow spillages to be directed towards a non-hazardous area, a dedicated cryogenic liquid drainage channel, or a boil-off pit (see paragraphs 2.10.7.04 – 2.10.7.10). Any containment walls around the plinth are not to allow the feet or external component parts of the tank to remain immersed in a cryogenic liquid.

2.10.9.16 Where horizontal tanks are installed under cover, winching points shall be provided behind each storage tank to allow the tanks to be drawn into position. There shall be no stops or uneven levels between the storage tank area and the outer apron to impede installation of the storage tanks.

2.10.9.17 **Site Boundaries and Security**. Physical security measures shall be established for cryogenic storage tanks and associated operating sites. These are to restrict entry to the site to authorised personnel who have had appropriate training and who understand the hazard within, and to prevent access to unauthorised persons.

2.10.9.18 In military areas, hazardous goods storage areas are potential sabotage targets and adequate physical security measures are mandatory.

2.10.9.19 For "open" compounds, or those with a "lean-to" roof, the site boundary is to be of "chain-link" fencing, or similar; to approximately 1.8 m height, or to the roof line, as appropriate.

2.10.9.20 Gates or doors shall be of similar construction, and all parts of the fencing and gates/doors shall be earthed. Gates/doors shall give direct assess to the filling connections on the storage tanks. The main gate should have two wings, at least 0.6 m wide.

2.10.9.21 The storage tank area shall have a second emergency exit gate/door, with one single wing, at least 0.8 m wide. All emergency exits are to open in the direction of escape and are to be fitted with panic furniture of a type not requiring a key, card or code to open. They are to provide an unobstructed means of escape and in operation are not to obstruct any other escape route. Where this communicates with the liquid oxygen (LOx) charging bay, or other enclosed structure, a sill of approximately 150 mm high shall be fitted to prevent spillage from migrating into the enclosed area.

2.10.9.22 For fully enclosed facilities, e.g. blast-proof shelters, forced ventilation at ground level shall be provided to ensure that an accumulation of vapour does not occur (see paragraph 2.10.9.98).

2.10.9.23 **Vehicle Access**. The approach road(s) shall be designed for use by articulated vehicles and will be required to allow easy access and egress to the storage tanks at all times.

2.10.9.24 Sufficient space shall be provided to ensure unimpeded freedom of movement between the delivery tanker and the controls of the installation. The delivery tanker will require close access to the refill point on the tank. An 'access apron' of concrete is required beneath the area where the rear of the tanker will be parked. Further information is detailed within *BCGA CP 36*.

2.10.9.25 The liquid transfer area shall be designated a 'No Parking' area.

2.10.9.26 Protective barriers (kerbs, bollards etc.) are to be installed around the tank to prevent any possibility of a collision between the storage tank and the tanker.

2.10.9.27 There shall be sufficient space to allow a cryogenic liquid replenishment trolley to be connected to the appropriate outlet from the storage tank(s) for filling purposes.

2.10.9.28 **Safety Signs and Warning Notices**. These shall be clearly displayed on or near the storage tanks, particularly at access points and are to be visible at all times. The relevant symbols, or pictograms, shall also be clearly displayed in accordance with the *Health and Safety (Safety Signs & Signals) Regulations, 1996*, and with *BS 5499, Part 5 "Safety Signs and Colours"*. All installations are to comply with the relevant requirements for safety signs and warning notices detailed in Part 2, Chapter 9. The following requirements are specific for cryogenic storage sites.

2.10.9.29 For all cryogenic liquid storage sites:

a. NO SMOKING

b. NO NAKED LIGHTS

c. NO STORAGE OF OIL, GREASE OR COMBUSTIBLE MATERIALS

d. EXTREME COLD HAZARD

e. AUTHORISED PERSONS ONLY

f. NO MOBILE PHONES

g. NO STEEL TIPPED SHOES / BOOTS

2.10.9.30 For oxygen storage facilities:

a. LIQUID OXYGEN

b. OXIDISING SUBSTANCE

2.10.9.31 For nitrogen and argon storage facilities:

a. LIQUID NITROGEN or LIQUID ARGON (as appropriate)

b. ASPHYXIATION HAZARD

2.10.9.32 At the entrance to the site the appropriate fire signs and notices (e.g. Fire Action Notice) are to be displayed (see *JSP 426, MOD Fire Safety Policy*). A sign shall also be displayed detailing any specific action to be taken in the event of an incident/emergency and showing whom to contact in the event of an incident/emergency with all appropriate contact details. This is to include the unit emergency contact details and the contact details for the cryogenic gas supplier and the cryogenic gas supplier's 24-hour emergency contact telephone number. The location of any access keys, as well as the contact details for the authorised key holder shall be displayed.

2.10.9.33 The following signs and pictograms are specific to cryogenic liquids storage areas.

2.10.9.34 Each individual bulk storage tank is to be clearly labelled with its contents and its associated UN product identification number. These are:

a. LIQUID OXYGEN UN 1073

b. LIQUID NITROGEN UN 1977

c. LIQUID ARGONUN UN1951

2.10.9.35 The connection fittings of multistorage installations, pipework connecting storage tanks to equipment or long fill lines are to be clearly marked with the gas name or symbol. Marking and labelling is to be at the inlet and outlet and at approximately 2 m intervals along the length of the pipework. Identification marking of pipelines is to comply with BS 1710.

2.10.9.36 All displayed safety signs and notices are to be kept legible, visible and up-to-date at all times.

2.10.9.37 **Fire protection**. First aid fire fighting equipment comprising water hose reels and / or dry powder extinguishers shall be available. The type and quantity of the fire fighting equipment will depend on the size of the installation. The regional Defence Fire & Rescue Service Fire Safety Officer should be consulted about appropriate equipment and its location within the site. A Fire Safety Risk Assessment is to be carried out on all storage sites and is to be incorporated into the Site Fire Safety Management Plan (see JSP 426).

2.10.9.38 The emergency services are to be made aware of the hazard stored within these areas and in the event of a fire or other incident/emergency the response provided by the emergency services, is to be included in the unit Standard Operating Procedures and regularly checked.

2.10.9.39 **Emergency Shower**. If the cryogenic liquid storage tank compound is separate from the cryogenics liquids and gases workshop, then a separate emergency shower is to be installed (paragraph 2.10.9.72 refers).

Cryogenics liquids and Gases workshops

2.10.9.40 **Liquid oxygen and gaseous oxygen charging bays**. The charging bay shall be constructed from non-combustible materials that meet the compatibility requirements specified in paragraphs 2.10.7.11 to 2.10.7.15. Adjacent rooms shall be separated by 60-minute fire-resistant walls and ceilings.

2.10.9.41 Where the bay is to be used for the servicing and maintenance of aircraft components then the bay is to comply with the minimum standard of cleanliness detailed in AP 107D-0001-1, Chapter 2.2. This requires controls on the temperature and humidity of the ambient air.

2.10.9.42 The floor shall be concrete, painted with a latex-epoxy anti-slip interior or exterior paint or alternaterly a cement based bed laid with quarry tiles. A gradient (a slope of between 1:80 and 1:100 is recommended) sloping away from the storage tanks and the compound entrance. Any spillages are to be directed towards a non-hazardous area, to a dedicated cryogenic liquid drainage channel, or boil-off pit (see paragraphs 2.10.7.04 to 2.10.7.10).

2.10.9.43 A drainage channel connected to the boil-off pit should cross the floor at its lowest point, to take away spillage from the work area. The drainage channel is to be subjected to regular inspection / maintenance to ensure the free flow of any spillage and to remove any debris or contaminants.

2.10.9.44 The bay is to have one set of double doors, of approximately 2.25 m height to allow access for large equipment (in particular the LOx and gaseous oxygen charging benches). Another, single door shall be provided as an emergency exit and is to lead directly to the outside (not into the tank area). Both the double doors and the single door shall open in the direction of escape and must be fitted with panic furniture of a type not requiring a key, card or code to open. The emergency exit shall not be adjacent to the boil-off pit (see paragraphs 2.10.7.04 to 2.10.7.10).

2.10.9.45 **Changing Room**. Where practicable, a separate room shall be provided where protective clothing can be donned and removed. Lockers shall be provided for outdoor / protective clothing, and communicating doors shall open into the changing room.

2.10.9.46 **Pressure systems and charging bench**. Gas, or cryogenic liquid, storage systems and their associated pipe work and protective devices are classed as pressure systems and are required to comply with the *Pressure Systems Safety Regulations, 2000*; there are certain exceptions, but most if not all such systems in cryogenic liquids and gases workshops will be subject to these regulations. *JSP 375, Volume 2, Leaflet 30* refers. Reference is also to be made to *Defence Estates Safety Rules and Procedures 02, Boilers and Pressure Systems Gas Systems Medical Gases and Pipelines*.

2.10.9.47 These regulations, amongst others, require that:

a. A written scheme of examination is prepared by a Competent Person.

b. The parts identified in the written scheme are examined by the Competent Person, at the stated inspection intervals.

c. The system is properly maintained and is in good repair.

d. Safe operating limits are established for the system before it is used.

e. Every person operating the system is adequately trained to safely operate the system. and

f. The User shall keep records of the last written scheme of examination by the Competent Person.

2.10.9.48 The following paragraphs provide guidance, but do not override the authority of the Competent Person.

2.10.9.49 **Liquid oxygen charging benches**. Liquid oxygen charging benches shall be supplied with liquid oxygen from the storage tank(s) through a Super Insulated Vacuum Line (SIVL). To avoid excessive pressure build-up within the LOx system a safety vent shall be fitted to the LOx bench to vent / drain excess LOx into a boil-off pit. It is to be manufactured using copper piping with appropriate compression type joint fittings.

2.10.9.50 The line shall be installed in a manner that permits inspection; and, the line is to be marked and labelled to indicate that it is an oxygen line. Identification marking of pipelines is to comply with BS 1710.

2.10.9.51 The instrument panels of the bench shall be supplied with electric power of 28 Volt DC, supplied by a transformer / rectifier.

2.10.9.52 LOx charging benches shall be raised above the level of the floor by use of a platform. The height of the platform shall be approximately 200 mm, and constructed of steel with a mesh plate to allow any spillage of liquid oxygen to run through to the floor below. The area of the platform shall be sufficient to allow easy movement of the bench operator, and provide the requisite “stand” for the bench itself

2.10.9.53 **Gaseous oxygen charging benches**. Gaseous oxygen charging benches shall be supplied with gaseous oxygen, through a system of rigid pipe work that is fit for purpose for the required maximum charging pressure, and whose internal diameter is such that the gas velocity does not exceed a recommended 30 m/second. The recommended system consisting of an oxygen MCP, fitted with a pressure regulator, which is connected by a short length of suitable flexible hose to the inlet stop valve of a rigid system of pipe work. The pipe work should distribute gas around the workshop to where it is to be used. Short lengths of suitable flexible hose may be used to connect the required equipment to the various outlet points on this system.

2.10.9.54 The pipework shall be manufactured from copper piping, tungham tubing, or stainless steel, as appropriate. All materials used are to be oxygen compatible. Avoid sharp bends in oxygen piping. Copper/brass based piping has better fire properties and tends to be self-extinguishing once the oxygen supply has been turned off; and is capable of being dried down to –60 ºC Dewpoint, or better. Stainless steel piping has the ability to transmit the dry gases that are needed in aircraft systems, to –72 ºC Dewpoint, or better; but once ignited may continue to burn in air. The choice between steel and copper/brass alloys is therefore a trade off between the need for dry gas and the need for fire resistance.

2.10.9.55 Copper piping, of suitable wall-thickness, in half-hard condition, to *BS EN 1057*, or *BS EN 12449*, where practicable with welded, brazed or silver soldered joints (otherwise proprietary brass compression fittings), may be used for pressures to up 132 bar.

2.10.9.56 For pressures within the range 138 to 430 bar, tungham tubing, of suitable wall-thickness, where practicable with welded, brazed or silver soldered joints (otherwise proprietary Monel compression fittings), may be used.

2.10.9.57 Stainless steel pipe work systems should be designed by specialist contractors with the necessary experience of high pressure oxygen systems.

2.10.9.58 Pipe work and fittings shall be ordered as “cleaned for oxygen service”, or cleaned before use; and purged before use. All piping connections and supply connections are to be blanked when not in use. This is particularly important for oxygen systems.

2.10.9.59 All pipework shall be identified with its contents and its working pressure. Appropriate labels are to be applied at the pipe inlet / outlet, and at approximately 2 m intervals along the length of the pipe. Identification marking of pipelines is to comply with BS 1710.

2.10.9.60 The pipe line shall be installed in a manner that permits inspection; long lengths of straight pipe work are to be attached to rigid supports at intervals not exceeding 2 m.

2.10.9.61 It is good practice to have a range of schematic or flow diagrams for all pressure systems which clearly indicate the necessary valves and controls to operate the pressure system safely.

2.10.9.62 Standard Operating Procedures for the use of cryogenic and gaseous equipment within the bay are to be developed and included in the training provided. This is to include adequate and suitable instructions for:

a. The safe operation of all pressure systems.

b. The actions to be taken in the event of any emergency.

c. Start-up and shutdown procedures.

d. Function and effect of controls and protective devices.

e. Likely fluctuations expected in normal use.

f. The requirement to ensure that the system is adequately protected against overpressure at all times.

Note: Ensure other departments are aware of your procedures and are able to support them e.g. medical response in the event of an incident with cryogenic liquid.

2.10.9.63 **Electrical supplies and equipment**. Electrical equipment shall be to a standard suitable for protection against dust and sprayed water from all directions (a limited ingress is permitted). In more severe conditions protection against dust and low pressure jets of water from all directions is required. In European countries, including the UK, this equates, as a minimum, to *IP 54*, or in more severe conditions, *IP 55* (see *BS EN 60529*). All electrical installation shall comply with current electrical legislation.

2.10.9.64 Earth bonding of all installation pipework and metal fixtures and fittings is required (see paragraph 2.10.9.94).

2.10.9.65 Within the defined Hazardous Area all power supplies and electrical accessories shall be intrinsically safe and compliant with DSEAR and ATEX regulations. They are to be located above the oxygen vapour line. All power supplies and electrical equipment are to be located a minimum height of 1 m above the floor. Power sockets / outlets shall be kept to a minimum. The type and design of any power supplies / outlets will be based on the unit requirement, however the hazard associated with providing a power supply / outlets, including the increased risk of sparks or fire, are to be assessed and appropriate mitigation taken. The DC power supply (for LOx Charging bench, see paragraph 2.10.9.51) is to be a minimum height of 1.5 m from the floor.

2.10.9.66 All electrical cables and accessories are to be located in a position where they can not be inadvertently damaged, or where they will not be immersed in a cryogenic liquid e.g. following a spillage. They are not to be located at ground level.

2.10.9.67 **Wooden Fitments**. Wood and wood based products are unsafe materials to use in an oxygen enriched environment; the use of fitments made from these materials shall be kept to the absolute minimum (see paragraph 2.10.7.12).

2.10.9.68 **Benches / Cupboards**. Wooden benches and cupboards are not to be used within the bay. (see paragraph 2.10.9.67).

2.10.9.69 All benches and enclosed cupboards shall be fitted with a vent at floor level to allow any oxygen vapour to dissipate from the interior. Failure to vent enclosed spaces can lead to a dangerous concentration of oxygen.

2.10.9.70 Any locker used to store clothing shall have a vent, in the same manner, even when the locker is outside the normal work area and is used to store protective clothing for use in an oxygen enriched environment.

2.10.9.71 Working surfaces are to be manufactured from a material that is compatible with oxygen, which will not spark and will not absorb oxygen or other substances such as oil or grease. Stainless steel is a suitable material. Where metal surfaces are fitted they shall be earthed in accordance with paragraph 2.10.9.94.

2.10.9.72 **Emergency Shower**. A drench type, platform operated, industrial shower, complete with eye bath shall be installed at all cryogenic storage or cryogenic workshop facilities. If these are separate facilities a shower at each is necessary. An automatic-operation alarm system shall be attached to the shower, and connected to the Main Guardroom or PBX and Station Medical Centre to alert emergency personnel. The use of the shower, and the response provided by the emergency services, is to be included in unit Standard Operating Procedures and regularly checked. There is to be clear responsibility for the inspection, testing and maintenance of the shower. Routine maintenance is to include:

a. A monthly visual inspection, flush, verification of proper operation and testing of the alarm system.

b. Annual cleaning, inspection and a compliance assessment.

2.10.9.73 The water supply is to be clean and potable. When activated the water flow is to be continuous and has to be able to maintain a flow for a minimum of 15 minutes. As these showers may be located outside, there is the possibility that water may freeze in the shower operating head or pipelines during cold weather conditions. To prevent freezing of the water, the water supply shall be maintained above freezing but below 20 ºC.

Note: Water maintained at a temperature between 20 and 45 ºC has the potential to allow the bacteria *Legionella* to grow. The hazard from this bacteria is to be assessed, and is to be included in the risk assessment for the use of the emergency shower. (*JSP 375, Volume 2, Leaflet 19* refers).

2.10.9.74 The shower shall be positioned such to avoid impeding the normal operations carried out in the Bay or restrict any of the doors. Access to the shower is to be free of any obstructions which may hinder personnel when using the shower in an emergency situation. Provision shall be made to enable the water to drain away freely from the shower area. Drainage of the shower shall be carefully considered, since use of the shower during cold weather may present a hazard due to the formation of ice.

2.10.9.75 A relevant symbol, or pictogram, shall be clearly displayed, in accordance with the Health and Safety (Safety Signs & Signals) Regulations, 1996, to indicate that it is an emergency shower. All pipelines are to be clearly identified with their contents. Identification marking of pipelines is to comply with BS 1710.

2.10.9.76 **Fire protection**. Fire fighting appliances to the approval of the regional Defence Fire & Rescue Service Fire Safety Officer shall be provided. It is recommended that a hose and a reel are also fitted within the charging bay. A Fire Safety Risk Assessment is to be carried out and is to be incorporated into the Site Fire Safety Management Plan (see JSP 426).

2.10.9.77 Appropriate fire detection systems are to be installed, including smoke detectors, which automatically operate the fire detection system. The fire alarm is to operate within the bay and is to be connected to the main guardroom or PBX to alert the emergency services.

2.10.9.78 Standard Operating Procedures are to be written and enforced detailing the actions to be taken when an alarm sounds by the bay personnel, as well as by other departments and the emergency services. Local emergency service personnel are to be advised on the hazards contained within the bay.

2.10.9.79 The advice of the regional Defence Fire & Rescue Service Fire Safety Officer must be sought to determine the necessary fire precautions including fire detection system required and to assist in the co-ordination of the response required in the event of a fire.

2.10.9.80 **Telephone(s)**. The provision of a telephone is to be made within the charging bay. The height restrictions given in paragraph 2.10.9.63 shall be complied with. A land-line is the preferred option; however for remote sites, a fixed cell-phone telephone may be provided for emergency use outside the relevant safety distances (see Table 2.10.6). In all cases, a copy of the incident/accident contact details information, specified at the site entrance (see paragraph 2.10.9.32), shall be provided adjacent to the telephone.

2.10.9.81 **Heating**. Heating of the bay shall be by the use of hot water or steam radiators. Gas, oil or electrical forms shall not be used within the oxygen bay. Exceptionally, where local conditions preclude the use of hot water or steam radiators, intrinsically-safe ATEX-rated flameproof electrical heaters may be used (see paragraph 2.10.9.63).

2.10.9.82 **Lighting**. It is important to have good lighting in all areas (see *BS ISO 8995*). Below 2 m, lighting in all areas shall be ATEX compliant and intrinsically safe, with intrinsically safe switches.

2.10.9.83 **Tools**. Dedicated tools shall be provided for use on LOx and/or gaseous oxygen systems. These tools shall not be used for other engineering activities; similarly, tools provided for other general engineering activities shall not be used in oxygen charging bays.

2.10.9.84 The use of tools made from brass, bronze, or other non-sparking materials may be necessary for some high-risk applications. The necessity to use such tools, if applicable, shall be identified on the corresponding written Risk Assessments.

Note: The use of a “peg board” or tool board with “stencilled tool outlines” provides a means of controlling tools and identifying what tools have been issued for use within the charging bay.

2.10.9.85 **Oxygen detection systems**. An oxygen detector system is to be fitted in all enclosed buildings to detect and warn against high (oxygen enrichment hazard) and, where appropriate, low concentrations (asphyxiation hazard) of oxygen (see Annex A). The oxygen detector system is to be subject to routine maintenance to ensure its serviceability.

2.10.9.86 The positioning and number of oxygen detection sensors will be dependent on several factors and will be subject to the requirements of the Risk Assessment for the building. Sensors are to be fitted in the 'breathing zone' at 1.5 m from the floor and at 0.6 m from the floor. The maximum oxygen level allowed is 23.5 %. The minimum oxygen level allowed is 19 %. If these limits are exceeded the area is to be evacuated and appropriately ventilated.

Notes: 1. Levels of oxygen of 30% and above are of extreme hazard.

2. Excessive levels of oxygen may affect the continued accuracy of the oxygen sensor.

2.10.9.87 The oxygen detection system is to provide audible and visual alarms within the immediate area. It is to be connected into the extraction system to allow automatic operation (see paragraph 2.10.9.89). It is to be connected into the main guardroom or PBX to alert the emergency services. Standard Operating Procedures are to be written and enforced detailing the actions to be taken when an alarm sounds by the bay personnel, as well as by other departments and the emergency services. Local emergency services personnel are to be advised on the hazards contained within the bay.

2.10.9.88 **Secondary oxygen detection system**. Where the Risk Assessment identifies a likelihood that oxygen levels will fluctuate whilst working in an enclosed area, it is recommended that all personnel who require access to the enclosed area are also provided with personal oxygen monitors.

2.10.9.89 **Ventilation**. All enclosed working areas shall have ventilation to the outside at ground level. This may take the form of louvered doors.

2.10.9.90 Where there is the potential for oxygen limits to exceed their ambient levels then an extraction system shall be fitted in the locations where enriched oxygen may be vented, suitable warning notices are to be displayed advising personnel of the hazard.

2.10.9.91 For blast proof shelters, forced air ventilation shall be provided and fan motors shall conform to the electrical requirements specified in paragraph 2.10.9.63.

2.10.9.92 The extraction system is to be connected to an oxygen detection system, which automatically operates when high levels of oxygen are sensed.

2.10.9.93 *STANAG 7175* recommends that, to prevent oxygen-enrichment the ventilation should be such as to give an air change of three to five times per hour.

Note: Consideration should be given to providing inlet vents at ceiling level to provide ingress of air.

2.10.9.94 **Earthing**. All metal fitments in the facility, including fencing, gates, tanks and all pipe work, shall be adequately earthed. This shall be in accordance with *BS 7430 – Code of practice for Earthing*.

2.10.9.95 Pipelines shall be electrically continuous through all connections.

2.10.9.96 A maximum resistance of 1 ohm shall be achieved across any joint and between equipment and the nearest earthing point.

Note: The LOx Super Insulated Vacuum Line (SIVL) or gaseous oxygen supply pipeline shall not be used as earthing routes for other equipment.

2.10.9.97 All earthing and lightning points bonded to earth, using earthing plates, electrodes, etc, are not to be located in cryogenic liquid boil-off pits, other soakaways, or in areas where they are likely, so far as is reasonably practicable, to come into contact with cryogenic liquids.

2.10.9.98 **Blast covers (blast proof shelters only)**. If the facility is a “blast proof shelter”, all vent openings, including forced air ventilation, shall be fitted with “blast proof” covers.

2.10.9.99 **Compressed air supplied into a charging bay**. Ideally any compressed air supply shall be from an oil-free compressor.

2.10.9.100 The compressor and its associated pipelines are to conform to the *Pressure Systems Safety Regulations, 2000 (PSSR). JSP 375, Volume 2, Leaflet 30* refers. Reference is also to be made to *JSP 375 Volume 3.*

2.10.9.101 All compressed air pipelines and outlets are to be clearly identified with their contents and working pressure. All component parts are to be bonded together and the whole system bonded to earth, with a maximum resistance to earth of 1 ohm.

2.10.9.102 Inlet air to the compressor is to be drawn from an area that is free from potentially flammable or corrosive concentrations of fumes or vapours, including vehicle and aircraft exhaust fumes.

2.10.9.103 Compressed air supplied into a charging bay is to comply with specification *BS ISO 8573*. Specifically:

a. To minimise the risks of compressed air giving rise to moisture / condensation hazards in any oxygen system under test that it might be used on, moisture levels are to be ≤ 7 mg/m^3 of water (-61 ºC dew point).

b. Where an oil lubricated compressor is used to supply compressed air into a charging bay the concentration of the total oil content is to be ≤ 0.1 mg/m^3.

2.10.9.104 **Gaseous nitrogen supplied into a charging bay**. Gaseous nitrogen supplies to charging bays should be in accordance with the requirements of paragraphs 2.10.9.46 to 2.10.9.62, including cleaned to oxygen clean standards. However, the line shall be labelled "nitrogen", not oxygen, and it should be fed from a nitrogen manifolded cylinder pack (MCP).

2.10.9.105 Stainless steel is the preferred material for pipe lines; nitrogen is not an oxidant so the use of copper, brass or tungham piping need not be taken into consideration.

2.10.9.106 **Access for personnel**. Entry into all areas where cryogenic liquid and / or compressed gases are in use or in storage is to be controlled. All persons who enter these controlled areas are to have the necessary authorisation and are to have been trained on the hazards associated with cryogenic liquids and compressed gases.

BIBLIOGRAPHY

British Compressed Gases Association (BCGA) Publications

1. CP23 - *Application of the Pressure Systems Safety Regulations 2000 to Industrial and Medical Pressure Systems Installed at User Premises*.

2. CP26 - Code of Practice: *Bulk Liquid Carbon Dioxide Storage at Users' Premises*.

3. CP27 - Code of Practice: *Transportable Vacuum Insulated Containers of not More than 1000 Litres Volume*.

4. CP30 - Code of Practice: *The Safety Use of Liquid Nitrogen Dewars up to 50 Litres*.

5. CP36 - Code of Practice: *Bulk Cryogenic Liquid Storage at Users' Premises*.
   Note: Replaced CP19 and CP21.

British Standards

6. BS 1710 – *Specification of Identification of Pipelines and Services.*

7. BS 6651 - *Code of Practice for Protection of Structures Against Lightning*.

8. BS7786 - *Specification for Unsintered PTFE Tapes for General Use*.

9. BS EN 1057 - *Copper and Copper Alloys – Seamless, Round Copper Tubes for Water and Gas in Sanitary and Heating Applications*.

10. BS EN 12449 - *Copper and Copper Alloys – Seamless, Round Tubes for General Purposes*.

11. BS EN 60529 - *Specification for degrees of protection provided by enclosures (IP Code)*.

12. BS ISO 8995 - *Lighting of Indoor Work Places*.

13. BS 5429 - *Code of Practice for Safe Operation of Small-Scale Storage Facilities for Cryogenic Liquids*.

14. BS 7430 - *Code of Practice for Earthing*.

Health and Safety Executive

15. EH40 – *Workplace Exposure Limits*: Containing the List of Workplace Exposure Limits for Use With the *Control of Substances Hazards to Health Regulations, 2002* (as amended).

Note: This document was, at one time, an annual publication. At the time of writing, the latest published edition was EH40/2005.

UK Legislation

16. SI 1996. No. 341 - *The Health and Safety (Safety Signs and Signals) Regulations, 1996*.

17. SI 1997 No. 1713 - *The Confined Space Regulations, 1997*.

18. SI 2000 No. 128 - *Pressure Systems Safety Regulations, 2000*.

19. SI 2001 No. 1426 - *Transportable Pressure Vessels Regulations, 2001*.

20. SI 2009 No. 1348 - *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (Amendment) Regulations, 2009*.

21. *Dangerous Substances and Explosive Atmosphere Regulations, 2002.*

22. *EU Directives, ATEX 95 (94/9/EC) and ATEX 137 (1999/92/EC).* For the supply and use of equipment in potentially explosive atmospheres.

MOD Documents

23. AP 107D-0001-1 - *General Information on Aircraft Oxygen Equipment*.

24. Defence Standard 58-96 - *Pure Gases for Weapons Systems and Detector Cooling Applications*.

25. Defence Standard 68-284 - *Compressed Breathing Gases for Aircraft, Diving and Marine Life-Support Applications*.

26. JSP 375 - *Health and Safety Handbook*.

27. JSP 426 - *MOD Fire Safety Policy*.

28. JSP 515 - *MOD Hazardous Stores Information Systems*.

29. MOD Form 640 - *Advice and Inspection Note*.

30. SRP 02 - *Boilers and Pressure Systems, Gas Systems, Medical Gases and Pipelines*.

31. SRP 06 - *Safety Rules and Procedures: Confined Spaces*.

NATO Documents

32. STANAG 7175 - *Definition of Safety Zones and Minimum Separation Distances for Use With Liquid Oxygen (LOx)*.

ANNEX A

(introduced at paragraph 2.10.4.09)

INERT GAS ASPHYXIATION

2.10.A01 Table 2.10.A1 provides a summary of the affects of various depleted oxygen concentrations. It is important to note that these effects and symptoms can occur within a relatively short time, without the person's knowledge and without prior warning (see the *Confined Space Regulations* and *JSP 375, Volume 2, Leaflet 10*).

2.10.A02 The following example shows how a spillage of an inert cryogen, such as liquid nitrogen, could give rise to oxygen deficiency.

2.10.A03 Example 1: Assume a full 25 litre Dewar of liquid nitrogen is stored in a small room 3 m by 3 m by 3 m; and that the original concentration of oxygen in the room was 20.95%.

2.10.A04 If this liquid were spilt then the following consequences may occur:

a. Volume of room = 3 x 3 x3 = 27 m^3.

b. Volume of spilt gas (nitrogen) = 25 litres x 682 = 17050 litres = 17.05 m^3.

c. This 17.05 m^3 of nitrogen gas displaces 17.05 m^3 of air from the room, replacing it with nitrogen.

d. The oxygen content of the room becomes reduced in the ratio:
(27 – 17.05) x 0.2095 = 2.08

2.10.A05 The resulting oxygen content of the room is now: 100 x 2.08 / 27.0 = 7.7%. From Table 2.10.A1, this will result in fainting within a few minutes; resuscitation is possible if carried out immediately, i.e. someone is on hand with a self contained breathing apparatus to remove the person(s) from the room.

Table 2.10.A1: Affects of oxygen deficiency

Oxygen Content (volume %)	Effects and Symptoms (at atmospheric pressure)
21 - 14	Increasing pulse rate, tiredness
14 -11	Physical movement and intellectual performance becomes difficult
11 - 8	Possibility of headaches, dizziness and fainting after a fairly short period of time
8 - 6	Fainting within a few minutes, resuscitation possible if carried out immediately
6 -0	Fainting almost immediate, death or severe brain damage.
Note: Remember this happens within a relatively short time, without the person's knowledge and without prior warning.	

Part 2

Chapter 11 (Sponsor – ACPT GS1d 1)

AVIATION GASES

SECTION 1 – SCOPE

2.11.1.01 This chapter discusses the gas, gas cylinders and associated equipment available in support of the military air environment. It differentiates between ground-use gas cylinders and those used in an airborne application.

SECTION 2 – GENERAL

2.11.2.01 **Gas Specifications**. The specification for any gas used within an aircraft is determined by the aircraft Design Organization.

2.11.2.02 The standard specification for breathing gases for aviation use in MOD aircraft are detailed in *Defence Standard 68-284*.

2.11.2.03 The standard specification gas for use in aircraft pneumatic systems in MOD aircraft is nitrogen to *Defence Standard 58-96*. RAF and civil aircraft use only nitrogen in their pneumatic systems. Nitrogen is also the choice of the vast majority of NATO countries.

2.11.2.04 In the Fleet Air Arm (FAA) some older designs of aircraft can use either compressed air or nitrogen as a medium for charging their pneumatic systems, however, modern aircraft such as the Merlin use nitrogen only. Historically, the requirement to use compressed air was due to the ease with which compressed air could be produced onboard ships. All FAA aircraft operating from shore bases, or from ships provided with a source of nitrogen, are to use nitrogen in their pneumatic systems where this is an approved medium by the aircraft Design Organization.

2.11.2.05 Compressed air provided from HM Ships systems are to comply with Defence Standard 68-284. Further information is detailed in BR 2000 (89), Article 0204.

SECTION 3 – AVIATION GROUND SUPPLY GAS CYLINDERS

2.11.3.01 Where practical, all aviation gas supplied in ground supply cylinders will be provided in 50 litre water capacity cylinders at a pressure of 300 bar. These are the standard cylinders fitted to the Mk 3 servicing trolleys.

2.11.3.02 The range of aviation ground supply cylinders available is detailed in Part 1, Chapter 3.

2.11.3.03 **Mk 3 servicing trolleys**. The Mk 3 servicing trolleys are approved aviation Ground Support Equipment. The procedure to be followed when changing cylinders is detailed in the equipment publication. See Table 2.11.1. The Support Authority for this equipment is the AC PT (GSE1d).

Table 2.11.1: Equipment details:

Item description	**Publication**	**NSN**
Mk 3 single and four cylinder Nitrogen Trolley	AP 119F-2743-123 & 5F AP 119F-2744-123 & 5F	71GD/3655-99-1293318 71GD 3655-99-3468696
Mk 3 single and four cylinder Oxygen Trolley	AP 119F-2743-123 & 5F AP 119F-2744-123 & 5F	71GD/3655-99-2121274 71GD/3655-99-2510525
Mk 3 single and four cylinder Breathing Air Trolley	AP 119F-2743-123 & 5F AP 119F-2744-123 & 5F	71GD/3655-99-8090034 71GD/3655-99-3769019

2.11.3.04 **STANAG 7146**. In order to comply with *STANAG 7146*, Assignment of NATO code numbers to gases used in aircraft cross-servicing, certain gases used by NATO armed forces in aircraft cross-servicing operations will be identified with additional information indicating the NATO code number and the NATO product description. These gases are identified in *Defence Standard 81-24*. This information may be included on the precautionary label or, alternatively, an additional label will be attached to the cylinder. The label displayed in Part 2, Chapter 3, Annex D may be used.

Note: It is the filler of a gas cylinder who is responsible for correctly identifying the contents.

SECTION 4 – AVIATION GAS CYLINDERS WITH AN AIRBORNE APPLICATION

2.11.4.01 A large variety of compressed gas cylinders and cylinder assemblies are utilised for airborne applications. They can be fitted as integral components in aircraft or missile systems, form part of independent safety systems such as life-rafts or ejection seats, or be fitted as part of removable mission specific role equipment.

2.11.4.02 All compressed gas cylinders and cylinder assemblies used in an airborne application are designed, maintained and handled to meet stringent airworthiness requirements. Because of this they will often be subject to different procedures than those applied to cylinders used solely in ground applications. Listed in paragraph 2.11.4.03 are major sources of information that can provide guidance concerning the handling, storage, specifications and maintenance, lifing, marking and operation of airborne compressed gas cylinders and cylinder assemblies.

2.11.4.03 The following are sources of information relating to airborne cylinders:

Generic policy	JAP100A-01 Chapters 13.3 and 13.5.
Marking of cylinders	Defence Standard 81-24. Identification Marking of Transportable Containers, Compressed Gas.
Seamless Steel Gas Containers	Defence Standard 81-121. Reconditioning of Airborne High Pressure Seamless Steel Gas Containers.
Oxygen Cylinders	The 107D series of Air Publications.

Note: Generic information can be found in *AP107D-0001-1* and *AP 107D-0111-1*, remaining publications are specific to particular equipment.

CO_2 and Air Cylinders used in life-rafts	The 108E series of Air Publications.

Note: Generic information can be found in *AP108E-0030-123*, remaining publications are specific to particular equipment.

United States DoT Cylinders	Code of Federal Regulations Title 49.
Cylinders supported by the Aircraft Support PT (AC PT)	AP107A-0101-2(N/A/R)1, Airborne Gaseous Components - Support Authority General Orders & Special Instructions (Technical).
Specific equipment assemblies	Specific Aircraft or Equipment Topic -1, Topic-2 (N/A/R) or Topic 5A1. (Identified in AP 100Z-0101). Aircraft or Equipment IPT responsible for item.

BIBLIOGRAPHY

1. STANAG 7146 - *Assignment of NATO code numbers to gases used in aircraft cross-servicing*.

2. Defence Standard 58-96 - *Pure Gases for Weapons Systems and Detector Cooling Applications*.

3. Defence Standard 68-284 - *Compressed Breathing Gases for Aircraft, Diving and Marine Life-Support Applications*.

4. Defence Standard 81-24 - *Identification Marking of Transportable Containers, Compressed Gas*.

5. Defence Standard 81-121 - *Reconditioning of Airborne High Pressure Seamless Steel Gas Containers*.

6. JAP 100A-01 - *Military Aviation Engineering Policy and Regulation*.

7. BR 2000(89) – Compressed Gas System Design and Engineering Practice

Part 2

Chapter 12 (Sponsor – FSAT, SAFETY 3)

REFRIGERANT AND FLUORINATED GASES

SECTION 1 – SCOPE

2.12.1.01 This chapter provides information on refrigerant and fluorinated gases. It provides guidance on relevant legislation and discusses their use, recovery, handling and storage.

SECTION 2 – HM GOVERNMENT AND MOD POLICY

2.12.2.01 **Introduction**. There is detailed information on refrigerant gases and ‘F’ gases, the Montreal Protocol, the Kyoto Protocol, associated European and UK Legislation and the MODs Climate Change Strategy and general policy for the use and control of these gases within *JSP 418, Volume 2*. In particular:

a. Leaflet 4 – MOD Climate Change Strategy.

b. Leaflet 5 – Fluorinated Greenhouse Gases. and

c. Leaflet 11 – Ozone Depleting Substances.

2.12.2.02 All persons handling or using refrigerant gases and ‘F’ Gases are to be fully aware of the MOD policy for using these products and are to ensure they comply with their responsibilities.

2.12.2.03 All users of refrigerants and ‘F’ Gases are:

a. To recover any controlled substance during maintenance and/or decommissioning of equipment.

b. Minimise leakages and avoidable emissions of the controlled substances from equipment.

2.12.2.04 Deliberate venting to atmosphere of a controlled substance is illegal.

2.12.2.05 Any waste material shall be disposed of in an approved manner. DFG can provide advice on the environmentally-safe disposal of refrigerants and sulphur hexafluoride and are able to dispose of them via their contractors.

2.12.2.06 In accordance with *JSP 418, Volume 2, Leaflet 5, Paragraph 55*, all refrigerants that are recovered during maintenance procedures or from decommissioned or converted systems shall be offered, in the first instance to the DFG, for recycling and possible use in support of MOD essential uses. Under no circumstances shall a contractor be allowed to take the refrigerants, unless they are to be used by that contractor in support of other MOD essential uses.

2.12.2.07 **The Hazardous Waste Regulations**. The government has introduced regulations controlling the disposal of hazardous waste. Recovered refrigerant gases and sulphur hexafluoride are classified as hazardous waste and the correct procedure for the disposal of hazardous waste is to be followed and the necessary documentation completed. All MOD units that produce hazardous waste need to have registered with the Environment Agency. Waste carriers will not collect waste from an unregistered producer and, ultimately, failing to register could be a prosecutable offence.

2.12.2.08 Further guidance is available in *MOD DIN 2005DIN07/004 April 2005 - New Hazardous Waste Regulations: Guidance for MOD Personnel & Sites* that produce hazardous waste on new site notification procedures.

2.12.2.09 The procedures to be followed and the required forms to be completed are detailed in Part 1, Chapter 3.

2.12.2.10 **Refrigerant Handlers**. The UK Government has introduced mandatory qualifications for handlers of Ozone Depleting Substances and other fluorinated gases (e.g. refrigerants, SF_6) within the scope of the 'F' Gas Regulations.

2.12.2.11 The regulations specify minimum qualifications for personnel handling refrigerants and halons, and its recycling, reclamation or destruction. Refer to 1.8.6.02.

2.12.2.12 Refrigerant suppliers are only authorised to supply refrigerant to personnel / units who hold the relevant qualification.

2.12.2.13 Employers of personnel who handle these refrigerants but do not have these qualifications will be liable to prosecution including fines.

2.12.2.14 All MOD personnel and all MOD contractors who are required to handle refrigerants are to hold the requisite qualification.

2.12.2.15 **'F' Gases Regulations**. As part of the European Climate Change Programme (ECCP) new legislation regulating the use of fluorinated (F) gases came into force in the UK in July 2006. There is a lead-in period of 12 months, following which all users of 'F' gases are to comply with the legislation. 'F' Gases are defined as gases with a Global Warming Potential (GWP) > 150. This includes all the refrigerant gases used by the MOD and sulphur hexafluoride (SF_6) (see Annex B). All Support Authorities with responsibility for equipment using refrigerant gas and all handlers of refrigerant gas are to comply with the requirements of the 'F' gas regulations. A summary of some of the major requirements are detailed below, details are also provided in *JSP 418, Volume 2, Leaflet 5*:

a. Owners and operators shall take all measures that are technically and economically feasible to prevent and minimise emissions of fluorinated greenhouse gases.

b. Operators of the following types of stationary equipment shall be responsible for putting in place arrangements for the proper recovery by certified personnel of fluorinated greenhouse gases to ensure their recycling, reclamation or destruction.

(1) The cooling circuits of refrigeration, air-conditioning and heat pump equipment.

(2) Equipment containing fluorinated greenhouse gas based solvents.

c. Equipment containing 3 kg or more of fluorinated gases shall be inspected at least once every year. Hermetic systems containing less than 6 kg are exempt, but must be marked to show this

d. Fixed Leak test periods:

(1) Equipment containing 3 kg or more of fluorinated gases shall be inspected by accredited companies/certified personnel at least once per annum.

(2) Equipment containing 30 kg or more of fluorinated gases shall be inspected by accredited companies/certified personnel every six months. Note however, that MOD Policy, as stated in *JSP 418, Volume 2, Leaflet 5, Paragraph 53*, mandates inspection at least quarterly.

(3) Equipment containing 300 kg or more of fluorinated gases shall be inspected by accredited companies/certified personnel every 3 months. Note however, that MOD Policy, as stated in *JSP 418, Volume 2, Leaflet 5, Paragraph 53*, mandates inspection at least monthly.

(4) If a fixed detection system is fitted (and maintained annually) the above times can be halved. Note however, that MOD Policy, as stated in *JSP 418, Volume 2, Leaflet 5, Paragraph 53*, does not provide this option.

(5) Records are to be kept.

(6) If a leak is found the system is to be checked again in 1 month for integrity.

(7) System with >300 kg must have leak detection equipment permanently fitted.

e. Owners or operators of stationary refrigeration, air-conditioning and heat-pump equipment and fire protection systems including at least one circuit containing 3 kg or more of fluorinated gases shall maintain records on the quantity and type of fluorinated gases installed, any quantities added and the quantity recovered during maintenance and servicing. Such data shall be recorded by trained and certified personnel. The records shall be made available on request to the competent authority and to the Commission. Records to show:

(1) Gas added

(2) Gas removed

(3) Gas type

(4) Name of engineer

f. Leaks shall be identified and repaired as soon as practicable by a duly certified person.

g. Marking and labelling. Systems will require labelling with industry nomenclature, clearly and indelibly marked, beside the charging points to a system. Hermetically sealed systems will need to be marked as such.

2.12.2.16 MOD Policy, as stated in *JSP 418, Volume 2, Leaflet 5, Paragraph 53*, mandates that any events that result in a significant accidental or avoidable loss of any of the substance are investigated and the appropriate measures taken to prevent a reoccurrence. A record should be retained of the investigation and actions taken. *JSP 418, Volume 2, Leaflet 5, Paragraph 51* requires that all events that result in significant accidental or avoidable loss of fluorinated greenhouse gases are reported to the appropriate MPTF Member; all single-event discharges greater than 25 kg of any gas are reported by the MPTF Member to CESO(MOD).

2.12.2.17 All users are required (*JSP 418, Volume 2, Leaflet 5, Paragraph 53*) to submit annual returns of the appropriate MPTF Member on all applications of HFCs, PFC's and SF_6, including:

a. Quantities installed and used by application.

b. Estimates of quantities emitted to atmosphere.

c. Narrative on measures taken to minimise emissions to atmosphere. and

d. Narrative on progress made in replacement or conversion programmes.

2.12.2.18 **HCFC Gases**. From the 1st January 2010 under the EC (ODS) Regulation 2037/2000 no virgin HCFC refrigerant gas can be supplied or used for servicing existing equipment. From the 1st January 2010 to the end of 2014 HCFC's may only be added to systems if they have been recovered *and then* recycled or reclaimed. From 1st January 2015 no HCFCs may be supplied or used to service existing equipment. The impact of this legislation means that certain refrigerant gases will not be available for supply as a virgin product with effect from 1st January 2010. MOD users of these gases should have implemented a replacement programme to change the refrigerant gases in their equipment. The HCFC refrigerant gases which will no longer be supplied as virgin products after 31st December 2009 include: R22, R123, R124, R141b, R142b, R401A, R401B, R401C, R402A, R402B, R403A, R403B, R408A, R409A, R409B, R411B, R412A, R414A, R414B, R416A.

SECTION 3 – REFRIGERANTS AND REFRIGERANT CYLINDERS

2.12.3.01 **Demanding refrigerants and sulphur hexafluoride (SF_6)**. Details of the different refrigerant cylinders and the procedures for demanding/returning refrigerants can be found in Part 1, Chapter 3. The majority of the refrigerants are Controlled Substances and are classified as 'F' gases. Stocks of strategically important refrigerants are held in the Montreal Protocol Substances Bank (MPSB). Unit stocks surplus to requirements are to be returned to the MPSB using the appropriate recovery cylinders (see Section 4).

2.12.3.02 Sulphur hexafluoride, an 'F' Gas, has been classified as a Hazardous Substance. All waste sulphur hexafluoride is categorised as Hazardous Waste and is to be returned using the appropriate sulphur hexafluoride recovery cylinder. Returns of full / part used sulphur hexafluoride cylinders and recovery cylinders is to be carried out via the DFG. Sulphur hexafluoride cylinders and the procedures for demanding/returning sulphur hexafluoride are detailed within Part 1, Chapter 3. JSP 340 details the joint Service policy for the provision, supply, management, servicing and repair of medical, dental and veterinary materiel. JSP 437 outlines the policies and procedures to be adopted for the inspection and maintenance of medical equipment used by the UK Armed Forces and its Agencies.

2.12.3.03 All holdings of these products have to be reported annually; managed to minimise losses; and losses are to be investigated and prevented, and where necessary reported to the MPTF (see Section 2).

2.12.3.04 **Disposable cylinders**. Refrigerants are not provided for MOD use in disposable cylinders. Disposable refrigerant cylinders shall not be used by MOD personnel or their contractors. Only reusable cylinders are to be used, where the cylinder can be returned to the supplier and any excess product recovered.

2.12.3.05 **Tropical fill**. All refrigerant cylinders, supplied from the DFG, are provided at a standard suitable for use in a tropical environment (see Part 2, Chapter 5 (cylinder filling) and Chapter 9 (cylinder storage)).

2.12.3.06 **Safety Data Sheets**. Safety Data Sheets are available for all refrigerant gases. See *JSP 515*, or look on the MOD / DFG Contractor website, details in Part 1, Chapter 3.

2.12.3.07 **Identifying common refrigerants**. The refrigerant can be identified by:

a. Looking at the contents label (see Part 2, Chapter 3).

b. Looking at the information stamped on the cylinder data plate.

c. Conducting the Standing Pressure Test (see Annex A).

2.12.3.08 It should be noted that the colour schemes applied to refrigerant cylinders differ between the various gas supply companies. Details of the colour scheme used by the current DFG contractor are published on the DFG/Contractor website (Part 1, Chapter 3 refers).

2.12.3.09 **Pressure Temperature Relationship Chart**. Pressure Temperature Relationship charts are available for all the refrigerant gases supplied to the military. There are two sources:

a. A pocket sized (7 x 10 cm) hard copy is available from DFG.

b. An electronic version is published on the joint DFG / Contractor website. Contact details in Part 1, Chapter 3.

2.12.3.10 **Determining cylinder contents by weight**. To determine accurately the cylinder contents at any given time, deduct the empty weight from the weighed weight. The empty weight is defined as the 'Tare Weight'. This will be stamped on the cylinder data plate. The weighed weight is known as the 'Gross Weight' and is a combination of the cylinder and its contents. The contents are known as the 'Net' weight.

2.12.3.11 To calculate:

Net Weight = Gross Weight - Tare Weight

2.12.3.12 **Filling capacity**. The maximum permissible contents of a virgin refrigerant cylinder is stamped on its data plate. The figure will be variable depending on the density of the refrigerant. Typically the maximum fill weight is approximately 80% of the cylinder's total capacity in order to allow for thermal expansion.

2.12.3.13 The maximum gross weight of a cylinder should never exceed the combined maximum fill weight (net) plus the tare weight.

Maximum Gross Weight = Tare Weight + Max fill weight (Net).

2.12.3.14 **Management of cylinders**. Refrigerants and sulphur hexafluoride cylinders need to be actively managed to ensure that cylinders do not leak, to detect leaks and to minimise the consequences of any leak. Cylinder management requires written procedures and record keeping for detecting and dealing with such problems (see Part 2, Chapter 9). Weighing of cylinders on calibrated instruments is one technique detecting losses; other techniques include electronic or electrical devices and warning alarms.

2.12.3.15 Further information on returning damaged or unserviceable cylinders, incident/accident reporting and emergency actions can be found in Part 1, Chapters 6, 7 and 9 respectively. Advice may also be sought from DFG and the DFG/DFG Contractors web portal (Part 1, Chapter 3).

SECTION 4 – BULK STORAGE OF REFRIGERANTS

2.12.4.01 All bulk storage tanks and their associated pipe-work and protective devices are classed as pressure systems and are required to comply with the *Pressure Systems Safety Regulations, 2000*; there are certain exceptions, but most if not all such systems in used for storing refrigerants will be subject to these regulations. *JSP 375, Volume 2, Leaflet 30* refers. Reference is also to be made to *JSP 375, Volume 3.*

2.12.4.02 Bulk storage systems are to be actively managed to ensure that there are no leaks, to detect leaks and to minimise the consequences of any leak. This management requires written procedures and record keeping for detecting and dealing with such problems.

2.12.4.03 The storage site is to follow similar requirements to that detailed within Part 2, Chapter 9, for the storage of gas cylinders, for its location, design, security and signage.

2.12.4.04 Each individual bulk storage tank is to be clearly labelled with its contents and its associated UN product identification number. The appropriate gas hazard diamond shall also be displayed (see Part 2, Chapter 3). For example:

REFRIGERANT GAS	R114	UN 1958
REFRIGERANT GAS	R404A	UN 3337

2.12.4.05 The connection fittings of multi-storage installations, pipe-work connecting storage tanks to equipment or long fill lines are to be clearly marked with the gas name or symbol. Identification marking of pipelines is to comply with BS 1710.

2.12.4.06 All displayed safety signs and warning notices are to be kept legible, visible and up-to-date at all times.

SECTION 5 – RECOVERY CYLINDERS

2.12.5.01 **Cylinders**. DFG provide a range of recovery cylinders to enable refrigerant and sulphur hexafluoride (SF_6) to be returned to the contractor for either recycling or disposal (see Table 2.12.1) and Part 1, Chapter 3).

2.12.5.02 Details of the refrigerants that may be recovered into a refrigerant recovery cylinder are listed on the body label attached to the cylinder wall, along with the maximum fill limit for each refrigerant.

Note: The maximum fill limit is a safe 'de-rated' weight for the cylinder specifically for a particular refrigerant. This is typically 25% of the normal virgin refrigerant maximum fill limit.

2.12.5.03 If you have a refrigerant which is not listed on the body label, contact DFG (see Part 1, Chapter 3, Annex A) for further advice.

WARNING: Not all recovery cylinders are suitable for all refrigerants. The correct recovery cylinder for a particular refrigerant is to be correctly identified.

2.12.5.04 For the sulphur hexafluoride recovery cylinder, the maximum permissible fill, 43 kg, is stencilled on the cylinder.

2.12.5.05 The filler of a recovery cylinder is responsible for ensuring that:

a. The cylinder is suitable for the refrigerant or sulphur hexafluoride being recovered.

b. The contents are correctly identified.

c. The cylinder is not over-filled.

d. The information on the body label is complied with and all relevant details are completed.

2.12.5.06 Recovery cylinders are only to be filled when they are in date of their Periodic Inspection and Test (see Part 2, Chapter 5).

2.12.5.07 Refrigerants are not to be mixed in refrigerant recovery cylinders, or placed in sulphur hexafluoride recovery cylinders.

2.12.5.08 MOD users are not to convert virgin refrigerant supply cylinders into recovery / decant cylinders.

2.12.5.09 To ease identification, refrigerant recovery cylinders will have a yellow band painted around the cylinder with the word "RECOVERY" or "RECOVERED REFRIGERANT" stencilled in 50 mm black letters.

2.12.5.10 All refrigerant recovery cylinders supplied by DFG are suitable for use in the decant role. They are provided with an appropriate level of internal cleanliness. These cylinders are vacuumed when returned to the contractor to ensure they are empty of gas then processed through a test shop where they are:

a. Externally inspected.

b. De-valved.

c. Internally inspected (visually).

d. Internally steam cleaned.

e. Internally dried.

f. Re-valved.

g. Re-painted (if necessary).

2.12.5.11 When used in the recovery role, refrigerant is to be recovered into the cylinder and then returned to the DFG contractor.

2.12.5.12 When used in the decant role, recovery cylinders may be used to recover gas from refrigerant systems. This is typically to allow maintenance to be carried out on the system. This refrigerant is then returned back into the original system. It is not unusual for this refrigerant to contain traces of oils and other contaminants. The user is responsible for ensuring the quality of any refrigerant returned into a system.

2.12.5.13 Refrigerant recovery cylinders may be used in either the decant, or the recovery role. However, once used in the recovery role, cylinders should not subsequently be used in the decant role.

2.12.5.14 Details of Recovery cylinders. Refer to MOD/ Contracors website – details in Pt 1, Chapter 3, Annex A.

Table 2.12.1: Recovery Cylinders

NSN **Contractor's Product Code No.**	**Water Capacity (litres)**	**Suitable for:**	**Alternative**
71C/0443 8120-99-8525944. 333102-RKZ	61	Halon 1211, R12, R114, R22, R134a, R236fa, R245fa, R401A, R403B, R404A, R407C, R409A, R410A, R413A, R417A	
71C/0443 8120-99-5516582. 333103-RAZ	11.34	Halon 1211, R12, R114, R22, R134a, R236fa, R245fa, R401A, R403B, R404A, R407C, R409A, R410A, R413A, R417A	
71C/O443 6830-99-6665358. P158964-R60	57.5	R134a+UV	
71C/O443 8120-99-9120280. 160392-RJ	47.2	Halon 1211, Halon 1301, R12, R114, R22, R134a R407C, R236fa, R245fa, R401A, R403B, R404A, R409A, R410A, R413A and R417A	
71C/O443 8120-99-7367462. 160383-RF	9.4	Halon 1211, Halon 1301, R12, R114, R22, R134a R407C, R236fa, R245fa, R401A, R403B, R404A, R409A, R410A, R413A and R417A	
71C/O443 8120-99-2508963. 161079 RJ	47.2	Sulphur hexafluoride (SF_6)	

2.12.5.15 **Overfilled recovery cylinders**. It is unsafe to overfill recovery cylinders. Under the *Environmental Protection Act (EPA 1990)* all producers of waste refrigerant have a duty of care to ensure:

a. Waste is properly identified on waste transfer documentation.

b. Waste is despatched to certified parties

c. Waste packages are safe to be transported.

2.12.5.16 The risks from overfilling a cylinder are:

a. Possible cylinder rupture during transport and storage

b. Increased risk when handling cylinders, with a potential risk of injury to personnel

c. Damage to the cylinder which will require the cylinder to be scrapped (weakening of the cylinder wall).

2.12.5.17 If a cylinder has been overfilled contact DFG (see Part 1, Chapter 3, Annex A) for further advice. Where cylinders have been overfilled, and returned through the supply chain without the knowledge of DFG or their contractor, apart from the risk of failure and subsequent risk of injury to personnel, the filler would be in breach of legislation and may be liable for any costs for the replacement of that cylinder.

2.12.5.18 **Return of Recovery Cylinders**. Recovered refrigerants, in recovery cylinders, virgin sulphur hexafluoride in opened/part full cylinders and recovered sulphur hexafluoride in recovery cylinders are to be returned in accordance with the current hazardous waste regulations (see Part 1, Chapter 3).

2.12.5.19 As recovered refrigerants and recovered sulphur hexafluoride may be contaminated with oils, water, trace acids, or other breakdown products, used recovery cylinders should be returned promptly to minimise the effects of corrosion on the cylinder walls. They must also be returned whilst they are within their Periodic Inspection and Test Date.

2.12.5.20 Further information on returning damaged or unserviceable cylinders, incident/accident reporting and emergency actions can be found in Part 1, Chapters 6, 7 and 9 respectively. Advice may also be sought from DFG and the DFG/DFG Contractors web portal (see Part 1, Chapter 3).

BIBLIOGRAPHY and JSP 375 MoD Health and Safety Handbook

1. JSP 418 - *MOD Sustainable Development and Environment Manual*.

2. JSP 515 - *MOD Hazardous Stores Information System*.

3. MOD DIN 2005DIN07/004 April 2005 - *New Hazardous Waste Regulations: Guidance for MOD Personnel & Sites That Produce Hazardous Waste on New Site Notification Procedures*.

4. BRF 3007 - *Refrigeration Manual*.

5. *Environmental Protection Act*, 1990. (EPA 1990).

6. H*azardous Waste (England and Wales) Amended Regulations*, 2009. No. 507.

7. *The Special Waste Amendment (Scotland) Regulations*, 2004. No. 112

8. *The Ozone Depleting Substances (Qualifications) Regulations*, 2006.

9. *The Montreal Protocol on Substances that Deplete the Ozone Layer*, as adjusted and/or amended in London 1990; Copenhagen 1992; Vienna 1995; Montreal 1997; Beijing 1999.

10. *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, Adopted 11th December 1997.

11. BS 1710 - *Specification of Identification of Pipelines and Services*.

ANNEX A

(introduced at paragraph 2.12.3.07c)

STANDING PRESSURE TEST

2.12.A.01 Comparing the standing pressure to the ambient temperature where the cylinder has been stored can identify most common refrigerants. This is achieved by using a pressure gauge, thermometer and a slide rule comparitor, or charts and tables.

2.12.A.02 It is important to remember that refrigerant manufacturers' charts and tables and proprietary slide rule comparitors show saturated pressure for various refrigerants. For a refrigerant to be in a saturated condition within a cylinder there has to be both liquid and vapour present. This method of identification, therefore, can only be used if liquid and vapour are present.

Note: The standing pressure test is by no means infallible. If there is any doubt then the refrigerant must be tested using more sophisticated equipment. Some refrigerants have very similar pressure temperature relationships, such as R12 and R134a. This method is not sufficiently accurate to determine the difference.

2.12.A.03 Method:

a. Identify that both liquid and vapour are present.

b. Connect a pressure gauge to the outlet valve and log the measured standing pressure.

c. Accurately obtain the temperature of the cylinder using a surface probe thermometer. This is to be taken where the liquid refrigerant is present. Record the refrigerant temperature.

d. Using a pressure / temperature refrigerant comparitor or charts, compare the relationship of refrigerants and attempt to match the measured data against the recorded data. Ensure you use comparable units of measurement (e.g. bar gauge scale and not bar absolute scale).

2.12.A.04 If a match cannot be found it is possible that the refrigerant is contaminated (e.g. with air or other refrigerants).

ANNEX B

(introduced at paragraph 2.12.2.10)

MOD USED REFRIGERANTS AND 'F' GASES

2.12.B.01 Table 2.12.B1 lists the Global Warming Potential (GWP) and the Ozone Depleting Potential (ODP) for sulphur hexafluoride and a number of refrigerants and 'F' gases used by MOD.

Table 2.12.B1: 'F' gases and their GWP and ODP.

'F' Gas	Chemical Formula	Notes	GWP	ODP
Sulphur hexafluoride	SF_6	1, 4, 6	22200 – 23900	
Chlorofluorocarbons (CFCs) and blended mixtures				
Dichlorodifluoromethane (R12)	CCl_2F_2	2, 3	10600	1.0
Chlorodifluoromethane (R22)	$CHClF_2$	2, 3	1900	0.055
1,2-Dichlorotetrafluoroethane (R114)	$C_2Cl_2F_4$	2,3, 5	9300	1.0
R403B, (Isceon R69L) (5% Propane, 56% R22, 39% Octafluoropropane.)	-	2, 4, 5	3700	
Halons				
Bromochlorodifluoromethane (HALON 1211)	CF_2ClBr	2, 3, 6	1860, 1300	3.0
Bromotrifluoromethane (HALON 1301)	CF_3Br	2, 3, 6	7030, 6900	10.0
Hydroflurocarbons (HFCs) and blended mixtures				
1,1,1,2-Tetrafluoroethane (HFC-134a)	CH_2FCF_3	1, 4, 6	1300, 1320	
HFC-134a + UV	-	2, 4		
HFC-236fa	$C_3H_2F_6$	1, 4, 5	6300	
HFC-245fa	$CHF_2CH_2CH_3$	1, 4, 5	950	
R404A (Near-azeotrope of: 52% HFC-143a, 44% HFC-125 and 4% HFC-134a)	-	2, 4	4540	
R407C (Azeotrope of 23% R32, 25% R125 and 52% R134a.)	-	2, 4, 5	1600	
R409A (60% R22, 25% R124 and 15% R142b)	-	2, 4, 5	1440	
R410A (50% R32 and 50% R125).	-	2, 4, 5	1900	
R413A (88% R134a, 9% R218 and 3% Isobutane)	-	2, 4, 5		

'F' Gas	Chemical Formula	Notes	GWP	ODP
R417A (50% R134a, 46.6% R125 and 3.4% n-butane)	-	2, 4, 5	3200	
R502 (Azeotrope of 48.8% R22 and 51.2% R115)	–			
Perfluorocarbons (PFCs)				
No MOD uses reported to MPTF (see *JSP 418, Volume 2, Leaflet 5*)				
Notes: 1. GWP data taken from ANNEX I of REGULATION (EC) No 842/2006. 2. No GWP data given in ANNEX I of REGULATION (EC) No 842/2006. 3. ODP data taken from ANNEX I of REGULATION (EC) No 2037/2000. 4. No ODP data given in ANNEX I of REGULATION (EC) No 2037/2000. 5. GWP data taken from Contractor's Safety Data Sheet. 6. GWP data from the US Environmental Protection Agency web site: several different values of GWP are given.				

Chapter 13 (M&GS Team Medical Gases Technical Officer).

MEDICAL GASES

SECTION 1 – SCOPE

2.13.1.01 This chapter provides information on medical gases and medical gas cylinders.

SECTION 2 – GENERAL

2.13.2.01 Physically medical gases are similar to other non-medical gases, however they are prescribed for a patient by a doctor. Under the Medicines Act (1968) medical gases are classified as medical products (drugs) and have to meet the specification detailed in the appropriate UK and/or European Pharmacopoeia. Only these approved medical gases are to be used for medical purposes.

Note: Medical gases and medical vacuum systems are not to be used for non-medical purposes, other than a power source for medical equipment or for testing medical equipment."

2.13.2.02 Information on medical gases can be obtained from the Medical & General Supplies Team (M&GS Team). The address and contact details for the M&GS Team is at Part 1, Chapter 4 and JSP 340 and JSP 437. JSP 340 details the Joint Service policy for the provision, supply, management, servicing and repair of medical, dental and veterinary materiel. JSP 437 details the Joint Service Regulations for the engineering support of medical, dental and veterinary equipment

2.13.2.03 M&GS Team authorise the use of all medical products including medical gases. This authorisation is managed by Projects (Equipment) (P(E)). Within the P(E) there are various Equipment Support Managers (ESM's) who liaise with the appropriate Defence Consultant Advisors and medical scale working parties. The Pharmacy & Regulatory Affairs Manager is the responsible person for the M&GS Team Warehouse Dealers Licence.

2.13.2.04 Medical gases are to be demanded via the M&GS Team (procedure detailed within Part 1, Chapter 4).

2.13.2.05 Units are to demand only those medical cylinders listed in Part 1, Chapter 4. These cylinders are all supplied by an authorised MOD contractor. No other medical gas cylinders shall be used without authority from the DFG and the M&GS Team.

2.13.2.06 All obsolete MOD owned medical gas cylinders are to be returned for disposal in accordance with the instructions listed in Part 1, Chapter 6. Part 1, Chapter 3, Section 4, Paragraph 1.3.4.03 provides further details on the procedure to follow for the disposal of MOD owned medical gas cylinders.

2.13.2.07 The DFG supply medical gases for the M&GS Team and is the Technical Authority for the gas cylinders and their associated valves, guards, etc.

2.13.2.08 Medical gases have a life of three years from the date of filling. The expiry date will be indicated on the contents label. Once this life has expired the gas cylinder is to be returned and replaced with a serviceable item.

Note: Liquid medical oxygen is not lifed.

2.13.2.09 Ancillary equipment. Information on ancillary equipment, including medical gas regulators, available for use with medical gas cylinders is detailed at Annex A.

2.13.2.10 **Entonox™**. Nitrous oxide begins to separate out from Entonox™ if the temperature falls below about -6 °C. A homogenous mixture is again obtained when the temperature is raised to above + 10 °C and the cylinder agitated. Before use, to ensure it is properly mixed, cylinders should be stored horizontally for 24 hours at a temperature above + 10 °C. If this is not practicable, before use the cylinders must be maintained at a temperature above + 10 °C for at least 2 hours and then completely inverted 3 times or placed in warm water at body temperature for 5 minutes and then completely inverted 3 times. Detailed information is available on the Safety Data Sheet.

SECTION 3 – MANUFACTURING MEDICAL GASES

2.13.3.01 Manufacturing medical gases. The Medicines and Healthcare products Regulatory Agency (MHRA) is the Executive Agency of the Department of Health which protects and promotes public health and patient safety by ensuring that medicines, healthcare products and medical equipment meet appropriate standards of safety, quality, performance and effectiveness, and are used safely.

2.13.3.02 Any organisation that wishes to manufacture medical gases is required to comply with the requirements of Good Manufacturing Practice (GMP) and must have a Manufacturers Licence issued by the MHRA to manufacture medical gases. This licence will also act as the individual Marketing Authorisations for each product, this will be identified on the labelling of medical gas cylinders.

2.13.3.03 Service units are NOT to manufacture gases for medical purposes without the appropriate authorisation from M&GS Team, AC PT and DFG.

SECTION 4 – MEDICAL GASES, TRANSITION TO WAR

2.13.4.01 Transition to war. Under Transition To War (TTW) conditions ONLY, Medical Oxygen cylinders may be filled with oxygen, produced in Out of Area Operations (OOA), from Liquid Oxygen produced in the Liquid Oxygen and Liquid Nitrogen Production Plants (NSN 71AS/3655-01-3234670). Liquid oxygen and liquid nitrogen produced by these plants is required to comply with Defence Standard 68-284 and Defence Standard 58-96 respectively. Cylinders are only to be filled using the High Pressure Oxygen & Nitrogen Charging Panels, MK8, (AP119L-0612-1235F). Before filling the approval of the DFG, M&GS Team and the AC PT (GSE1d) shall be obtained. All cylinders filled by this method are to be clearly identified as such using the contractor-supplied labels (see Part 2, Chapter 3, Annex C). The use of these cylinders is to be strictly controlled. For further information on cylinder filling (see Part 2, Chapter 5).

SECTION 5 - CONTAMINATED MEDICAL CYLINDERS

2.13.5.01 Handling / returning contaminated medical gas cylinders. When being used in the medical environment, there is the potential for medical cylinders to become contaminated. The contaminants may include:

a. Visible contamination, with blood or other body fluids where there may be a risk to humans from blood borne pathogens such as:

(1) Hepatitis B.

(2) Hepatitis C.

(3) Human Immunodeficiency Virus (HIV).

b. Non-visible contamination, such as:

(1) Methicillin Resistant Staphylococcus Aureus (MRSA).

(2) Severe Acute Respiratory Syndrome (SARS) virus.

(3) Avian Flu virus.

2.13.5.02 To prevent the spread of contamination, any cylinders that are suspected of being, or known to have been, contaminated (externally) are to be controlled and appropriate safety and cleaning/decontamination procedures followed before being returned to the gas cylinder supplier. Cleaning/decontamination is to be carried out to the standard approved by the chief medical officer in theatre. All appropriate bio-security measures are to be taken before cylinders are returned. The gas cylinder is to be returned to the gas cylinder supplier in the appropriate bag as detailed in Annex A, Table 2.13.A1.

WARNING: MOD personnel are not to use chemicals to assist in the cleaning process as these may have a detrimental effect on the cylinder or its gas. As required, seek advice from the DFG (Part 1, Chapter 3, Annex A) or the gas cylinder supplier.

2.13.5.03 Many modern medical cylinders are manufactured using composite materials. The use of certain detergents or chemical cleaning agents may have an adverse effect on the properties of the composite material. Before any cleaning/decontamination takes place using detergents or chemical cleaning agents, or for general advice on returning any cylinders that may have been contaminated contact the DFG (Part 1, Chapter 3, Annex A) or the gas cylinder supplier.

SECTION 6 – MODERN LIGHTWEIGHT COMPOSITE GAS CYLINDERS

2.13.6.01 Modern lightweight composite gas cylinders are the preferred cylinder design for use by military medical personnel. They offer a number of advantages over traditionally manufactured cylinders such as an increased gas capacity and a lighter weight, however they are charged to a greater pressure and, as with all gas cylinders, they do need to be handled and used with care and protected from damage when used in a military environment.

2.13.6.02 These cylinders are supplied complete with an integrated valve and regulator. There is no requirement for an independent regulator.

2.13.6.03 The range of medical cylinders available to demand is detailed in Part 1, Chapter 4, Annex B.

2.13.6.04 These cylinders have been cleared for use in the Forward Edge Battle Area but may only be carried in the Forward Edge Battle Area when the increased "Battlefield" level of risk of not providing medical gas outweighs the increase in "Platform" risk of carrying the medical gases.

WARNING: Testing has shown that penetration by 7.62 mm ammunition causes explosive rupture of the cylinder.

SECTION 7 – MEDICAL GAS PIPELINE SYSTEMS AND DENTAL GAS SYSTEMS

2.13.7.01 All Medical Gas Pipeline Systems (MGPS) and Dental Gas Systems (DAVS), which includes vacuum systems, are to be compliant with the standards required by the Department of Health. Compliance is required with:

a. Health Technical Memorandum (HTM) 02 – Medical Gas Pipeline Systems

(1) Part A, Design, Installation, Validation and Verification.

(2) Part B, Operational Management.

b. HTM-02 Supplements:

(1) Dental Compressed Air and Vacuum (2003).

(2) Medical Gas Systems for Ambulances (1997)

(3) Pressure Systems Safety Regulations (PSSR) 2000. See also JSP 375, Volume 2, Leaflet 30.

2.13.7.02 Only personnel who have had appropriate training, are authorised and who are adequately supervised are to operate, or work on, any part of a MGPS or DAVS. JSP 375, Volume 3, mandates the MOD Safety Rules and Procedures for working on MGPS and DAVS.

2.13.7.03 Each unit is to have its own Operational Policy document clearly identifying personnel with responsibility for MGPS and DAVS, including details of the day-to-day operational requirements, arrangements for control, monitoring of modifications, maintenance, training and management during any emergency situations.

2.13.7.04 For training requirements refer to 1.8.6.07. Refer also to JSP 375, Volume 3.

2.13.7.05 For quality testing of MPGS and DAVS refer to Part 2, Chapter 6, Section 9.

SECTION 8 – HANDLING MEDICAL GAS CYLINDERS

2.13.8.01 Medical staff are to be trained on the safe handling and transportation of gas cylinders within a medical environment.

2.13.8.02 Where patients are mobile and need a regular medical gas supply from a cylinder, consideration needs to be given to providing a cylinder which is within the patients capability to handle. Incidents have occurred where cylinders mounted on a trolley have fallen over and caused injury.

2.13.8.03 When not being moved, gas cylinders are to be securely restrained to prevent them from falling over. Gas cylinders, which are mounted within a gas cylinder trolley, are to be secured to an appropriate strong point to prevent the combined trolley and gas cylinder falling over.

BIBLIOGRAPHY

1. JSP 340 - *Joint Service Regulations for the Management of Medical, Dental and Veterinary Materiel and Equipment*.

2. JSP 375 – *MOD Health and Safety Handbook*.

2. JSP 437 - *Joint Service Regulations for the Engineering Support of Medical, Dental and Veterinary Equipment*.

2. Defence Standard 68-284 - *Compressed Breathing Gases for Aircraft, Diving and Marine Life-Support Applications*.

3. Defence Standard 58-96 - *Pure Gases for Weapons Systems and Detector Cooling Applications.*

4. BS EN 149:2001 - *Respiratory protective devices. Filtering half masks to protect against particles. Requirements, testing, marking*.

5. Health Technical Memorandum (HTM) 02 – *Medical Gas Pipeline Systems*.

6. HTM-02 Supplement*: Dental Compressed Air and Vacuum* (2003).

7. HTM-02 Supplement: *Medical Gas Systems for Ambulances* (1997).

8. *Pressure Systems Safety Regulations* 2000.

ANNEX A

(introduced at paragraph 2.13.2.09)

ANCILLARY EQUIPMENT FOR MEDICAL GAS CYLINDERS

Table 2.13.A1

NSN	Contractor Part No.	Description
71C/6515-99-9126614	888829	Cylinder Key, Bullnose
71C/6515-99-7405257	888876	Cylinder Key, Pin Index
6530-99-8994952	888817	Cylinder Trolley, Type J cylinders
6530-99-9882834	888816	Cylinder Trolley, Type F, HX & ZX cylinders
6530-99-2975818	33410	Carrying bag for DD, CD & RD cylinders
6515-99-7320288	51071	Backpack for ZX lightweight cylinder
6515-99-5514460	51070	Backpack for CD lightweight cylinder
6515-99-9112258	19305689	Valve outlet protection blank. Lightweight cylinders (bag of 500)
6515-99-5736807	8001	Entonox™ Concentrator
6545-99-5052225	No Part No	BOC Lifeline Kit
6680-99-9960673	No Part No.	Oxygen concentrator complete with 24c humidifier low flow meter emergency back-up.
71C/0443 6530-99-9582351	MED/008998/AP UK/0806/10M	Contaminated Cylinder Bag, Plastic, Small, 800 x 290 mm, 1 box, containing 100 bags & 100 cable ties.
71C/0443 6530-99-8729242	MED/008999/AP UK/0806/10M	Contaminated Cylinder Bag, Plastic, Large, 1150 x 320 mm, 1 box, containing 100 bags & 100 cable ties.

Medical regulators.

Information on oxygen regulators is promulgated in AESP 6500-H-108-111. http://dlobicsvr007.dloas.r.mil.uk/TDOL_Release/6500-H-108-111_1_0_SCAN0002_D_H.PDF

Information on entonox regulators is promulgated in AESP 6680-Q-128-111. http://dlobicsvr007.dloas.r.mil.uk/TDOL_Release/20080110-AESP6680-Q-128-111_CRC_U.pdf

Part 2

Chapter 14 (Sponsor – FSAT, SAFETY 3)

DIVING GASES

SECTION 1 – SCOPE

2.14.1.01 This chapter provides information on gases and associated gas cylinders used by military divers, where the gas cylinders are provided to replenish military dive sets. It does not cover diving cylinders that are used underwater.

SECTION 2 – GENERAL

2.14.2.01 The use of diving gases and diving gas mixtures is controlled by written instructions and procedures by the MOD Superintendent of Diving. Detailed information is available in the UK Military Diving Manual BRd 2806 and JSP 375, Volume 2, Leaflet 29 (Diving Safety Policy).

2.14.2.02 DFG are responsible for the provision of bulk diving quality gas in cylinders and Manifolded Cylinder Packs (MCPs). Procedures for the demand and return of diving gas cylinders, and details of available cylinders and MCPs are in Part 1, Chapter 3.

2.14.2.03 All compressed breathing gases procured for military diving applications comply with *Defence Standard 68-284*. A Certificate of Conformity to this specification will be supplied by the DFG contractor with all deliveries of gas cylinders and MCPs. Within NATO military diving gas has to be compliant with STANAG 1458. STANAG 1458 is implemented in the UK via Defence Standard 68-284. The specification and testing requirements for diving gases is detailed in Part 2, Chapter 6.

Note: In the event of a gas being supplied by the DFG contractor which does not meet the required specification DFG (Technical Team Manager) are to be informed. See Part 1, Chapter 3, Annex A.

2.14.2.04 All diving gases have a life expiry date, beyond which they are **NOT** to be used. Typically this is 5 years from the date of fill. The DFG contractor will put a label on each cylinder / MCP it delivers with its expiry date.

2.14.2.05 DFG supplied cylinders and MCPs are **NOT** authorised for use underwater.

2.14.2.06 Where cylinders are used in a salt water environment, all reasonable precautions are to be taken to prevent contact with salt water. In the event of salt water contact then the cylinder is to be thoroughly washed down with fresh water at the earliest opportunity. If the user believes that, for whatever reason, water may have entered the cylinder, the cylinder is to be declared unserviceable and returned. See Part 1, Chapter 6.

2.14.2.07 As divers may operate in explosive areas it is standard practice to provide gas cylinders, and their associated components, that are manufactured from non-magnetic materials.

2.14.2.08 MOD divers are specifically authorised to re-fill DFG supplied compressed air cylinders. To meet this requirement the standard Pressure Retention Valves are removed from compressed air cylinders. Oxygen and mixed gas cylinders are **NOT** to be refilled by anyone other than the DFG contractor. For filling procedures and authorisations see Part 2, Chapter 5.

Notes:

1. Compressed air cylinders are only to be refilled when in date for their Periodic Inspection & Test. If out-of-date then the cylinder is to be replaced. The test life is 5 years.

2. The filler is responsible for ensuring the correct specification and quality of the gas.

2.14.2.09 **Manifolded Cylinder Packs**. DFG provide the following two types of MCP:

a. 'WL' MCPs which consist of 15 cylinders, stored vertically, manifolded together and contained within a frame. These are designed for use within the UK and meet the requirements for the transportation of dangerous goods by road (*JSP 800 Vol 4b / ADR*). These are the preferred MCPs for use in the UK.

b. 'ELD' MCPs which consist of 16 cylinders, stored vertically, manifolded together and contained within a frame. These are more robust than the 'WL' MCPs and are designed for use world-wide. They meet all the requirements for the transportation of dangerous goods by road (*JSP 800 Vol 4b / ADR*) and sea (*Vol 4b / IMDG*) and are also cleared for transportation on military transport aircraft (*JSP 800 Vol 4a superseding JSP 335*). This MCP has also been cleared for carriage as a helicopter underslung load, DAP101A-1105-1B, helicopter underslung load clearance No. 7006 refers. As these are more expensive to supply it is recommended that their use is restricted to areas outside of the UK.

Notes:

1. All MOD owned Mk 12Q MCPs (often referred to as 'Quads') are obsolete and are to be returned for disposal. These consist of 4 cylinders, stored horizontally, manifolded together in an open frame. If required, contact DFG for advice.

2. 'ELD' MCPs are subject to more frequent inspection requirements.

SECTION 3 - QUALITY ASSURANCE

2.14.3.01 **Checking contents of breathing gases**. Although gas supply companies are rigorous in controlling diving breathing gases, experience has shown that it is possible for a gas to be supplied which does not correspond to the cylinder marking.

2.14.3.02 All diving gas cylinders are to be checked on receipt, and re-checked prior to connecting them to a diving gas supply or breathing apparatus charging system. Each check is to ensure that:

a. Gas cylinder “Receipt and Issue” checks are carried out, refer to 2.9.6.05.

b. The precautionary label correctly identifies the gas contents, refer to 2.3.3.11.

c. The gas is “Diving Quality” and it is the correct gas for the system it is to be used in.

d. The colour code aligns with the contents of the cylinder, refer to 2.3.4.13.

e. The Certificate of Conformity is present and aligns with the contents of the cylinder.

f. The gas is in-date for use.

g. The cylinder is in date for its Inspection and Test, refer to 2.3.4.08.

h. The serial number of the cylinder is highlighted.

These checks are to be carried out by a competent person when the gas is delivered to the storage area and again by the person conducting the charging of diving equipment or fitting to a re-compression chamber prior to use.

2.14.3.03 All diving gases are to be analysed prior to use using the test equipment detailed in Part 2, Chapter 6, Section 12, and/or other test equipment approved for use by the Superintendent of Diving. Once analysed this is to be noted on the Certificate of Conformity with the date and name of the person who conducted the check. There is no requirement to re-analyse the storage gas each time it is used provided that the supervisor is content that it has been analysed between delivery and use. If there is any doubt as to the composition of the gas then it is to be re-analysed prior to use.

Notes:

1. When using commercially supplied breathing air MCPs, gas mixtures and pure oxygen, it is recommended that oxygen analysers, fitted with audio and visual Hi-Lo alarms, are provided.

2. Gas analysers typically require calibration just before use, at the immediate location and under the same ambient conditions as the gas cylinder to be tested. Always comply with the manufacturers operating instructions.

2.14.3.04 **Identification of diving gases**. All cylinders and MCPs containing diving gases are to be identified in accordance with Part 2, Chapter 3, additionally the following information shall also be shown:

a. Where the gas is a mixture, the percentage by volume, quoting the percentage of oxygen first.

b. Marked with the words “DIVING QUALITY”.

2.14.3.06 To assist in the identification of individual cylinders and their maintenance history the following details are highlighted on all cylinders supplying diving quality gas:

a. Serial number of the cylinder.

b. The most recent (periodic) inspection and test date.

2.14.3.07 **Quality assurance of compressed natural breathing air**. Where compressed natural breathing air is produced on-site comply with the quality testing requirements detailed in 2.6.4.09.

SECTION 4 – HANDLING AND USE

2.14.4.01 The range of contractor supplied diving gas 20 litre cylinders are fitted with a valve guard (refer to Part 1, Chapter 3, Annex B, Table 4). This valve guard has been designed and manufactured to allow a cylinder to be lifted either manually or by slinging.

2.14.4.02 The gas cylinder supplier will ensure the valve guard is secure and serviceable on delivery. However it is good practice to ensure that the guard is securely attached and that there are no obvious signs of damage before attempting to lift or sling the cylinder.

BIBLIOGRAPHY

1. BRd 2806, Volumes 1 to 6, *UK Military Diving Manual*

2. JSP 375 – *MOD Health and Safety Handbook*

3. JSP 800 *Defence Movement and Transport Regulations*.

4. DAP101A-1105-1B – *Underslung Load Clearances.*

5. Defence Standard 68-284 - *Compressed Breathing Gases for Aircraft, Diving a Marine Life-Support Applications*.

6. STANAG 1458 - *Diving Gas Quality*.

7. ADR - *The European Agreement Concerning the International Carriage of Dangerous Goods by Road*.

8. IMDG - *The International Maritime Dangerous Goods Code*.

9. International Marine Contractors Association (IMCA) D 043, Marking and colour coding of gas cylinders, Quads and Banks for Diving Applications.

Part 2

Chapter 15 (Sponsor – FSAT, SAFETY 3)

WELDING GASES

SECTION 1 – SCOPE

2.15.1.01 This chapter provides information on welding gases and welding gas cylinders.

SECTION 2 – GENERAL, (insert comment – 2.14.02 To be completed)

BIBLIOGRAPHY

1. AP 119G-0008-1 - *Welding Practices and Procedures*.

2. AP 119G-0008-1(N) - *Welding, Brazing and Soldering – Principles, Processes and Approvals*.

Part 2

Chapter 16 (Sponsor – FSAT, SAFETY 3)

LIQUEFIED PETROLEUM GAS (CYLINDERS)

SECTION 1 – SCOPE

2.16.1.01 This chapter specifically covers Liquefied Petroleum Gas (LPG) Cylinders. Bulk LPG is covered in Part 3.

SECTION 2 – GENERAL

2.16.2.01 LPG cylinders are to be demanded/returned using the procedures detailed in Part 1, Chapter 5.

2.16.2.02 **Package Size**. LPG may be measured by volume of liquid or weight. In cylinders it is measured by weight by deducting the empty tare weight of the cylinder from the total weight of the cylinder once filled.

2.16.2.03 **Portable containers**. A portable LPG container is defined as a container with a capacity that does not exceed 150 litres of water, i.e. 150 litre Water Capacity. Portable containers are of two types:

a. Refillable. Referred to as cylinders these are fitted with a manually operated or automatic valve. Butane containers are normally 4.5, 7, 11.3 and 15 kg capacity, however the MOD does not have a contract for the 7 kg capacity cylinder therefore this cylinder is not to be ordered or procured. Propane containers are normally 3.9, 13, 19 and 47 kg capacity. Cylinders usually belong to the supplier and are exchanged on a one for one basis, see Part 1, Chapter 5, Annex B, which uses Calor Gas cylinders as an example).

b. Expendable. Often referred to as cartridges, these containers are for once use only and will either be fitted with a pierceable disc or a self sealing valve. The capacity of an expendable container does not exceed 1.4 litre, i.e.1.4 litre Water Capacity.

SECTION 3 – LPG CYLINDER MARKING AND LABELLING

2.16.3.01 The markings listed in the following paragraphs apply to LPG cylinders procured and used within the UK. Differing standards may apply in other countries and in such cases the information is to be sought from the organisation responsible for setting the contract.

2.16.3.02 All LPG cylinders are to have their contents appropriately identified (see Part 2, Chapter 3). Propane cylinders are normally coloured red and butane cylinders and cartridges are normally coloured blue. The markings applicable to butane and propane cylinders under these regulations are outlined in the Table 2.16.1 (see also Part 1, Chapter 5, Annex B, which uses Calor LPG Gas Cylinders as an example).

Table 2.16.1

ITEM	BUTANE	PROPANE	REMARKS
Supplier	Name, Address & Telephone No	Name Address & Telephone No	See Note 1
Danger warning Symbol	Class 2.1	Class 2.1	See Note 2
Risk Phrase	Extremely Flammable	Extremely Flammable	
Product Name	Butane	Propane	
UN Number	1011	1978	See Note 3
Nett Contents	xxx kg	xxx kg	
Notes: 1. To be sufficient for clear identification and contact. The telephone number is for information purposes only and does not need to be continuously manned. 2. The symbol should be as large as practicable up to 100 mm sides. It is to be clearly displayed on the cylinder (see Part 2, Chapter 3). 3. There are also other products e.g. unstenched LPG UN 1965 Hydrocarbon gas mixture N.O.S.			

2.16.3.03 Cylinders will also display the following information:

a. Manufacturer's mark and serial number.

b. Design code and year of manufacture.

c. Date of pressure test and test pressure (bar).

d. Minimum water capacity (litres).

e. Tare weight (kg).

2.16.3.04 Marking of the cylinders may be achieved by body stencilling or printing or by attached labels to either the body or shoulder, or by the use of neck ring labels etc. The words and phrases may be dispersed if practical constraints prevent them being brought together.

SECTION 4 – LPG CYLINDER HANDLING

2.16.4.01 Cylinders containing LPG are designed to give liquid or vapour off-take.

a. Vapour off-take must be used in the vertical position.

b. Liquid off-take must be stored and used in the position indicated on the cylinder.

2.16.4.02 Where a safety valve is fitted, LPG cylinders are always to be handled in the upright position, valve uppermost, to ensure the correct operation of the safety valve.

2.16.4.03 Where applicable suitable handling equipment is to be provided in order that cylinders can be handled efficiently and safely without damage to either the cylinder or danger to the individual. Personnel handling cylinders are to ensure that the process has been risk assessed and that they wear the appropriate PPE (see Part 2, Chapter 2).

2.16.4.04 Always check cylinder connections and hoses regularly and replace hoses as soon as you spot cracks. Reveal leaks by applying soapy water to all connections - where there are bubbles, there are leaks. Tests for suspected leaks are not to be made with a naked light. Recommended leak detection equipment is detailed in Part 2, Chapter 17, Section 3.

2.16.4.05 Remember that LPG is heavier than air and will not disperse in a confined space. Do not allow the vapour to enter drains or ducts.

2.16.4.06 Change or connect LPG to an appliance in the open air. Always use the appropriate PPE (see Part 2, Chapter 2).

2.16.4.07 Ensure LPG appliances are used only in well-ventilated areas.

2.16.4.08 Never smoke or have a naked flame near a LPG cylinder which is being changed. Beware of sparks from electrical tools, grinders, welding equipment, cooking equipment, etc.

2.16.4.09 If you smell the distinctive odour of LPG turn off the gas and get the appliance checked. Avoid inhalation of vapour.

2.16.4.10 The actions to be taken in the event of a LPG leak are detailed in Part 1, Chapter 9 and Part 3, Chapter 5.

2.16.4.11 No attempt is to be made to heat a container. If the cylinder or the labelling appears to show heat or scorch marks do not use the cylinder. Seek advice immediately from the supplier or the FLC (see Part 1, Chapter 9).

WARNING: Users should be aware that an LPG cylinder involved in a fire may fail catastrophically, resulting in Boiling Liquid Expanding Vapour Explosion (BLEVE). DO NOT attempt to extinguish a cylinder that is alight (see Part 1, Chapter 9 and Part 3, Chapters 5 and 6).

2.16.4.12 Filled containers are to be capped, and plugs fitted where applicable during storage and transportation. Caps or plugs are not to be removed without making sure that the container valve is closed.

2.16.4.13 Valves on empty containers are to be closed, capped or plugged and if supplied, the valve protecting cover is to be in place.

2.16.4.14 Empty expendable cartridges are to be treated as potentially dangerous waste particularly if significant numbers are to be disposed of. Units are to contact their FLCs to ascertain the extant disposal instructions.

2.16.4.15 Store spare cylinders outside but not below ground level. Cylinders are not to be stacked unless designed to do so. The maximum height of unpalletised cylinders is not to exceed 2.5 m. The distance between palletised and unpalletised stacks should not be less than 1.5 m and where access is required for mechanical handling equipment (MHE) this distance should be a minimum of 2.5 m.

2.16.4.16 The maximum amount of LPG that can be stored vertically in any one column is to be in accordance with Table 2.16.2:

Table 2.16.2

Amount of LPG in any cylinder (kg)	Palletised (kg)	Un-palletised (kg)
<6	35	30
6 - 15	75	45
16 - 20	80	50
21 - 55	110	55

2.16.4.17 Further information on the storage of LPG gas cylinders is located at Part 2, Chapter 9.

2.16.4.18 Guidance for the safe handling and storage of LPG cylinders for units whilst on exercise is located at Annex A.

SECTION 5 – LPG CYLINDER MAINTENANCE

2.16.5.01 Cylinders are usually owned by the supplier who has the responsibility for their testing and maintenance at the prescribed intervals. MOD personnel are not to carry out any maintenance activities on LPG cylinders. If a suspect or damaged cylinder is encountered the supplier is to be advised after removing the cylinder to a well-ventilated location and applying an applying an Equipment Conditioning Label, (U/S) (e.g. *MOD Form 731*) detailing the problem (see Part 1, Chapter 6). Additionally, if the cylinders are leaking the actions detailed in Part 3, Chapter 5 are to be followed.

2.16.5.02 It is important that all threads of cylinders, valves and seatings are kept free from dirt and foreign matter. No oil or grease is to be used to lubricate the cylinder valves.

BIBLIOGRAPHY

1. MOD Form 731 - *Equipment Conditioning Label*.

ANNEX A

(introduced at paragraph 2.16.4.18)

UNIT GUIDE TO THE SAFE HANDLING AND STORAGE OF LPG CYLINDERS ON EXERCISE

2.16.A.01 **General**

a. Handle cylinders with care and avoid damaging the valve.

b. Always store cylinders upright.

c. Always ensure that valve protectors are fitted and secure.

d. Only store the minimum number of cylinders necessary.

e. Do not store LPG cylinders with fuel, lubricants, oils, greases, ammunition or any other hazardous or readily combustible stores.

f. Do not allow smoking or naked lights near LPG.

g. Do not place cylinders in locations that will hinder escape in an emergency.

h. Do read the safety data sheets and learn the hazards associated with LPG.

2.16.A.02 **Site Location**

a. Level and firm enough to support the cylinders. Limited quantities of LPG may be left on 'wheels'. Ensure the canopy is rolled up to provide maximum ventilation.

b. If storage is indoors, the building is to be well ventilated and not used as sleeping accommodation.

c. Only store cylinders on the ground floor and do not block escape routes. Never store cylinders in cellars or below ground level.

d. Avoid areas close to drains pits and gullies and do not store beneath power lines.

2.16.A.03 **Fire Precautions**

a. Provide a minimum of two fire extinguishers suitable for use on a Class C (gases or liquefiable gases) fire. It is recommended that these should be 2 x 9 kg dry powder extinguishers.

b. Keep the area surrounding the cylinders free from combustible materials as far as is practicable.

c. Ensure that emergency drills are known and practised.

2.16.A.04 **Action on Discovering a Leaking Cylinder**

a. If the cylinder is not alight and it is safe to do so, the cylinder valve should be closed (remember that escaping gas can cause the exit point to become very cold causing frost burns if touched).

b. Evacuate people from the immediate area and isolate and identify the damaged cylinder.

c. If the cylinder is alight raise the fire alarm. Do not attempt to extinguish the flame from a leaking cylinder.

Part 2

Chapter 17 (Sponsor – FSAT, SAFETY 3)

ACCESSORIES

SECTION 1 – SCOPE

2.17.1.01 This chapter discusses a variety of ancillary equipment attached to, or directly associated with the use of, gas cylinders. The information provided is not comprehensive, but is sufficient for the majority of applications within the military and can be used as examples of best practice.

SECTION 2 – VALVES

2.17.2.01 **Valves**. Flammable gas valves have a left-hand thread on the valve outlet. Non-flammable gas valves have a right-hand thread on the valve outlet.

2.17.2.02 **Cylinder valve operation**. The DFG provide a range of valve spindle keys suitable for opening or closing valves (see Table 2.17.1). Alternatively, many cylinder valves used by the MOD are fitted with handwheels.

Table 2.17.1

Description	Contractor Part No.	NSN
Bullnose cylinder key	888829	71C/O443/6515-99-9126614
'T' handle valve key	10034405	71C/O443/8120-99-8494059
Medical spindle keys		
Bullnose cylinder key	888829	71C/O443/6515-99-9126614
Pin index cylinder key	888876	71C/O443/6515-99-7405257

2.17.2.03 Before using a spindle key examine it for defects, such as excessive wear or cracks. Do not use defective spindle keys. If defective replace with a serviceable item.

2.17.2.04 Cylinder valves should be opened slowly (anti-clockwise) using the correct spindle key or handwheel.

2.17.2.05 Soft seat, spindle key operated cylinder valves should not be subjected to excessive torque.

2.17.2.06 An opened valve should not be left against its backstop, but should be turned back at least half a turn to avoid seizure in an open position.

2.17.2.07 When closing a valve, turn it clockwise just enough to stop the gas completely. Never wrench it shut. Do not leave cylinder keys fitted into cylinder valves. Always remove after use.

Note: All cylinder valve spindles have right-hand threads, whether they control flammable or non-flammable gases.

2.17.2.08 Only use the recommended keys for operating valves. Never increase the leverage of keys or use longer versions. Do not use spanners with long handles. If the valve spindle is too stiff to open by hand, using the spindle key, return the cylinder as unserviceable (see Part 1, Chapter 6).

2.17.2.09 If the valve has a broken or damaged spindle, do not try to get gas out. Do not attempt to remove the gland nut, the broken spindle could be ejected or unwound at great risk to the operator. Contact DFG, the cylinder owner or the responsible Support Authority for advice. Return as unserviceable (see Part 1, Chapter 6).

2.17.2.10 **Valve protection devices**. The majority of contractor owned gas cylinders are supplied with tamperproof heat-shrink seals covering, in whole or part, the valve outlet and the valve spindle. Many cylinders will have plastic disposable valve caps fitted. These protective devices are to be left in place and only removed immediately before use. They help to prevent contamination and provide a visual indication as to whether the gas cylinder has been used.

2.17.2.11 Many cylinders are fitted with a protective “3/4” valve guard that protects the valve outlet and the valve spindle from mechanical damage during handling, transportation and storage. These guards shall not be removed by the user; access is available to both the outlet and the valve through cut-outs in the guard.

2.17.2.12 Certain cylinders (e.g. aviation 50 litre Water Capacity cylinders) are provided with a spring-loaded plastic valve cap which provides protection for the valve outlet, which is vertical, from entry of rain water and other contaminants. These valve caps shall not be removed by the user.

2.17.2.13 Certain cylinders (mainly older designs) are supplied with a metal valve protection cap that screws onto a threaded portion of the cylinder’s shoulder. The valve protection cap shall be kept on the cylinder during handling, transportation and storage; it is to be removed only when the cylinder is in use and refitted immediately afterwards. The user is responsible for the safe storage of valve protection caps when they are removed from a cylinder.

2.17.2.14 **Valve sealant**. Only oxygen compatible polytetrafluoroethylene (PTFE) to BS 7786 is to be used as a valve sealant. See Table 2.10.3. The procedures detailed in BS EN ISO 13341 for the fitting of valves to gas cylinders are to be followed.

SECTION 3 – LEAK DETECTION

2.17.3.01 Leak detection can be carried out using special equipment such as ‘sniffers’ or manometers. However, the simplest means of checking that an assembly is leakproof is by coating the fittings with a surface active liquid after the system is pressurised. Any leak is revealed by the formation of a bubble which is seen to expand.

Note: The gas-tightness of the fittings of an assembly are never to be checked by the application of a low flame to gaskets and fittings.

2.17.3.02 Only approved leak detection fluids are to be used on gas cylinders. The use of certain chemicals can affect the integrity of cylinders and/or valves. Ammonia in association with oxygen and water, is very frequently responsible for stress corrosion cracking of copper based alloys such as brass, which are often used for manufacturing cylinder valves. Also, consideration should be given to the likely presence of halide ions (usually chloride). Though not necessarily harmful to steel or brass surfaces, they do cause significant damage to aluminium alloy cylinders in the form of pitting corrosion. Further, the progressive accumulation of residues often in the form of a thin film of fatty acids, especially in the valve outlet, can cause an ignition in an oxygen environment.

2.17.3.03 The user will need to make their own decision on which leak detection fluid to use taking into account the following:

a. Avoid using leak detection fluids which contain ammonia / ammonium radicals.

b. Avoid using leak detection fluids that contain halide ions especially in conjunction with aluminium alloy cylinders.

c. Select leak detection fluids having a residue with an auto-ignition temperature (as measured using an oxygen environment), which is compatible with the intended application.

d. Carefully use the most diluted solution of a leak detection fluid consistent with the leak detection cycle.

e. General detergents or soapy water solutions are not to be used for leak detection.

2.17.3.04 After the check has been completed ensure the area is dry by wiping with a clean lint free cloth.

Table 2.17.2: Recommended Leak Detection Fluids

Description	Quantity	Support Authority	Contractor Part No.	NSN
Teepol™ HB7	5 litre container	DFG	11833457	71C/O443-6665-99-1335974
Teepol™ HB7 hand spray	800 ml container	DFG	57801	71C/0443/6665-99-6665330

Notes:

1. Teepol HB7 is provided ready for use (1% Teepol HB7 solution in distilled water).

2. Swagelok SNOOP® is **NOT** to be used as a leak detection fluid for use on gas cylinders and their fittings. Some containers have been found to contain ammonia.

2.17.3.05 The DFG provide a cylinder valve leak tester (bubble tester).

Table 2.17.3:

Description	Contractor Part No.	NSN
Cylinder valve leak tester	13140053	71C/0443/8120-99-3974578

2.17.3.06 The DFG also provide a residual gas valve tester (prodder) use with for gas cylinders fitted with outlet valves containing positive residue pressure devices:

Table 2.17.4

Description	Contractor Part No.	NSN
Residual gas valve tester	11857003	71C/O443-8120-99-9580541

SECTION 4 – PRESSURE REGULATORS

2.17.4.01 Gas cylinders and their associated outlet valves are designed to supply gas through approved pressure regulators. This also applies to the outlet valve(s) on multi-cylinder packs.

2.17.4.02 Fitted to the outlet of the gas cylinder valve, the pressure regulator reduces the pressure of the gas from the cylinder pressure to the lower pressure required for the operation of the process equipment. Regulators may be designed to be adjustable in respect of outlet pressure or flow or may be pre-set.

2.17.4.03 Pressure reduction within the regulators may be in 1 or 2 stages. Multi-stage regulators provide a more precise and consistent pressure.

2.17.4.04 Pressure regulators may be supplied with a pressure gauge or indicator to show the cylinder contents and a pressure gauge or flowmeter to indicate the outlet pressure or flow.

2.17.4.05 Pressure regulators shall conform to an approved standard, such as *BS EN ISO 2503* (Gas welding equipment. Pressure regulators for gas cylinders used in welding, cutting and allied processes up to 300 bar) or *BS EN 738* (*Pressure regulators for use with medical gases*) or *BS EN ISO 10524-1* (*Pressure regulators for use with medical gases. Part 1: Pressure regulators and pressure regulators with flow-metering devices*). Regulators conforming to previous standards *BS EN 585* (for regulators up to and including 200 bar), or *BS 7650* (for regulators up to and including 300 bar) are also suitable for continued use provided they are within life and are not used beyond their original design pressures.

Note: Regulator repairers may be unable to repair or refurbish regulators made to withdrawn standards. Regulators outside the scope of these standards shall conform to the essential safety requirements of these standards.

2.17.4.06 Never install additional piping or fittings between regulators and the outlet valves. Use needle or fine adjustment valves downstream of the pressure regulator only, never upstream.

2.17.4.07 Pressure regulators should be treated as precision instruments and should not be jarred or knocked. They should not be stressed by rapid opening of the cylinder valve. (This is also important to prevent ignition in oxygen systems from adiabatic compression of the gas).

2.17.4.08 Whether they are in store or in use, inlet and outlet connections must be kept free of contaminants, including water, dirt, grit, any form of oil, grease or solvents. Contaminated units must not be used and must be removed from service. Always examine the inlets/outlets of the regulator before use and ensure they are free of contamination.

2.17.4.09 Regulators are designed for use with a particular gas. A regulator shall not be used with any gas other than that for which it is designed and labelled.

2.17.4.10 A regulator shall be suitable for the maximum cylinder pressure being used and shall be marked with the maximum inlet pressure and delivery pressure.

2.17.4.11 Regulators having damaged pressure gauges, pressure indicators, inlet or outlet connections, or threads, shall not be used. Do not use regulators with external damage to the housing. This may have caused damage to internal components.

2.17.4.12 Outlet pressure shall not be set in excess of that needed for the operation in hand. The regulator pressure adjusting screw shall be set to the zero pressure position when the regulator is not in use by turning the control knob fully anti-clockwise. *BS EN ISO 2503* states that the pressure adjusting screw shall be captive to prevent inter-changeability between regulators.

2.17.4.13 To prevent oxygen ignition of components, oxygen regulators shall be kept free from oil or grease and be suitable for the maximum cylinder pressure being used. The oxygen cylinder valve shall be opened slowly.

2.17.4.14 Before attaching a regulator to a cylinder, check first that the cylinder is correctly identified and that the regulator is suitable for the duty (design pressure required, outlet pressure range, gas type and maximum flow-rate). Always ensure that the pressure adjusting screw is set to the zero pressure position so that there can be no flow through the regulator when the cylinder valve is opened.

2.17.4.15 Inspect the inlet connection for damage and ensure the inlet filter is in place and is not blocked or contaminated. If an ‘O’ ring is fitted to the inlet, check for damage and replace, if necessary, with an ‘O’ ring recommended by the regulator manufacturer.

2.17.4.16 Always ensure that the threads on the valve outlet are compatible with the mating threads on the regulator. Do not use any form of jointing paste or tape between the regulator and cylinder valve. Do not apply oil or grease to regulator threads.

2.17.4.17 All regulators shall be identified with a life, on expiry of which they are to be removed from service and either totally refurbished or replaced. Typically this life is five years.

Notes:

1. This life is set at the time of manufacture and is based on the deterioration over time of certain components and the potential for internal corrosion. When procuring regulators as stock items this life still applies. Although a regulator may not be in-use it will still deteriorate whilst in a store.

2. Regulators manufactured before 1997 may not be marked with a replacement date. These regulators are to be replaced, unless they are clearly identified as being refurbished and within any additional service life.

2.17.4.18 Repairs, or maintenance, to regulators is only to be carried out by trained, authorised, competent personnel. Modification of regulators is forbidden. If design changes are required seek the advice of the manufacturer.

2.17.4.19 Annex A provides guidance on maintenance and examination of regulators.

2.17.4.20 The DFG are able to source a range of regulators from their Prime Contractor which are suitable for use with DFG supplied gas cylinders.

SECTION 5 – FLAME (FLASHBACK) ARRESTORS

2.17.5.01 A safety device which arrests a flame front (caused by flashback or decomposition) from travelling back into a gas cylinder and which is suitable for the most severe type of flame which may occur, i.e. detonation. It is designed to be effective in stopping a flame forming from either one or both directions, depending upon the application and design. Some designs may incorporate a pressure cut-off valve and/or a temperature cut-off valve, which will automatically shut-off the gas flow. Typically flashback arrestors are used in oxygen, acetylene, propane and hydrogen systems.

2.17.5.02 When fitting flashback arrestors ensure that all threads and seats are in good condition. Mount the device in accordance with supplier's instructions, taking particular care of the correct direction of flow for the device. The direction of flow is normally indicated with an arrow.

2.17.5.03 Flashback arrestors are fitted downstream of the pressure regulator either on, or very close to, the regulator.

2.17.5.04 All flashback arrestors shall be identified with a life, on expiry of which they are to be removed from service and either totally refurbished or replaced. Typically this life is five years.

Note: This life is set at the time of manufacture and is based on the deterioration over time of certain components. When procuring flashback arrestors for stock this life still applies even if the item has not been used.

2.17.5.05 Annex A provides guidance on maintenance and examination of flashback arrestors.

SECTION 6 – PRESSURE GAUGES

2.17.6.01 An instrument for indicating, by pointer and calibrated scale, the amount by which the pressure applied to it differs from that of the surrounding atmosphere. Some pressure gauges are designed for use with a particular gas, e.g. oxygen, and will be labelled as such. These pressure gauges shall not be used with any gas other than that for which they are designed and labelled.

2.17.6.02 All pressure gauges will be subject to periodic calibration. Refer to the appropriate equipment publications, or responsible Support Authority, for further advice.

Note: Some pressure gauges may be de-rated to act as indicators and as such may not require calibration. Refer to the appropriate equipment publications, or responsible Support Authority, for further advice.

2.17.6.03 The pressure range of a gauge should be such that the maximum working pressure does not exceed 75% of the maximum scale value for steady pressure or 65% of the maximum scale value for cyclic pressures.

SECTION 7 – HOSES

2.17.7.01 The means by which the gases are conveyed from the pressure regulator to the process equipment. Hose assemblies can be used to convey the gas from the cylinder to the process equipment at pressures up to the maximum regulator outlet pressure.

2.17.7.02 Hoses shall be of a composition compatible with the gas with which they are to be used. Hoses shall not be used for gases, or at pressures, other than those for which they have been designed. The internal hose lining contains the material that comes in contact with the gas. Certain chemicals can attack hose linings and these differ from gas to gas. For example, a lining suitable for acetylene is not resistant to the chemicals found in propane.

2.17.7.03 All hoses are to be identified with the following information:

a. The gas they contain.

b. Maximum design (test) pressure.

c. Date of manufacture and/or expiry life.

d. The manufacturing standard.

e. Direction of flow.

2.17.7.04 When used for welding applications (*BS EN 559* refers) hoses are colour coded or marked with the gas name to prevent inadvertent use of the wrong hose; hose assemblies are fitted with left-hand threads for fuel gases and right-hand threads for oxygen and inert gases.

Table 2.17.5

Gas	Hose Colour	Thread
Oxygen	Blue	Right hand
LPG/Methane	Orange	Left hand
Hydrogen/Acetylene	Red	Left hand
Inert Gases	Black	Right hand
Mixed gas (flammable and inert)	Red	Left hand
Mixed gas (Oxygen and inert)	Blue	Right hand

2.17.7.05 All welding hoses are to be manufactured to an approved recognised standard. The following standards are applicable for welding hoses and hose assemblies:

BS EN 559	Gas welding equipment. Rubber hoses for welding, cutting and allied processes. Note: To be assembled and tested in accordance with BS EN 1256.
BS EN 1256	Gas welding equipment. Specification for hose assemblies for equipment for welding, cutting and allied processes.
BS EN 1327	Gas welding equipment. Thermoplastic hoses for welding and allied processes.
BS 5120	Specification for rubber hoses for gas welding and allied processes. Superseded by BS EN 559.
BS EN ISO 14113	Gas welding equipment. Rubber and plastic hoses assembled for compressed or liquefied gases up to a maximum design pressure of 450 bar.
BS EN 560	Gas welding equipment. Hose connections for welding, cutting and allied processes.
BS EN 561	Gas welding equipment. Quick action couplings with shut-off valves for welding, cutting and allied processes.

2.17.7.06 All medical hoses are to be manufactured to an approved recognised standard. The following standards are applicable for medical hoses and hose assemblies:

BS EN 737	Medical gas pipeline systems
BS EN 739	Low-pressure hose assemblies for use with medical gases

2.17.7.07 Other gas hose approved standards include:

BS 5118	Specification for rubber hoses for compressed air. Note: Superseded by *BS EN ISO 2398*.
BS EN ISO 2398	Rubber hose, textile reinforced, for compressed air. Specification.
BS EN ISO 5774	Plastic hoses, textile reinforced, for compressed air. Specification.

2.17.7.08 The condition of the hose is of vital importance to safety. Correct hose connections, properly fitted and tested and retained by suitable clips or ferrules, are also essential. Re-usable worm-drive clamps shall **not** be used. Hoses shall be protected from heat, mechanical damage, sparks, oil or grease.

2.17.7.09 Hose lengths should not be adjusted. Hoses should not be longer than is necessary for the work in hand. It is recommended that where long lengths of hose are often used, a permanent, piped system, in accordance with BCGA Codes of Practice CP4 or CP6, should be considered. This is particularly important for hoses used for the supply of very dry gases, such as aviation standard oxygen or nitrogen.

2.17.7.10 On many hoses, the danger of "whipping" from the uncontrolled leakage of gas from a hose can be reduced by fitting whip restraints. These are usually strong, but flexible steel cables which reinforce the hose assembly (either internally or externally) and reduce the lash effect. These whip restraints should be regularly examined for signs of weakness, defects or corrosion and replaced as necessary.

2.17.7.11 Since a fire in a coiled hose is difficult to extinguish, oxygen or fuel gas hoses should not be coiled around the cylinders, regulators or cylinder trolley during operation.

2.17.7.12 Always replace hoses when the general condition shows signs of deterioration.

2.17.7.13 Hose connections to process equipment with non-standard threads shall be made and tested generally in accordance with *BS EN 1256* or *BS EN ISO 14113*.

2.17.7.14 Before fitting the hoses to the safety device or regulator, as appropriate, examine all fittings, threads, connection seatings and clips. Also, check for signs of cuts, abrasions, burns or general deterioration. Reject any hose that shows signs of damage under any of the headings mentioned above.

2.17.7.15 All hoses are to be blanked when not in use to prevent the ingress of contamination. Hoses are to be purged before use to ensure they are free of contamination.

2.17.7.16 Annex A provides guidance on maintenance and examination of hoses.

SECTION 8 - ADAPTORS

2.17.8.01 Adaptors may be required when British standard regulators are used in conjunction with some cylinders from non-European countries or European countries using their own National specifications.

2.17.8.02 Table 2.17.6 lists the thread details and drawing numbers of suitable adaptors that may be used when using oxygen and acetylene.

2.17.8.03 The threads on the British regulators are:

Oxygen	0.625 - BSP - F14 - r.h. – External
Acetylene	0.625 - BSP - F14 - l.h. External

2.17.8.04 The British regulators fit, without adaptors, to the cylinders of the following countries:

Australia	oxygen and acetylene
France	acetylene only
India	oxygen and acetylene
Ireland	oxygen and acetylene
Netherlands	oxygen only
New Zealand	oxygen and acetylene
South Africa	oxygen and acetylene
United Kingdom	oxygen and acetylene

2.17.8.05 If it is impossible to obtain the adaptors listed in Table 2.17.6, they may be manufactured in workshops. All adaptors are to be cleaned to a standard suitable for use with oxygen. Drawings (Table 2.17.6, column 4) are obtainable from the DFG (see Part 1, Chapter 3, Annex A).

Table 2.17.6

Country (1)	**Cylinder** (2)	**Adaptor Details** (3)	**Drawing Number** (4)
Austria	Oxygen Acetylene	Adaptor - 0.860 - BSW 14 - r.h. External Clamp	V 10327/7 V10327/8 (WTG 12388) V 10327/1 (WTG 12389)
Canada	Oxygen Acetylene	Adaptor - 0.903 - 14 NGO - r.h. External Adaptor - 0.885 - 14 NGO - l.h. Internal	V 10327/7 V 10327/8 (WTG 12390) V 10327/6 V 10327/9 (WTG 12391)
Czechoslovakia	Oxygen Oxygen Acetylene	Adaptor - 0.860 - BSW 14 - r.h. External Adaptor - 0.750 - BSP - F14 - r.h. External Clamp	V 10327/7 V 10327/8 (WTG 12388) V 10327/7 V 10327/8 (WTG 12392) V 10327/1 (WTG 12389)
Germany	Oxygen Acetylene	Adaptor - 0.750 - BSP - F14 - r.h. External Clamp	V 10327/7 V 10327/8 (WTG 12389) V 10327/1 (WTG 12389)
Denmark	Oxygen Acetylene	Adaptor - 0.860 - BSW 14 - r.h. External Adaptor - 0.750 - BSP - F14 - r.h. Internal	V 10327/7 V 10327/8 (WTG 12388) V 10327/1 (WTG 12389)
France	Oxygen Acetylene	Adaptor - S1 - r.h. Internal Clamp	V 10327/6 V 10327/10 V 10327/1 (WTG 12389)
Hungary	Oxygen Acetylene	Adaptor - 0.860 - BSW 14 - r.h. External Clamp	V 10327/7 V 10327/8 (WTG 12388) V 10327/1 (WTG 12389)
Italy	Oxygen Acetylene	Adaptor - 0.860 - BSW 14 - r.h. External Clamp	V 10327/7 V 10327/8 (WTG 12388) V 10327/1

			(WTG 12389)
Netherlands	Acetylene	Clamp	V 10327/1 (WTG 12389)
Norway	Oxygen Acetylene	Adaptor - 0.860 - BSW 14 - r.h. External Adaptor - 0.750 - BSP - F14 r.h. Internal	V 10327/7 V 10327/8 (WTG 12388) V 10327/6 V 10327/10 (WTG 12393)
Poland	Oxygen Acetylene	Adaptor - 0.750 - BSP - F14 r.h. External Clamp	V 10327/7 V 10327/8 (WTG 12392) V 10327/1 (WTG 12389)
Sweden	Oxygen Acetylene	Adaptor - 0.860 - BSW 14 - r.h. External Adaptor - 0.750 - BSP - F14 - r.h. Internal	V 10327/7 V 10327/8 (WTG 12388) V 10327/6 V 10327/10 (WTG 12393)
Russia	Oxygen Oxygen Acetylene	Adaptor - S1 - r.h. External Adaptor - 0.750 - BSP - F14 - r.h. External Clamp	V 1032717 V 10327/8 (WTG 12395) V 10327/7 V 10327/8 (WTG 12392) V 10327/1 (WTG 12389)
United States of America	Oxygen Acetylene	Adaptor - 0.903 - 14 NGO - r.h. External Adaptor - 0.885 - 14 NGO - l.h. Internal	V 10327/6 V 10327/10 (WTG 12390) V 10327/6 V 10327/10 (WTG 12391)

BIBLIOGRAPHY

1. BS 5118 - *Specification for Rubber Hoses for Compressed Air*.
Note: Superseded by BS EN ISO 2398.

2. BS 5120 - *Specification for Rubber Hoses for Gas Welding and Allied Processes*. Superseded by BS EN 559.

3. BS 7650 - *Specification for Pressure Regulators Used in Welding, Cutting and Related Processes with Compressed Gases up to 300 bar*.
Note: Superseded by BS EN ISO 2503.

4. BS 7786 - *Specification for unsintered PTFE tapes for general use*.

5. BS EN ISO 13341 - *Transportable gas cylinders. Fitting of valves to gas cylinders*.

6. BS EN 559 - *Gas Welding Equipment. Rubber Hoses for Welding, Cutting and Allied Processes*.

7. BS EN 560 - *Gas Welding Equipment. Hose Connections for Welding, Cutting and Allied Processes*.

8. BS EN 561 - *Gas Welding Equipment. Quick Action Couplings with Shut-off Valves for Welding, Cutting and Allied Processes*.

9. BS EN 585 - *Gas Welding Equipment. Pressure Regulators for Gas Cylinders Used in Welding, Cutting and Allied Processes up to 200 bar*.
Note: Superseded by BS EN ISO 2503.

10. BS EN 737 - *Medical Gas Pipeline Systems*.

11. BS EN 738 - *Pressure Regulators for Use With Medical Gases*.
Note: Part 1 is superseded by BS EN ISO 10524-1.

12. BS EN 739 - *Low-Pressure Hose Assemblies for Use With Medical Gases*.

13. BS EN 1256 - *Gas Welding Equipment. Specification for Hose Assemblies for Equipment for Welding, Cutting and Allied Processes*.

14. BS EN 1327 - *Gas Welding Equipment. Thermoplastic Hoses for Welding and Allied Processes*.

15. BS EN ISO 2398 - *Rubber Hoses, Textile Reinforced, for Compressed Air. Specification*.

16. BS EN ISO 2503 - *Gas welding equipment. Pressure Regulators for Gas Cylinders used in Welding, Cutting and Allied Processes up to 300 bar*.

17. BS EN ISO 5774 - *Plastic Hoses, Textile Reinforced, for Compressed Air. Specification*.

18. BS EN ISO 10524-1 - *Pressure Regulators for Use With Medical Gases. Part 1: Pressure Regulators and Pressure Regulators With Flow-Metering Devices.*

19. BS EN ISO 14113 - *Gas Welding Equipment. Rubber and Plastic Hoses Assembled for Compressed or Liquefied Gases up to a Maximum Design Pressure of 450 bar*.

20. BCGA Code of Practice CP7 - *The Safe Use of Oxy-Fuel Gas Equipment (Individual Portable or Mobile Cylinder Supply*.

21. BCGA Code of Practice CP17 - *The Repair of Hand-Held Blowpipes and Gas Regulators Used With Compressed Gases for Welding, Cutting and Related Processes*.

22. BCGA Guidance Note GN7 - *The Safe Use of Individual Portable or Mobile Cylinder Gas Supply.*

ANNEX A

(introduced at paragraph 2.17.4.19)

Table 2.17.A1: Guidance on maintenance & examination

EQUIPMENT	MAINTENANCE			
	EACH TIME THE EQUIPMENT IS USED (by the Operator) - Carry out visual examination to determine suitability for service (e.g. gas, pressure rating, damage), oil or grease contamination. Check hoses for condition of cover (e.g. kinking twisting or cracking). Check that pressure gauge on regulator zeroes correctly and rises smoothly when gas is turned on. This applies to the regulator incorporated in cylinder valves with integral pressure regulators. Leak test all joints at working pressure.			
	As per the manufacturer's instructions, and to include: Each time the equipment is connected together	**ANNUAL** ** To include, as per instructions for each time the equipment is connected together, plus:	**REPLACEMENT or REFURBISHMENT INTERVALS** (Subject to conditions of use)	**REPLACEMENT or REFURBISHMENT GUIDELINE**
1. **REGULATORS** and their integral protective devices	Check condition of threads and sealing surfaces, oil or grease contamination. Leak test all joints at working pressure.	Functional tests to ensure correct operation. Typically this will include a creep test to ensure regulator integrity.	5 years or manufacturer's recommendations.* N.B. If regulators are refurbished this shall be in accordance with BCGA Code of Practice CP17 **	Replace with a new, or service exchange unit.
2. **FLASHBACK ARRESTORS** and their integral cut-off valves	Check condition of threads and sealing surfaces, oil or grease contamination. Leak test all joints at working pressure.	Check unit for flow restriction. Reverse flow to ensure correct operation of non-return valves. Where pressure sensitive cut-off valves are fitted, they must operate at a pressure of no greater than 1.2 bar. If of a pressure sensitive type check shut-off in the tripped condition in the direction of flow.	5 years or manufacturer's recommendations.	Replace with a new, or service exchange unit.
3. **HOSE ASSEMBLIES** (including **Non-Return Valves**)	Check threads and sealing surfaces. Reverse hose to ensure the correct operation of	Reverse hose to ensure the correct operation of non-return valve where fitted. Bend hose in a tight radius to ensure	Determined by local operating conditions.	Replace as required.

	non-return valve where fitted. Leak test of all joints at working pressure.	reinforcement is not visible.		
4. **Blowpipes**	Check condition of the nozzle and inlet seatings for damage. Leak test all joints at working pressure.	Test valve functions. Blank exits and leak test for internal malfunction.	Determined by local operating conditions.	Replace with a new, or service exchange unit.
5. **Cylinder valve with integrated pressure regulator** (VIPR)	Check condition of threads and sealing surfaces. oil or grease contamination. Leak test all joints at working pressure.	Functional tests to ensure correct operation. Typically this will include a creep test to ensure regulator integrity.	This is the responsibility of the owner, typically the gas supplier.	

* Regulator elastomers and seals will wear and deteriorate in service and will deteriorate out of service. Items stored for 1 year or over without use should receive inspection as per the annual maintenance inspection.

** This should be carried out by a suitably trained person. Such training will be formally recorded and include the following topics:

- Sufficient practical experience of oxy-fuel gas equipment; and
- Theoretical knowledge of the functioning of the equipment, the properties of gases used, the potential defects and hazards which may occur and their importance to the integrity and safety of the equipment.

Part 3

Chapter 1 (Sponsor – FSAT, SAFETY 3)

INTRODUCTION TO BULK LIQUEFIED PETROLEUM GAS

SECTION 1 – SCOPE

3.1.1.01 This chapter introduces Part 3 of JSP 319, which covers all relevant topics relating to bulk LPG within the military environment. It discusses the roles of Defence Estates and the UKLPG trade association, and provides information on the various chapters within Part 3.

SECTION 2 – GENERAL

3.1.2.01 Part 3 covers the overall requirements for a wide range of infrastructure facilities necessary for the design and storage of bulk LPG on the MOD Estate.

3.1.2.02 For LPG cylinders see, in particular, Part 2, Chapter 16; and, in general, Part 2.

3.1.2.03 Liquefied Petroleum Gas (LPG) is used in bulk by the MOD for heating of premises, including field accommodation; for cooking; and in Automotive Mechanical Transport Fuelling Installations (MTFI) for dispensing LPG to vehicles. Typically the bulk storage system will be designed, installed, commissioned and filled/re-filled by a LPG contractor.

3.1.2.04 Part 1, Chapter 5 details the procedures for demanding LPG for the replenishment of bulk tanks.

SECTION 3 – DEFENCE ESTATES

3.1.3.01 The provision of bulk LPG facilities is managed within a framework laid down in *JSP 434, Defence Construction in the Built Environment*, and in *Defence Estates (MOD) Safety Rules and Procedures (SRPs)*, which are now published in *JSP 375, Volume 3*. Fire fighting facilities should be in accordance with those specified in *Crown Fire Standards*.

3.1.3.02 The main safety framework is described in SRP *Common Elements & Requirements (SRP CER)* (see *JSP 375, Volume 3, Chapter 2*); *SRP 02*, *Boilers and Pressure Systems Gas Systems Medical Gases and Pipeline*s, (see *JSP 375, Volume 3, Chapter 4*); and *SRP 03*, *MOD safety rules and procedures for work on petroleum installations,* (see *JSP 375, Volume 3, Chapter 5*).

3.1.3.03 *SRP 03* applies fully to the replacement of bulk LPG storage vessels, 'hot works', tank access, operations where there is release or exposure to LPG, and other high risk elements; and these activities come under the control of the AP (Petroleum). *SRP 02*, in the context of bulk LPG, applies to small gas systems and to large systems downstream of the pressure reduction valve (*SRP 03* applies upstream). Activities within the scope of *SRP 02* come under the control of the AP (Boilers and Pressure Systems).

3.1.3.04 Permanent infrastructure on the MOD estate is the responsibility of Defence Estates. The MOD focal point for permanent infrastructure within Defence Estates is the

Senior Mechanical Engineering Advisor, Construction Support Team, Kingston Road, Sutton Coldfield, West Midlands, B75 7RL.

SECTION 4 – GENERAL INFORMATION ON JSP 319, PART 3

3.1.4.01 This section describes the various chapters in Part 3. The various chapters are discussed in general numerical sequence; however some chapters 'naturally' group together due to their overlapping aims. In this instance, some chapters are discussed here out of strict numerical sequence.

3.1.4.02 Chapters 2, 3 and 4 describe the Properties of LPG, its Hazards and Safe Handling, respectively.

3.1.4.03 Chapters 5, 6, 7, 8, 9 and 15 all concern the hazards associated with bulk LPG. Chapter 8, *Siting boards and siting requirements,* discusses the specifics of selecting a site for bulk LPG storage; it should be read in conjunction with *JSP 434* and *Defence Estates (MOD) Safety Rules and Procedures (SRPs).* Chapter 9, *Notification to Civilian Authorities of LPG facilities,* duplicates the more detailed requirements of *JSP 375, Volume 3*, i.e. to notify and/or obtain planning consent from Local Authorities once certain bulk LPG storage thresholds are likely to be reached. This may also involve the preparation of Safety Cases and Major Accident Prevention Policies.

3.1.4.04 Chapter 5, *Emergency Procedures*, discusses the emergency procedures that should be in place on existing bulk LPG storage sites. It requires the provision of training of users; the provision of fire fighting equipment in accordance with *Crown Fire Standards*; calling the local fire brigade to all incidents; and the setting up of Exclusion Zones in order to safeguard people.

3.1.4.05 Chapter 6, *General requirements and Fire precautions*, discusses fire precautions in a wider context than Chapter 5. It is concerned with ensuring that suitably zoned electrical equipment is used; the prohibition of smoking and naked lights; the provision of adequate fire fighting equipment for local use and for the fire brigade (see also SRPs and SRP CER); the provision of safety signs and warning notices around the boundary of the bulk storage area; and the labelling of pipework and emergency shut-off valves.

3.1.4.06 Chapter 7, *Lightning / Radiation*, discusses lightning protection and potential explosion hazards from radio and radar transmitters.

3.1.4.07 Chapter 15, *Piping Systems*, discusses the distribution of LPG from the bulk storage area to the point of use; it should be used in conjunction with the more detailed requirements of *SRP CER* and *SRP 02*.

3.1.4.08 Chapter 10, *Measurement of LPG in bulk storage tanks*, discusses measurement of capacity of charged LPG storage cylinders and vessels.

3.1.4.09 Chapters 11 and 13 expand some of the general requirements of Chapter 8 in respect of above ground installations and underground and mounted tanks, respectively.

3.1.4.10 Finally, Chapter 14, *Automotive LPG Mechanical Transport Fuelling Installations*, discusses the requirements for MTFI installations.

SECTION 5 – LIQUEFIED PETROLEUM GAS TRADE ASSOCIATION

3.1.5.01 UKLPG is the trade association for the liquefied petroleum gas industry in the UK, promoting the benefits of LPG and of safe operations and standards throughout the industry. UKLPG is a non-profit making association which was founded in 2008. UKLPG was formed by the merger of the LP Gas Association (LPGA) and the Association for Liquid Gas Equipment and Distributors (ALGED). It represents all the major liquefied petroleum gas companies in the UK.

3.1.5.02 The UKLPG Trade Association sets the technical and safety standards for the industry. It produces a range of Codes of Practice and Guidance Notes which are referenced within this publication.

Contact details:

The UKLPG Trade Association
Unit 14, Bow Court
Fletchworth Gate
Burnsall Road
Coventry
UK
CV5 6SP
Tel: 02476 711601
Fax: 02476 672108
www.UKLPG.org
mail@UKLPG.org

Part 3

Chapter 2 (Sponsor – FSAT SAFETY 3)

PROPERTIES OF LPG

SECTION 1 – SCOPE

3.2.1.01 This chapter provides information on the properties of LPG.

SECTION 2 – GENERAL

3.2.2.01 LPG is a generic term used to describe liquefiable gases consisting predominantly of C_3 (Propane) and C_4 (Butane) hydrocarbons. These are hydrocarbon products produced by the oil and gas industries. Commercial Propane predominantly consists of hydrocarbons containing three carbon atoms, mainly propane (C_3H_8), see Figure 3.2.1. Commercial Butane predominantly consists of hydrocarbons containing four carbon atoms, mainly n- and iso- butanes (C_4H_{10}), see Figure 3.2.2. The term LPG includes commercial butane, propane and mixtures of both.

Figure 3.2.1: Propane atoms

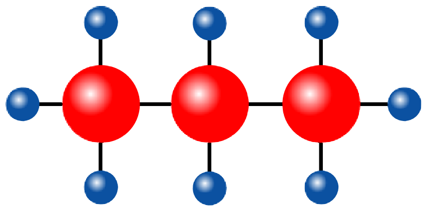
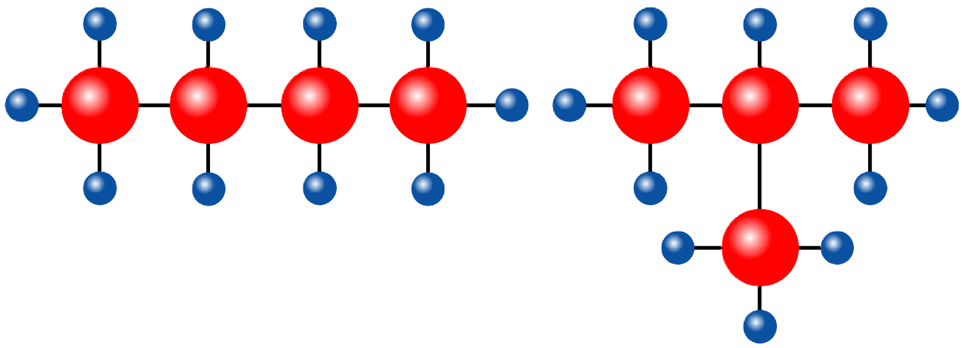


Figure 3.2.2: Butane atoms: n-butane and iso-butane, respectively



3.2.2.02 C_3 and C_4 hydrocarbons exist as gases at normal atmospheric temperature and pressure but they can be liquefied under moderate pressure. If the pressure is subsequently released, the hydrocarbons again become gaseous. They can also be liquefied and stored under refrigeration but this method is not used in general applications in the military environment.

3.2.2.03 As liquids they occupy only about 1/250th of the space they would need if they were stored as gases. From a practical perspective it is therefore more efficient to store and convey the hydrocarbons as liquids rather than as gases. Butane is usually supplied to customers in cylinders; propane can be supplied in cylinders or in bulk for storage in tanks at the customers premises.

3.2.2.04 It is important that the distribution system is suitable for the type of LPG to be used. Commercial propane, butane or mixtures are all possible types. It is particularly important to ascertain the LPG type in overseas theatres. Propane has a higher vapour pressure than butane. Storage tanks and containers are designed for a particular product and operating temperature. This means that containers designed for butane storage are not applicable to propane or propane butane mixtures.

3.2.2.05 LPG in vapour form is heavier than air by a factor of 1.5 to 2. This means that a vapour release will drop to the ground and remain at that level. It is important that LPG is not stored or handled in locations where a release would enter drains, cable ducts, pits or depressions, or basements.

Table 3.2.1: Properties of LPG

Property	**Commercial Butane**	**Commercial Propane**
Relative Density of liquid at 15 °C	0.57 to 0.58	0.50 to 0.51
Litres per Tonne at 15 °C	1723 to 1760	1965 to 2019
Relative density to air at 15 °C and 1015.9 mbar	1.90 to 2.10	1.40 to 1.55
Approximate Boiling Point at 1015.9 mbar (°C)	- 2	- 45
Vapour pressure at 15.0 °C (bar g)	1.93	6.9
Flammability limits, Lower: Upper (percentage volume of gas in gas-air mixture)	1.8 : 9.0	2.2 : 10.0
Latent heat of Vaporisation (kJ/kg at 15 °C)	372.2	358.2
Gross Calorific Value (Btu/ft^3)	3270	2500

Notes:

1. LPG is a petroleum product. It is classified under the Energy Institute's *IP 15 Model Code of Safe Practice* (Part 15, Area Classification code for installations handling flammable fluids) as Class 0.

2. For transportation purposes, LPG is classified under the *Carriage of Dangerous Goods* legislation as Class 2, Division 2.1, Flammable Gas.

3.2.2.06 LPG is procured against the specification detailed in *BS 4250, Specification for commercial butane or commercial propane*.

3.2.2.07 Automotive LPG is procured against BS EN 589.

Part 3

Chapter 3 (Sponsor – FSAT, SAFETY 3)

HAZARDS OF LPG

SECTION 1 – SCOPE

3.3.1.01 This chapter provides information on the hazards of LPG.

SECTION 2 – GENERAL

WARNING: Before using any hazardous substance or material, the user is to be conversant with the hazards and associated information detailed on the applicable Safety Data Sheet.

3.3.2.01 LPG is colourless, and its weight is only just over half that of an equivalent volume of water.

3.3.2.02 LPG vapour is heavier than air; commercial butane being twice as heavy and commercial propane about one and a half times as heavy as air. As a result of this, vapour may flow along the ground into drains or underground cable ducts, sinking to the lowest level of its surroundings and in still air it will take time to disperse.

3.3.2.03 LPG vapour when mixed with air at the right levels is readily flammable making it an ideal fuel, however it is this fact that can make LPG a potentially dangerous and an explosive entity.

3.3.2.04 LPG will ignite in most temperatures provided there is the correct mixture of LPG / Air and a source of ignition available.

3.3.2.05 Because of the characteristics of LPG any mixture of LPG and air in the right proportions which has been allowed to flow, may be ignited some distance from the point of origin where upon the flame will travel back towards the supply.

3.3.2.06 LPG vapour is slightly anaesthetic and may also cause suffocation if present in sufficiently high concentrations. High concentrations can cause nausea and headaches; and, in poorly ventilated or Confined Spaces, unconsciousness and asphyxiation.

3.3.2.07 Cold burns (frostbite) will result from skin/eye contact with the liquid. Liquid release or vapour pressure jets present a risk of serious damage to the eyes.

3.3.2.08 Further information can be found in the supplier's Safety Data Sheet for the specific product(s) in use (see *JSP 515*).

SECTION 3 – SPECIFIC HAZARDS OF LPG

3.3.3.01 LPG is normally odorised by the addition of an odorant such as ethyl mercaptan before distribution for safety reasons, LPG in its normal state is odourless and non-toxic. Special grades of LPG may not be odorised (Aerosol Propellants for example, make it impractical to detect leaks by sniffing for odour).

3.3.3.02 Escaping LPG may be noticeable other than by its smell, when the liquid evaporates it reduces the temperature causing condensation and even freezing water vapour in the air, showing as frost at the point of escape. It can cause serious frost burns when in contact with the skin and the eyes and appropriate Personal Protective Equipment (PPE) must be worn (see Part 2, Chapter 2).

3.3.3.03 A container or tank, which has held LPG and is empty may still contain LPG in vapour form and is potentially dangerous. In this state the internal pressure is approximately atmospheric and if a valve is leaking or left open, air can diffuse into the container, forming a flammable mixture creating a risk of explosion while LPG can be displaced to the atmosphere.

3.3.3.04 Any fire involving, or in the proximity of, a cylinder or tank containing LPG can lead to disastrous consequences; as the vessel warms up the internal pressure increases at the same time as the tensile strength of the vessel decreases. The majority of cylinders and bulk storage facilities are fitted with Pressure Relief Valves (PRV) which help prevent pressure build up and guard against vessel failure. However small cylinders for example non-refillable cartridges are not provided with PRV, and may burst under severe heating.

3.3.3.05 Two problems may arise with the discharge of LPG through the PRV. They are:

a. If it ignites, as well as possibly generating loud noise and significant radiated heat, it may pose a threat to adjacent and associated plant and structures.

b. If it does not ignite, large quantities of flammable vapour mixture may be present over a large area until it seeks out a source of ignition. This will create a flash fire which, if it occurs in a confined space, may have explosive results.

3.3.3.06 If an LPG cylinder or tank is directly affected by fire above the liquid fuel line then the metal shell can weaken to the point when catastrophic failure can occur this is commonly known as a BLEVE (Boiling Liquid Expanding Vapour Explosion).

Note: LPG can be used for heating, lighting, refrigeration, power generation and cooking purposes in static or mobile installations e.g. barrack rooms, offices, workshops and caravans as well as marine craft. Various sizes of cylinders and vessels are in wide use throughout the MOD and associated departments, the hazard is with us constantly.

Part 3

Chapter 4 (Sponsor – FSAT SAFETY 3)

SAFE HANDLING OF BULK LPG

SECTION 1 – SCOPE

3.4.1.01 This chapter provides information on the safe handling of LPG. It includes the procedures and medical response actions to be followed in the event of a medical incident involving LPG. It discusses the organisation of works and the management of maintenance.

SECTION 2 – GENERAL

3.4.2.01 **Safe Handling of LPG**. The types of liquid petroleum gases generally available within the UK are Commercial Propane and Commercial Butane. Everyone concerned with storage and handling of LPG are to make themselves familiar with the following characteristics and potential hazards.

3.4.2.02 Before using any hazardous substance or material, the user is to be conversant with the hazards and associated information detailed on the applicable Safety Data Sheet (see *JSP 515*).

3.4.2.03 LPG is stored as a liquid under pressure. It is almost colourless and its weight is approximately half that of an equivalent volume of water.

3.4.2.04 LPG vapour is denser then air, propane vapour is about 1.5 times heavier then air. Consequently, it may flow along the ground and into underground cable ducts, drains and gullies sinking to the lowest level of the surroundings and be ignited at distance from the source. In still air the vapour will disperse more slowly.

3.4.2.05 LPG can form a flammable mixture when mixed with air. The flammable range at ambient temperature and pressure extends between approximately 2 % of the vapour in air at its lower limit and approximately 10 % of the vapour in air at its upper limit (Note: For comparison, Natural gas has a flammable range of 5.0 % to 13.5 % in air). Within this range there is a risk of ignition. Outside this range any mixture is either too rich or too weak to propagate a flame. However over-rich mixtures can be hazardous when diluted with air. At pressures greater then atmospheric, the upper limit of flammability is increased but this increase with pressure is not linear.

3.4.2.06 Escape of even small amounts of LPG can give rise to large volumes of vapour/air mixture and thus cause a considerable hazard. A suitably calibrated explosimeter may be used for testing concentration of LPG in air. DO NOT use a flame for detecting leaks. Similarly do not turn electrical equipment on or off, as a spark may be produced.

3.4.2.07 At very high concentrations in air, LPG vapour is an anaesthetic and consequently an asphyxiant, by diluting or decreasing the available oxygen. Therefore, if an LPG leak is suspected do not enter any Confined Spaces, basement areas, drains, or gullies, etc.

3.4.2.08 Commercial LPG is normally odorised before dilution by the addition of an odorant such as ethyl mercaptan or dimethyl sulphide, to enable detection by smell of the gas at concentrations down to one fifth of the lower limit.

3.4.2.09 Escape of LPG may be noticeable other then by smell. When the liquid evaporates, the cooling effect on the surrounding air causes condensation and even freezing of water vapour in the air. This effect may show itself as frost at the point of escape thus making detection easier. Leaks can also be identified due to shimmering in the air.

3.4.2.10 Because of the rapid vaporisation and consequent lowering of temperature, LPG can cause severe frost burns when in contact with the skin or the eyes. Personal Protective Equipment (PPE) is to be worn when handling LPG (see Part 2, Chapter 2).

3.4.2.11 If an LPG cylinder or tank is exposed to flame above the liquid fuel line, it may rupture (BLEVE) causing violent release of the LPG, resulting in a fireball.

3.4.2.12 **Competence of personnel maintaining LPG systems**. The Gas Safety (Installation and Use) Regulations 1998 apply to the majority of vapour phase LPG installations. Only personnel registered with Gas Safe Register are permitted to carry out work on gas installations as defined in the regulations. Refer to 1.8.6.06 and comply with JSP 375, Volume 3.

SECTION 3 – LPG, MEDICAL FIRST AID

3.4.3.01 In all cases of injury from LPG qualified medical assistance is to be called immediately. All cases of injury through contact with LPG shall be given medical attention without delay.

3.4.3.02 All units who use, store or transport LPG are to have Standard Operating Procedures in place for dealing with cases of injury through contact with LPG. These are to be endorsed by the senior medical officer on the unit. The unit is to carry out a First Aid Assessment with emphasis on the hazard from LPG (see JSP 375, Volume 2, Leaflet 27). Any equipment identified in the First Aid Assessment is to be provided and maintained in a serviceable condition. Signage across the site is to clearly identify First Aid equipment locations and the nominated First Aiders.

3.4.3.03 LPG can cause the following problems:

a. Cold burns (frostbite) will result from skin/eye contact with liquid, prolonged contact can result in hypothermia.

b. Liquid release or vapour pressure jets present a risk of serious damage to the eyes.

c. Abuse involving wilful inhalation of very high concentrations of vapour, even for short periods can produce unconsciousness and might prove fatal. Inhalation may cause irritation to the nose and throat, headache, nausea, vomiting, dizziness and drowsiness. In poorly ventilated or confined spaces, unconsciousness or asphyxiation may result.

3.4.3.04 **Skin Contact**. Freeze burns may be caused when liquid LPG is in direct contact with exposed skin. The following First Aid is to be carried out:

a. Immerse affected area, or flush copiously, with tepid or clean cold water for at least 10 minutes to normalise temperature and until circulation returns. Do not expose area to hot water or direct heat.

b. Loosen any clothing that may restrict blood circulation to the affected area.

c. Thaw out frozen protective clothing, if it is NOT stuck to the skin remove it, avoid excessive heat. LPG vapour may be driven off during thawing.

d. Cover affected area with clean, dry, sterile dressing, bulk protective dressings should not be too tightly applied. Do not apply ointments or powders.

e. Alcoholic beverage and smoking is not to be permitted.

3.4.3.05 **Inhalation**. Remove the affected person to fresh air. Keep the patient warm and at rest. If breathing has stopped administer artificial respiration. Give external cardiac massage if necessary. If the person is breathing, but unconscious, place them in the recovery position.

3.4.3.06 **Eyes**. Cold burns should be flushed immediately with cold water for at least 15 minutes to normalise temperature. Hold eyelids apart while flushing to rinse entire surface of the eye and lids with water. Cover the eye with a sterile dressing.

SECTION 4 – ORGANISATION OF WORKS AT LPG INSTALLATIONS

3.4.4.01 Because of the division of ownership of facilities, there is a need for co-ordination between the MOD and others on works issues.

3.4.4.02 The demarcation of ownership of facilities and responsibilities for inspection and maintenance of facilities is to be recorded in writing and precisely defined/detailed on a schematic or line diagram. The ideal demarcation will be a point of isolation under the secure control of the MOD.

3.4.4.03 The different scenarios that can occur include:

a. Gas supplier owned storage tank linked to MOD distribution systems.

b. MOD owned system.

c. Gas supplier owned system.

3.4.4.04 *MOD Safety Rules & Procedures (SRPs)* apply to LPG and natural gas installations. They provide a systematic approach to the management of works employing the Authorised Person (AP) as the focal point for works co-ordination (see also Section 5 of this chapter).

SECTION 5 – MANAGEMENT OF MAINTENANCE

3.4.5.01 This section introduces the concept of a safe system for the organisation of modification and maintenance work on gas installations on the MOD Estate. It is based on MOD SRP's (Refer to JSP 375, Volume 3) and is mandatory and represents the minimum requirement. These SRPs provide the means of discharge of responsibilities under, and in compliance with, the *Health and Safety at Work, etc*, Act 1974; the *Management of Health and Safety at Work Regulations*; the *Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)*; and the *Pressure Systems Regulations, 2002*. The safety duties of the officer responsible for the site and MOD owned and maintained facilities are recognised and systems and procedures are presented accordingly.

3.4.5.02 These SRPs apply to a wide range of permanent, fixed gas (natural and LPG) installations which differ in terms of type, capacity and complexity.

3.4.5.03 The SRPs are for adoption by the person responsible for the base or site as part of the safety plan for the establishment. This action will assist in the discharge of safety responsibilities.

3.4.5.04 The application of the SRPs is principally by the organisation tasked to manage the maintenance of facilities, in order to control works.

3.4.5.05 The SRPs use the practice of the appointment of Authorising Engineers to select and monitor Authorised Persons who are trained and appointed with the purpose of ensuring safe working practice for works on gas installations.

3.4.5.06 At overseas locations MOD SRPs are to be applied as far as is practicable. In case of conflict between the SRPs and local legally enforceable or locally adopted overseas regulations, the latter are to be complied with provided they are fully equated with or more stringent than the SRPs (see Part 3, Chapter 1 regarding the *German Status of Forces Agreement (SOFA)* regulations).

3.4.5.07 Most static tanks for the storage of LPG are owned, inspected and maintained by the gas supplier. It is a general requirement for the supplier to have company safe systems of work in place. This includes written schemes of examination. The MOD must be satisfied on a generic basis that these systems are adequate for tank installation, inspection, repair and removal. In all cases where works are to take place, full co-operation with those officers on site with work and works safety responsibilities, must take place. The co-operation must take place because of the need to define the demarcation between MOD and supplier systems, and the fact that the systems are connected.

Part 3

Chapter 5 (Sponsor – FAST SAFETY 3)

EMERGENCY PROCEDURES

SECTION 1 – SCOPE

3.5.1.01 This chapter provides information on the emergency procedures and actions to be followed for incidents involving LPG. It includes the requirement to provide adequate training, fire-fighting equipment and the involvement of the emergency services in all incidents.

SECTION 2 – GENERAL

3.5.2.01 Any fire involving bulk LPG can be extremely difficult to contain and control. Procedures must be in place to prevent LPG loss due to leakages and also to prevent fires occurring in the vicinity of LPG in use or in storage. Radiant heat reaching a LPG vessel will raise the vapour pressure in the vessel and the Pressure Release Valve (PRV) may operate, releasing LPG vapour.

3.5.2.02 Commercial propane and commercial butane both form flammable mixtures with air, with LPG vapour concentrations of between 2% and 10%. Ignition of an accidental release can occur, resulting in fire or explosion. If ignition of LPG occurs immediately, then it burns in the form of a jet or pool fire. If an LPG cylinder or tank is exposed to flame above the liquid fuel line, it may rupture (BLEVE) causing violent release of the LPG, resulting in a fireball.

3.5.2.03 The possibility of a fire and/or explosion hazard is reduced by the provision of good design, layout, and adequate/appropriate operating procedures (see Part 3, Chapters 6 to 15).

3.5.2.04 All persons engaged in the handling of LPG must receive adequate instruction and training to understand the dangers associated with LPG and the actions to be taken in an emergency. In addition they must be fully aware of the duties required of them in accordance with *JSP 375 MOD Health and Safety Handbook*. Only approved and appropriate PPE is to be worn (see Part 2, Chapter 2).

3.5.2.05 Even with adequate safety systems in place, the potential effects of any fire involving LPG is so great that fire precautions are needed to minimise the risks to equipment and personnel; and to restrict the escalation of the incident (see Part 3, Chapter 6). These precautions must include:

a. Protection of plant and equipment especially that not directly involved in the fire.

b. Water Supplies both for fire fighting and for fire protection systems.

c. Fire brigade access both for vehicles and fire fighting operations.

d. Arrangements for calling assistance inclusive of the emergency services.

e. The provision of any fire suppression systems, which subject to risk assessment unless required by specific regulations shall be designed, installed and commissioned in accordance with the *Crown Fire Standards (CFS)*.

3.5.2.06 A fire and/or explosion hazard may arise from:

a. Leakage of LPG and subsequent ignition of flammable gas mixtures.

b. Heat from an adjacent fire reaching gas pipes, meters, appliances or compressed gas cylinders and bulk storage vessels.

c. LPG plant and cylinders may become damaged by external forces such as vehicles.

3.5.2.07 Various measures can be taken to reduce the risks and these include:

a. Effective ventilation to ensure dispersal of any leakage.

b. Safe siting of meters and LPG storage areas.

c. Adequate and appropriate operating practices.

d. Appropriate maintenance.

e. Adequate and effective staff instruction and training.

3.5.2.08 There are two aspects which must be considered when LPG is used/stored within a building:

a. LPG cylinders and storage tanks need protecting from a fire in the building.

b. The building needs protecting from a fire and from leaks from the LPG cylinders, storage tanks and pipe work.

3.5.2.09 It is therefore important that the risk is assessed in each and every case, and should take cognisance of life safety issues, asset losses, consequential losses and the effect on national and strategic importance (see Part 3, Chapter 8).

SECTION 3 – SPECIFIC EMERGENCY ACTIONS

3.5.3.01 In any fire/incident involving LPG the Local Fire Brigade must be called to the incident. They have the necessary skills and equipment to deal with this type of incident. Once they have arrived they will assume responsibility for fire fighting. The LPG supplier and the owner of the storage vessel(s) should also be informed.

3.5.3.02 When dealing with LPG incidents a careful risk assessment must be undertaken; and the correct PPE equipment, including clothing and head protection, must be used. In many instances the affected area will have been declared a Restricted Area and access to the area strictly controlled by the Authorised Person using a Permit to Work system (see JSP 375, Volume 3), or under the control of a Fire Officer.

3.5.3.03 For gas and LPG leaks non-sparking hand tools and equipment must be used, as specified on the Permit to Work (if appropriate). The hazards to personnel range from cold burns (frost bite), from direct skin contact with LPG; through to heat burns from thermal radiation, from fire and explosion; and exposure to toxic smoke and combustion products (see Part 2, Chapter 2). Any approach must be made from upwind; and you must ensure you have both safe access and egress from the incident. It must be borne in mind that compressed gasses / vapours may cause rupture of the vessels causing in itself changes in the size of the fire and or vapour cloud. If in doubt at all do not approach the incident.

WARNING: Users must be made aware that any clothing or PPE that becomes “wetted” with LPG remains a severe fire hazard to the user and bystanders until all the LPG gas has been safely vented from it. LPG saturated clothing or PPE may also induce hypothermia or frost bite.

3.5.3.04 Any LPG equipment or cylinders that may have been affected by an incident (dropped, crushed, etc) must be thoroughly inspected for signs of damage and or leaks, if it is safe to do so. Leaks although not present at the time may well develop and lead to catastrophic failure. Until the inspection and assessment is carried out access to the area must be restricted and if needed the cylinders and or plant should be cooled with water spray. In any case every effort must be made to isolate the fuel supply by closing valves.

3.5.3.05 An exclusion zone, known as a Restricted Area (see JSP 375, Volume 3), must be set up around the incident; wind direction should be taken into account with the evacuation route directed in an upwind direction away from the incident. Everybody should be evacuated from within this exclusion zone and entry prohibited except those authorised by the Authorised Person or Fire Officer, as appropriate.

3.5.3.06 Every precaution must be taken to prevent ignition of the escaping LPG gas / vapour. If safe to do so, then ignition sources should be removed for instance shutting down boilers, stop all smoking and extinguishing naked flames and fires. Electrical equipment must be switched off at a remote point from the leak. Switch off vehicle engines, however vehicles within the exclusion zone must be left there and no attempt should be made to remove them.

3.5.3.07 The exclusion zone must be reviewed constantly as it may be possible to reduce it or may need to be extended as the circumstances require. LPG leaks, especially as a liquid, can remain flammable for considerable distances from the source. This condition is affected by weather conditions and the layout of the site or facility, which must be taken into account when assessing the exclusion zone. Never search for leaks with a naked flame, use only approved detectors.

Table 3.5.1: Suggested Initial Exclusion Zones (also known as a Restricted Area)

Size of Leak	**Exclusion Zone (m)**
Small Vapour Leak (smell of Gas)	30
Large Vapour Leak (Loud hissing sound of gas escaping)	100
Liquid leak (Loud roaring sound)	200

3.5.3.08 Should the escaping LPG vapour be ignited and a fire has resulted then every effort should be made, if safe to do so, to isolate the fuel supply, wherever possible. Do not attempt to put out the fire as an assessment will be required, as you may well make the situation worse by introducing an explosion hazard due to the vapour escaping.

3.5.3.09 Should other vessels become threatened by the effects of the fire, then water sprays should be considered to cool the affected surface of the vessels and prevent the pressure building within them. If available, the option to remove LPG cylinders should be taken if safe to do so.

Note: This does not apply to acetylene cylinders; they must not be moved or approached for 24 hours (see Part 1, Chapter 9).

3.5.3.10 Additional guidance on specific issues can be found in documentation listed in the Bibliography, any further assistance can be sought from the Regional Defence Fire & Rescue Service Officer and where appropriate, the Enforcing Authority.

3.5.3.11 **Action in the event of a spillage**. An assessment of the quantity, and therefore the actions required to contain and control the spillage will be required, however the general procedure to be followed for a spillage is:

a. Evacuate the area except for personnel dealing with the emergency.

b. Do not operate electrical equipment unless flameproof.

c. Summon the aid of emergency services.

d. Treat or refer casualties if necessary.

e. Extinguish naked lights, e.g. cigarettes – AVOID MAKING SPARKS.

f. Isolate power from sources of ignition and ventilate the area.

g. Position fire fighting equipment.

h. Try to stop the flow of liquid product.

i. Cover drains and sewers. Disperse vapour with water spray.

j. Inform the relevant authorities of the incident (see Part 1, Chapter 7),

Notes:

1. Vapour may collect in confined spaces

2. Details on the range of Pollution Control Equipment that is available to help stop the flow of liquid product is listed in *JSP 317, Part 5, Chapter 6*.

3.5.3.12 **ACTION IN THE EVENT OF A FIRE**.

IN CASE OF FIRE, VACATE THE AREA AND IMMEDIATELY ALERT THE EMERGENCY SERVICES

a. Evacuate the area except for personnel dealing with the emergency.

b. Do not operate electrical equipment unless flameproof.

c. Summon aid of emergency services.

d. Treat or refer casualties if necessary.

e. Ensure an escape path is always available from any fire.

f. If gas has ignited, do not attempt to extinguish but, if safe to do so, stop gas flow and allow it to burn out.

g. Use water spray to cool heat-exposed containers, and to protect surrounding areas and personnel effecting shut-off.

h. Beware of vapour accumulating to form explosive concentrations. Explosive vapours may travel, be ignited at remote locations and flash back. A water spray may be used for vapour dispersal.

i. Every precaution must be taken to keep containers cool to avoid the possibility of a boiling liquid expanding vapour explosion (BLEVE).

j. Pressurised containers are liable to explode violently when subjected to high temperatures

3.5.3.13 **EXTINGUISHING MEDIA**

LARGE FIRES

a. None. Product flow must be stopped and container cooled by water spray. Water fog should be used to assist approach to source of the fire. Large fires should only be fought be the Fire Brigade.

b. DO NOT USE WATER JET

SMALL FIRES

a. Use dry powder or carbon dioxide extinguishers

b. DO NOT USE WATER OR FOAM

Note: Fires in confined spaces should be dealt with by trained personnel wearing approved breathing apparatus.

Part 3

Chapter 6 (Sponsor – FSAT, SAFETY 3)

GENERAL REQUIREMENTS AND FIRE PRECAUTIONS

SECTION 1 – SCOPE

3.6.1.01 This chapter covers the general requirements for the safe storage of LPG and the associated fire precautions. It covers the requirements for equipment that is allowed to be used within LPG storage areas, the prohibition of smoking and naked lights, the provision of safety signs and warning notices, and the provision of fire-fighting equipment.

SECTION 2 – GENERAL

3.6.2.01 The safe operation of bulk LPG systems is ensured by the provision of good design, layout, adequate/appropriate operating procedures; the avoidance of leaks and the prevention of fires or other ignition sources in the vicinity of LPG. Bulk LPG systems require, amongst others, written schemes of examination and regular maintenance (see Part 3, Chapter 4, Section 4).

3.6.2.02 LPG is delivered, stored and used at temperatures above its flash point. LPG Hazardous areas (see Tables 3.6.A1 and 3.6.A2 in Annex A) should be protected by:

a. Prohibition of fixed sources of ignition, i.e. pilot lights, naked flames, etc.

b. Prohibition on smoking.

c. Control of other sources of ignition.

d. Only vehicles associated with LPG product transfer permitted within the area.

e. Suitably Zoned electrical equipment to *BS EN 50014*, or existing adequately-maintained equipment to *BS 5501*, installed.

f. Electrical equipment, such as motors, which are potential sources of ignition to be certified in accordance with the *Potentially Explosive Atmospheres Regulations, 1996*.

g. Ensuring that the Separation Distances considered by the Siting Board (see Part 3, Chapter 8) do not become degraded over time by encroachments.

h. Ensuring that all maintenance operations, including grass cutting, are strictly controlled using a Permit to Work system issued by the Authorised Person (see JSP 375, Volume 3).

3.6.2.03 All persons engaged in the handling of LPG must receive adequate instruction and training to understand the dangers associated with LPG and the actions to be taken in an emergency (see Part 3, Chapters 3, 4 and 5).

3.6.2.04 Specific fire training and general health and safety awareness training is mandatory and should be accompanied by annual refresher training and fire drills. This training should be documented. In addition they must be fully aware of the duties required of them in accordance with *JSP 375 - MOD Health and Safety Handbook*.

3.6.2.05 Only PPE that is approved and appropriate for use with LPG is to be worn (see Part 2, Chapter 2). Foot wear should be antistatic with no exposed steel tips on the soles or heels. For fire fighting operations the PPE should provide protection against thermal radiation and flames.

WARNING: Users must be made aware that any clothing or PPE that becomes "wetted" with LPG remains a severe fire hazard to the user and bystanders until all the LPG gas has been safely vented from it. LPG saturated clothing or PPE may also induce hypothermia or frost bite.

3.6.2.06. Standard Operating Procedures (SOPs) should be available for users covering standard operations on the LPG storage system, including: filling, use, routine maintenance (see Part 3, Chapter 3, Section 3), emergency shut-down procedures, isolation of the bulk LPG storage system and/or the LPG gas supply to buildings; for dealing with LPG spillages, leaks and fires. The Defence Fire & Rescue Service should be invited to participate in the preparation of these SOPs where appropriate.

3.6.2.07 Systems and procedures should be in place to prevent tanks from being over-filled. Where an LPG storage vessel cannot be readily seen from the delivery tank this may necessitate a two-man delivery operation. The Maximum Fill Level device, where fitted, should be used to prevent over-fill. Any tanks or vessels over-filled must have the excess LPG removed immediately.

3.6.2.08 Even with adequate safety systems in place, the potential effects of any fire involving LPG is so great that fire precautions are needed to minimise the risks to equipment, personnel and to restrict the escalation of the incident. These precautions must include:

a. Protection of plant and equipment especially that not directly involved in the fire.

b. Water Supplies both for fire fighting and for fire protection systems.

c. Fire brigade access both for Vehicles and Fire fighting operations.

d. Arrangements for calling assistance inclusive of the emergency services.

e. The provision of any fire suppression systems, which subject to risk assessment unless required by specific regulations shall be designed, installed and commissioned in accordance with the *Crown Fire Standards (CFS)*.

3.6.2.09 A Fire Safety Risk Assessment is to be carried out on all storage sites and is to be incorporated into the Site Fire Safety Management Plan (see JSP 426). Advice should be sought from the Fire Safety Officer, and where appropriate the Enforcing Authority.

3.6.2.10 Other chapters and sections within JSP 319 contain specific precautions to be observed in relation to operations, use, and storage involving LPG and associated equipment. This section must be read in conjunction with all other relevant sections contained within this document.

SECTION 3 – SPECIFIC PRECAUTIONS

3.6.3.01 As part of the bulk LPG siting process (see Part 3, Chapter 8) adequate provision should be made for the safe access and egress of bulk LPG delivery vehicles within a fenced compound, wherever practicable. Ad hoc arrangements whereby LPG supply hoses are run across a public footpath or pavement from a delivery vehicle, or run over fencing, are not to be condoned.

3.6.3.02 Safe vehicle access may include:

a. Level ground, or a slight camber to direct spillage away from the tanker.

b. A clear line of sight for the controller to see both the delivery tanker and the LPG storage vessel(s) being replenished.

c. The provision of bollards or crash barriers to protect storage vessels and pipelines, as fences, signs and warnings alone do not provide physical protection.

d. Fire extinguishers.

e. Warning signs to be erected during product transfer:

**“WARNING
FLAMMABLE GAS TRANSFER
NO SMOKING OR NAKED LIGHTS”**

or similar words, in accordance with *BS 5499 – Safety Signs and Colours Standard* and the *Health and Safety (Safety Signs and Signals) Regulations 1996*.

f. LPG transfers to be carried out under the direct control of a Responsible Person and discontinued if that person is called away.

3.6.3.03 If deliveries take place during the hours of darkness then adequate lighting, to Zone 1 or 2, as appropriate, must be provided (see Annex A).

3.6.3.04 The bulk delivery vehicle should be bonded to earth, or bonded to the storage vessel bonding point, as appropriate, before delivery commences.

3.6.3.05 Bulk LPG vessels should not be bunded; however, they may be protected by diversions kerbs, not exceeding 500 mm in height, designed to divert LPG spillages away from storage vessels and potential sources of ignition to an Evaporation Area. The Evaporation Areas should be located in a safe area at least 3 m away from the storage vessel. It should be surfaced with stone chippings, or similar material, to increase the surface area and promote evaporation and dispersal of the LPG gas. See *UKLPG Code of Practice 1* for further details.

3.6.3.06 In any fire/incident involving LPG the Local Fire Brigade must be called to the incident. They have the necessary skills and equipment to deal with this type of incident; on arrival they will assume responsibility for fire fighting (see Part 3, Chapter 5, for further details, including suggested Initial Exclusion Zones).

Note: These are known as Restricted Areas in *SRP 02* and *SRP 03*.

3.6.3.07 LPG storage tanks and vessel should be sited to provide adequate access for the local Fire Brigade and have adequate free ventilation. Access from more than one direction should be provided wherever practicable to enable an escape route and for any fire or spillage to be tackled from up-wind (see Part 3, Chapter 4).

3.6.3.08 If a LPG fire should occur and only if it is safe to do so steps should be taken to cool the vessel and any adjacent storage vessels in an effort to reduce the internal pressure being increased by the action of radiated heat and to minimise LPG discharges through Pressure Relief Valves (PRVs). No attempt is to be made to extinguish the fire until the supply has been isolated, as gas that continues to escape may create an explosive atmosphere (see Part 3, Chapter 4).

3.6.3.09 LPG installations are to be provided with a water supply that meets the requirements of CFS for fire fighting which can be useful in several ways, e.g. for cooling storage vessels and containers adjacent to a fire, affording protection to fire fighters during their duties, and for the extinction of fires.

3.6.3.10 Fire hydrants, monitors and fixed systems should be designed so that the water supply can be controlled from a remote location in relation to the storage so as to be relatively safe. Any manually operated systems should be clearly identified and the method of operation clearly indicated.

3.6.3.11 Fire hose reels and portable fire fighting equipment must be selected and installed in accordance with CFS. In any case at least two dry powder extinguishers to *BS EN 3* not less than 9 kg each suitable for LPG fires with a test fire rating of at least 21A and 183B as defined in *BS EN 3-1* and/or *BS EN 3-7*, should be available at strategic points. One of these must be within 15 m of any LPG dispenser. Foam extinguishers are not suitable for LPG fires due to the fact that the products are gases at atmospheric temperatures.

3.6.3.12 In addition to the usual water mains with hydrants fitted for the attachment of fire hoses, LPG storage vessels may be equipped with a water spray system utilising non-clogging spray nozzles. When in operation the system is to be capable of enveloping the entire vessel in water spray. This may be used for cooling purposes during periods of exceptionally high ambient temperatures or to protect an adjacent storage vessel or other equipment against radiated heat from fires. A typical design spray rate is a minimum of 9.8 litres/m^2.

3.6.3.13 The UKLPG recommended fire fighting requirements can be summarised in Table 3.6.1; however, the Defence Fire & Rescue Service are to be consulted on the appropriate equipment for particular LPG storage facilities.

Table 3.6.1:

Bulk LPG Installation Capacity (litres)	**Fire Equipment**
<2500	Water supply for fire fighters use in accordance with CFS. 2 x 9 kg dry powder extinguishers. 19 mm hose reel (or extinguishers).
2500 – 56250	Water supply for fire fighters use in accordance with CFS. 2 x 9 kg dry powder extinguishers. 19 mm hose reel.
56251 – 112500	Water supply for fire fighters use in accordance with CFS. 2 x 9 kg dry powder extinguishers. 19 mm hose reel. Fixed or portable monitors for vessels and LPG vehicle bays.

3.6.3.14 Weeds, long grass deciduous shrubs and trees and any combustible material must be removed from LPG Hazardous Areas. Chemical weed killers which introduce a potential fire hazard, such as those containing sodium chlorate or other oxidising agents, should not be used (see JSP 375, Volume 3). Grass cutting within the LPG Hazardous Area shall be strictly controlled using a Permit to Work system issued by the Authorised Person (see JSP 375, Volume 3).

3.6.3.15 The LPG Hazardous Areas should be kept free from a build up of combustible materials such as fallen leaves and grass cuttings, this is particularly important during dry weather.

3.6.3.16 Areas outside the fenced LPG Hazardous Area should also be kept free from a build up of combustible materials such as fallen leaves and grass cuttings, old pallets, etc. Any fires that may break out in these areas are a potential threat to the safety of the LPG installation and, where possible to do so, should be tackled at an early stage before the threat to the LPG storage area escalates (see Part 3, Chapter 8, Annex A).

3.6.3.17 Appropriate steps must be taken to prevent unauthorised interference with storage and or equipment and plant. If fencing is erected then at least two means of escape should be provided. All emergency exits are to open in the direction of escape and are to be fitted with panic furniture of a type not requiring a key, card or code to open. They are to provide an unobstructed means of escape and in operation are not to obstruct any other escape route. Any installed fire walls can be regarded as part of the security fencing.

3.6.3.18 **Safety signs and warning notices**. Appropriate and legible warning signs and pictograms shall be displayed and maintained in good condition in accordance with the *Chemical (Hazard Information and Packaging for Supply) (Amendment) Regulations 2005 (CHIP 3.1)*; *Use of Transportable Pressure Receptacles Regulations 1996*; and the *Health and Safety (Safety Signs and Signals) Regulations 1996; BS 5378*, or its replacement *BS 5499-5*. All wording shall be in English. For installations located overseas there is a legal obligation to provide notices in the language relevant to the local civilian population and work force (operator). Boundary warning signs and pictograms shall be clearly visible from all angles of approach, preferably sited with the centre of the sign at the average eye level (between 1.5 and 1.7 m above the ground). In exceptional cases, sites may be subject to the imposition of additional requirements by their local authority. All LPG storage sites shall display the following signs/pictograms/notices on the access point and boundary fence or wall:

a. NO SMOKING.

b. NO NAKED LIGHTS.

c. NO STORAGE OF OIL, GREASE OR COMBUSTIBLE MATERIALS.

d. AUTHORISED PERSONS ONLY.

e. NO MOBILE PHONES.

f. NO STEEL TIPPED SHOES / BOOTS.

g. THE FLAMMABLE GASES TRANSPORT DIAMOND HAZARD LABEL.

H. LIQUEFIED PETROLEUM GAS OR LPG

3.6.3.19 As an explosive atmosphere may exist, the Dangerous Substances and Explosive Atmospheres (DSEAR) (see Annex A), requires that an Explosives Atmospheres sign be displayed (see Figure 3.6.1).

3.6.3.20 At the entrance to the site the appropriate fire signs and notices (e.g. Fire Action Notice) are to be displayed (see *JSP 426, MOD Fire Safety Policy*). A sign shall also be displayed detailing any specific action to be taken in the event of an incident/emergency and showing whom to contact in the event of an incident/emergency with all appropriate contact details. This is to include the unit emergency contact details and the contact details for the gas supplier and the gas supplier's 24-hour emergency contact telephone number. The location of any access keys, as well as the contact details for the authorised key holder shall be displayed.

3.6.3.21 Each individual bulk storage tank is to be clearly labelled with its contents and its associated UN product identification number. These are the proper shipping name and the UN number, e.g.

a. PROPANE UN 1987

b. BUTANE UN 1011

Figure 3.6.1: Example of Warning Signs with Pictograms.

3.6.3.22 LPG pipe lines, Pressure Relief Valves and system shut-off and Emergency valves should be suitably labelled (see Part 3, Chapter 15 – *Piping Systems*).

3.6.3.23 A sign is to be displayed at the LPG emergency shut-off valve, at the location, where it enters a building. The sign is to indentify the cation to be taken to shut-off the valve.

SECTION 4 – DANGEROUS SUBSTANCES REGULATIONS

3.6.4.01 The requirements of the *Dangerous Substances and Explosive Atmospheres (DSEAR)* apply to bulk LPG storage and their surroundings. This requires that a written risk assessment is undertaken; and that risks are reduced or eliminated (see *JSP 375, Volume 2, Leaflet 56*). Detailed guidance in respect of bulk LPG storage can be found in UKLPG Code of Practice 1 – *Bulk LPG Storage at Fixed Installations, Part 1: Design, Installation and Operation of Vessels Located above Ground.* Hazardous areas need to be zoned based on the frequency and occurrence of explosive atmospheres (see Tables 3.6.A1 and 3.6.A2 in Annex A). A drawing is to be produced showing the hazardous areas. A copy of the DSEAR Risk Assessment and the drawing showing the hazardous area(s) is to be kept on-site and made available for any persons requiring access.

3.6.4.02 Sites holding 25 tonnes of more of dangerous substances are subject to the requirements of the *Dangerous Substances (Notification and Marking of Sites) Regulations, 1990*. These require that suitable signs be erected at access points and at locations specified by the enforcing authority; and notification to the fire authority and the HSE Local Authority of the presence of dangerous substances.

3.6.4.03 For bulk storage of 50 tonnes or more of LPG the Lower Tier Threshold and of 200 tonnes or more the Top Tier Threshold of MOD's *Major Accident Control Regulations (MACR)* apply (see *JSP 498*). This is the MOD's implementation of the *Control of Major Accident Hazards Regulations (COMAH).* Lower Tier sites require a Major Accident Prevention Policy and Top Tier sites additionally require a Safety Report. UKLPG Guidance Note *GN 3 – A Guide to the preparation of Major Accident Prevention Polices (MAPP's)* – provides guidance in this area.

3.6.4.04 Additional guidance on specific issues can be found in documentation listed in the bibliography, any further assistance can be sought from the Departmental Fire Adviser and where appropriate, the Enforcing Authority.

ANNEX A

(introduced at paragraph 3.6.2.02)

DSEAR and LPG HAZARDOUS ZONES

3.6.A01 Hazardous places are classified in terms of Zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere (see *BS EN 60079-10*).

Table 3.6.A1: DSEAR Zone Classification.

Zone	Description
0	A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.
1	A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.
2	A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does, will persist for a short period only.
Other	By implication, an area that is not classified Zone 0, 1 or 2 is deemed to be a non-hazardous or safe area in respect to the selection of apparatus.

Table 3.6.A2: LPG Hazardous Area Classification.

Item	Extent of Hazardous Area	Zone
Discharge orifice of liquid level detection device.	Within 1.5 m of the point of discharge	1
Pressure Relief Valve (PRV)	Within direct path of discharge.	Fixed electrical equipment not to be installed.
Tank vehicle Loading / Unloading Connections.	Within 1.5 m in all directions from a point where connections are made or disconnected for product transfer.	1
Tank Flanges	Within 1.5 m in all directions unless a specific DSEAR risk assessment justifies a lower value.	2
Pumps, Compressors, LPG-Air plant, Vaporisers. Operational: bleeds, vents, drips, drains in pipelines containing liquid	Outdoors at or above ground level: - within 4.5 m in all directions.	Site specific DSEAR risk assessment required
	In indoor locations: - Entire room and any adjacent room not separated by a vapour-tight partition.	

Part 3

Chapter 7 (Sponsor – FSAT, SAFETY 3)

LIGHTNING / RADIATION

SECTION 1 – SCOPE

3.7.1.01 This chapter discusses the requirement for protecting LPG facilities against lightning and the potential explosion hazards from radio and radar transmitters.

SECTION 2 – LIGHTNING PROTECTION

3.7.2.01 In accordance with the guidance given by the UKLPG horizontal LPG storage tanks do not normally require special lightning protection; where vertical vessels are to be installed *BS 6651* and /or *BS EN 62305* should be consulted.

Note: *BS 6651* is in the process of being superseded by *BS EN 62305*.

SECTION 3 – RADIATION HAZARDS

3.7.3.01 An explosive hazard can exist to LPG from radio/radar transmitters. The degree of risk depends on:

a. The strength of transmitted power. and

b. The presence of objects which allow a spark to develop.

3.7.3.02 It is not possible to state constant safe distances because of different transmitter powers, aerial gain and frequency involved. Safe distances can, in the case of high powered radars, extend several hundred metres. Responsibility for safety lies jointly between the transmitter operator and the LPG user. Refer to Part 3, Chapter 8 for the procedure to be followed for determining the location of LPG installations.

Part 3

Chapter 8 (Sponsor – FSAT SAFETY 3)

SITING BOARDS AND SITING REQUIREMENTS

SECTION 1 – SCOPE

3.8.1.01 This chapter discusses the specific requirements for selecting a site for LPG storage, including the use of a Siting Board and an Acceptance or Handover Board.

3.8.1.02 Part 3 covers the overall requirements for a wide range of infrastructure facilities necessary for the design and storage of bulk LPG on the MOD Estate; for LPG cylinders (see Part 2, Chapter 16). Permanent infrastructure on the MOD estate is the responsibility of Defence Estates.

SECTION 2 – SITING BOARDS

3.8.2.01 The installation of bulk LPG should be undertaken in accordance with the procedures given in *JSP 434*, Part Two; reference is also to be made to *Defence Estates SRPs 02 and 03* (see Part 3, Chapter 1).

3.8.2.02 A feature common to all new bulk LPG infrastructure is the mandatory requirement for a properly constituted Siting Board at the initiation stage of the project. The Siting Board should be held as early as is practicable for the project.

3.8.2.03 The latest point in time in the project initiation programme for the Siting Board should be when option and feasibility studies are complete and prior to the preparation of the technical brief for the project manager appointed to deliver the project or task. However, before a Siting Board can be convened, a Statement of User Requirement (SUR) or Statement of Requirement (SOR) must have been prepared. A Land Quality Assessment should be conducted either before the Siting Board, or just afterwards, before construction commences. This will ascertain what level of contamination, or pollution may already exist at the site. Land Quality Assessments are conducted by the Military Works Force. Siting of bulk LPG storage is to be carried out in consultation with the regional Defence Fire & Rescue Service Fire Safety Officer.

3.8.2.04 All Units are to advise the Fuel Safety Assurance Team (FSAT) of proposals for new, or major refurbishment to, bulk LPG and/or gas cylinder storage sites. FSAT are to be invited to all Siting and Handover Boards. FSAT will expect information on all bulk LPG and gas cylinder storage sites to be included within the routine returns for the Fuel Safety Assurance Assessment (FSAA). Contact details are found at Part 1, Chapter 3, Annex A.

3.8.2.05 Additionally, for Army units, inspections of bulk LPG and gas cylinder sites are co-ordinated by the Combat Fuels Desk at HQ LAND, this role is currently carried out by the LAND Petroleum Inspectorate. All siting and handover boards for LPG are to include a member of the LAND Petroleum Inspectorate at the earliest opportunity. The LAND Petroleum Inspectorate will inspect all LPG stores, installations and compounds after the completion of any build or rebuild.

3.8.2.06 The Siting Board is a mandatory requirement and it is the responsibility of the sponsor of the project to task the person responsible for all works services at the base or site to convene the Siting Board. He/she must ensure that all organisations with responsibility for facilities and/or functions which potentially may be affected by the proposed installation are called to the Siting Board. These functions can include explosives, radar, air traffic control and local works staff.

3.8.2.07 The Siting Board will take into account the siting and layout of the installation, primarily based on safety, efficiency and economy, having regard to the proximity of associated military installations such as explosive stores, aircraft and aprons, and HM Ships and their associated instruments (e.g. radio, radar and lasers) and living accommodation, where appropriate; in some cases that Local Authority Planning Permission is also required. The amenity value and environmental aspects of the site and its surroundings must be taken into account.

3.8.2.08 In countries outside of the UK, the standards specified in Part 3 shall be applied unless the host nation requires a higher standard in which case that standard must be applied. In Germany, where the *Status of Forces Agreement (SOFA)* has precedence, all facilities must be constructed to German Standards irrespective of the standards specified in this publication.

3.8.2.09 Bulk LPG storage installations must be sited, wherever possible on level, well drained, open and ventilated areas, as far from explosive stores, dangerous goods stores, airfield runways and aircraft taxiways, buildings, sources of ignition and fire as is practicable and, in any case outside the prescribed safety distances for such installations or areas. Consideration must be given to the most efficient traffic flow and proximity to utilities such as water, power and fire fighting facilities.

3.8.2.10 When the Siting Board is satisfied that all conditions have been met, it will be empowered to issue the appropriate service document that will authorise the siting of the installation. Siting Boards for all other infrastructure proposals are to ensure that the safety, efficiency and economy, with regard to the proximity of associated Fuels and Lubricants installations, are fully taken into account.

3.8.2.11 The Siting Board is to comprise of representatives of the following; and other interested parties, as appropriate:

a. FSAT.

b. TLB's, HQ LF, Air Comd, Navy Comd.

c. Army – Land Petroleum Inspectorate.

d. A suitable person(s) from the Maintenance Management Organisation (MMO).

c. AP(Petroleum) and AP(Electrical) as appropriate.

d. Project Manager.

e. Contractor.

f. Defence Fire and Rescue Service Officer.

g. Unit/Station Environmental Officer.

h. Ammunition Technical Officer (ATO) (or Service equivalent).

i. Communications Officer/Radiation Hazard Officer.

j. Unit/Station Health & Safety Representative.

3.8.2.12 Siting Boards are to include a regional Defence Fire & Rescue Service Fire Safety Officer and a person (normally an officer) trained in LPG handling and safety matters as members. Apart from RAF installations, a suitably qualified warrant officer or senior NCO may replace the officer.

3.8.2.13 When complete, but prior to commissioning, the Maintenance Management Organisation must obtain to their satisfaction a Certificate of Fitness for Purpose (CFFP) for the new or modified installation. The project manager, the Maintenance Management Organisation, or the contractor may issue this certificate. The certificate must state that the installation has been constructed, or modified, in conformance with the approved design and that it is fit for its intended purpose.

3.8.2.14 The certificate must be counter-signed by:

a. Project manager.

b. AP (Petroleum).

c. Defence Fire and Rescue Service Officer.

3.8.2.15 Commissioning of an installation is a contractor's responsibility. To commission an installation, the appropriate live product(s) must be used. Prior to receiving live product, a CFFP must be issued and approved by the Maintenance Management Organisation. The AP (Petroleum) is to approve the commissioning procedure adopted by the contractor.

3.8.2.16 Once an installation has been commissioned, the Acceptance and Handover Plan produced, and the system is considered ready for take-over by the Services, the original Siting Board is to re-convene as an Acceptance/Handover Board (see *JSP 434, Part Two*).

3.8.2.17 The Acceptance/Handover Board is to ensure that the installation has been constructed in accordance with all safety and legislative requirements, has been correctly commissioned and is in a fit and proper state for take-over by the user. When the Acceptance/Handover Board is satisfied that all conditions have been met, it is empowered to issue the appropriate Service document that will authorise take-over of the installation. This document is to be signed by all members of the Acceptance/Handover Board and, in particular, is to accept the installation for the following reasons:

a. For use: by the Operating Authority.

b. For maintenance: by the Maintenance Management Organisation.

3.8.2.18 As part of the take-over process, the Maintenance Management Organisation is to arrange for any necessary installation specific familiarisation training required by the AP(Petroleum), the maintainer, and the operators of the installation. An appropriate record of those personnel who have received training is to be maintained by the Operating Authority.

SECTION 3 – EXISTING INSTALLATIONS

3.8.3.01 The regulations contained in Part 3 are generally applicable to new installations and to those installations which are subject to significant modification. There may be older installations which do not fully conform to the new build requirements, such as Zoned electrical installations to the *BS 5501* series specifications rather than the newer *BS EN 50014* specification.

3.8.3.02 The approach selected for evaluating such older installations is for the officers responsible for the facilities in question to note the areas of non-compliance and to perform or manage an assessment of the risks to gain an indication of the impact of the non-compliance. The risk areas appropriate to the particular non-compliance can include levels of maintenance, safety and environmental issues. The output of the assessment can then be used as a basis for decision making regarding the continued operation of the facility and the need for development. The non-compliance areas and the assessments must be recorded.

3.8.3.03 However, when a one-for-one replacement is carried out for an existing bulk LPG storage tank the new system must comply with all mandatory legal requirements, such as *Pressure Systems Regulations, Gas Safety (Installation and Use) Regulations, Dangerous Substances* and *Explosive Atmospheres Regulations (DSEAR)*, etc. See *SRP CER*, *SRP 02* and *SRP 03*.

SECTION 4 – SPECIFIC CONSIDERATIONS FOR BULK LPG

3.8.4.01 This Section summarises the considerations that apply to the siting of bulk LPG storage vessels. It is based on *UKLPG Code of Practice 1, Parts 1 and 2* and as such does not cover all the considerations that are needed for buried and mounded LPG storage vessels. See *UKLPG Code of Practice 1, Part 4*.

3.8.4.02 The proposed storage site should be surveyed for any possible hazards, including overhead cables, fixed sources of ignition and ground conditions. Bulk LPG should not be stored in buildings; it should be stored outside in well ventilated areas away from fixed sources of ignition and avoiding open pits, hollows and ground depressions where leakages may collect. Tables 3.8.A1 and 3.8.A2 in Annex A provide minimum separation distances between LPG storage vessels; between LPG storage tanks fixed ignition sources, buildings and site boundaries; and between LPG storage vessels and other hazards / hazardous materials, such as flammable liquids and liquid oxygen.

3.8.4.03 Ideally, bulk LPG should not be stored in the same compound as gas cylinders, flammable liquids or liquid oxygen; but in all cases the minimum safety separation distances, given in Tables 3.8.A1 and 3.8.A2 in Annex A, shall be observed for LPG vessels located above ground. The minimum safety separation distances for buried and mounded LPG storage vessels shall also be observed, where appropriate. They may, however, differ from those given in the two tables (see Part 3, Chapter 13).

3.8.4.04 The location and layout of bulk LPG storage vessels should be carefully considered to ensure:

a. Adequate separation from other hazards, such as fixed sources of ignition, ammunition stores, bulk fuels and lubricants, flammable stores, bulk liquid oxygen, etc.

b. Adequate separation from site boundaries, buildings, public roads, runways, etc.

c. Site accessibility for the ground works, delivery and installation of the storage vessel(s).

d. Adequate free ventilation.

e. Accessibility for LPG delivery tankers (access and egress, particularly in the event of an incident occurring).

f. Accessibility for fire fighting.

g. Water supply for fire brigade use.

h. Clear line of sight for LPG delivery drivers between the delivery tanker and the storage vessel(s).

i. Storage vessels not to be sited under electricity or phone cables, trees or overhanging tree branches, car ports or roof eaves.

j. Storage vessels not to be sited where damage from cranes, gantries or other overhead structures may occur.

k. Buried LPG storage vessel(s) not to be sited in areas subject to flooding, or close to Party Walls (see Part 3, Chapter 13).

l. No open drains, gullies or ducts located within the vessel safety distances (see Tables 3.8.A1 and 3.8.A2 in Annex A) unless they protected from access and passage of LPG vapours.

m. No underground services to pass under the foundations of the LPG storage vessel(s).

n. In the case of multiple LPG storage vessel, adequate siting so that spillage from one vessel does not affect other vessels or adjacent facilities.

o. Safe passage for LPG gas pipe line(s) to service locations.

p. Suitable location(s) for Evaporation Area(s) to allow spillages from LPG delivery vehicle and LPG storage vessel(s) to be diverted to a dedicated area where it may safely evaporate (see Part 3, Chapter 6). The use of an indicator, such as a windsock or other device, to provide in the early stages of any spillage or leak an indication of which neighbourhood might be exposed to plumes and/or ground strike is recommended.

3.8.4.05 The Acceptance/Handover board should check that the considerations discussed above have been adequately resolved. In addition the following should be assessed:

a. Physical security, such as fence around bulk LPG storage area or other access controls.

b. Physical protection of storage vessels and pipe lines from vehicles, e.g. bollards or curb stones.

c. Means of escape, such as outward opening exits.

d. Adequate means of fire fighting, such as fire extinguishers in delivery area, water supplies, etc.

e. Adequate signage, including safety signs and warning notices, are displayed around the boundaries of the storage area; pipe lines are labelled; and all LPG system and building stop valves both labelled and with provided with operating instructions.

f. Emergency telephone numbers, including the LPG supplier's 24 hour emergency telephone number, are prominently displayed.

g. Training and Standard Operating Procedures.

h. Absence of fixed sources of ignition or the presence of other hazards within the minimum separation distances between bulk LPG and site boundaries, buildings, fire walls, etc.

ANNEX A

(introduced at paragraph 3.8.4.02)

MINIMUM SEPARATION DISTANCES FOR BULK LPG VESSELS

3.8.A.01 Table 3.8.A1 provides minimum separation distances for bulk LPG storage vessels, based on vessel capacity, between vessels; and between vessels and buildings, boundaries and fixed sources of ignition, depending on whether a fire wall is, or is not installed. It does not apply to Underground and Mounded LPG storage vessels (see Part 3, Chapter 13).

3.8.A.02 Table 3.8.A2 provides minimum separation distances for bulk LPG storage vessels and other hazards, such as flammable materials, liquid oxygen and electrical cables. It does not apply in full to Underground and Mounded LPG storage vessels (see Part 3, Chapter 13).

3.8.A.03 The separation distance between bulk LPG tanks and oil tanks/tank bunds is given in UKLPG CP1, Part 1, Table 2. For oil tanks containing upto 3000 litres of product having a flash point of 65 °C or less and LGP tanks up to 60 tonnes this distance is 3m. To allow access and ventilation to the LPG tank the separation distance between bulk LPG tanks and oil tanks contraining products having a flash point of more than 65 °C should not be less than 1m.

Table 3.8.A1: Minimum Separation Distances for bulk LPG vessels

Maximum LPG Capacity			Minimum Separation Distance (m)		
Any single vessel in a group		All vessels in group	From buildings, boundary, fixed source of ignition		Between vessels
Vessel Water Capacity (litres)	LPG Capacity (kg)	LPG Capacity (kg)	With Fire Wall (Note 1)	No Fire Wall	
150 - 500	50 – 250	800	0.3	2.5	1
> 500 - 2500	> 250 – 1100	3500	1.5	3	1
> 2500 - 9000	> 1100 – 4000	12500	4	7.5	1
> 9000 - 135000	> 4000 – 60000	200000	7.5	15	1.5

Notes:

1. A Fire Wall is intended to protect a vessel from thermal radiation from a nearby fire; and to ensure adequate dispersion for leaking LPG where the distances between the building, boundary or source of ignition are too short to provide adequate dispersion. For vessels up to 1100 kg the fire wall need not be higher than the top of the vessel and may be part of the site boundary. It may also be part of a building wall provided it is imperforate and has 60 minutes fire resistance. See UKLPG Code of Practice 1.
2. This table does not apply to Underground and Mounded LPG storage vessels (see Part 3, Chapter 13).
3. See UKLPG Code of Practice 1 for further information, including minimum separation distance for vessels of higher capacity.

Table 3.8.A2: Minimum Separation Distances between bulk LPG vessels and other hazards / hazardous substances

Hazard / Hazardous substances				
Hazard / Hazardous Substance		**Hazard / Capacity of Hazardous Substance (litres)**	**LPG storage vessel capacity (tonnes)**	**Minimum Separation Distance (m)**
Bulk Flammable Liquids (Flash Point)	< 32 °C e.g. Petrol (Class I and some Class II)	-	≤ 60	6 (see Note 1)
			> 60	15 (see Note 1)
	32 °C - 65 °C e.g. Kerosene, Diesel fuel, Gasoil (Some Class II & some Class III)	≤ 3000	≤ 60	As per Table 3.8.A1 or 3 m, which ever is smaller
			> 60	6 (see Note 1)
		> 3000	≤ 60	3 to bund wall or diversion wall and 6 to tank
			> 60	15 to tank, bund wall or diversion wall
Bulk Liquid oxygen		≤ 125000	0.1 - 1.1	6
			> 1.1 - 4	7.5
			> 4 - 60	15
			> 60 - 150	22.5
		(See Note 2)		
LPG Evaporation Area(s)		-	-	3 from vessel and/or delivery vehicle
Electricity Cables, including telephone cables		< 1.0 kV	-	1.5 from vertical plane below cable(s)
		≥ 1.0 kV	-	10 from vertical plane below cable(s)
Powered vehicles (see Note 4)		-	-	As per Table 3.8.A1 or 6 m, which ever is smaller
LPG Cylinders		> 50 kg total quantity; horizontal venting PRV	> 2.2	7.5
			< 2.2	3
		< 300 kg total quantity; vertical venting PRV	-	1
Weeds, long grass, deciduous shrubs, trees, combustible material		–	≤ 1.1	As per Table 3.8.A1
			> 1.1	6

Notes:

1. To bund wall.
2. For large capacities of Liquid oxygen and/or LPG see *UKLPG Code of Practice 1*.
3. The separation distance must be controlled, i.e. no fixed sources of ignition, prohibition on smoking, no vehicles except delivery vessels, all electrical installations to be explosion protected.
4. This limitation does not apply to LPG delivery vehicles.
5. PRV = Pressure Relief Valve.
6. Table 3.8.A2 may not apply in full to Underground and Mounded LPG storage vessels (see Part 3, Chapter 13).

Part 3

Chapter 9 (Sponsor – FSAT SAFETY 3)

NOTIFICATION TO CIVILIAN AUTHORITIES OF LPG FACILITIES

SECTION 1 – SCOPE

3.9.1.01 This chapter details the requirement to notify and/or obtain planning consent from local authorities for Bulk LPG storage sites. It also includes the requirement for compliance with *JSP 498*.

SECTION 2 – GENERAL

3.9.2.01 The Commanding Officer or Head of Establishment is responsible for compliance with the civilian regulations and legislation discussed in JSP 319, Introduction, (where 25 tonnes of LPG or over are held on site).

3.9.2.02 *The Notification of Installations Handling Hazardous Substances Regulations*, *1982*, requires that the Health and Safety Executive be informed. Local Authority consent is also required under *the Planning (Hazardous Substances) Act, 1990*, and *the Planning (Hazardous Substances) Regulations, 1992*. Similar regulations apply in Scotland.

3.9.2.03 *The Dangerous Substances (Notification and Marking of Sites) Regulations*, *1990*, requires the local Fire Authority and Health and Safety Executive to be informed when 25 tonnes or more of dangerous substances, including LPG are to be stored. Hazard warning signs to be installed at all access points.

3.9.2.04 Notification is to include, in each case, the following:

a. Name, address and official capacity of the person making the notification.

b. Full postal address and grid reference of the LPG installation.

c. The area of the installation covered by the notification and details of adjacent sites.

d. The date storage is to commence.

e. A general description of the activities to be carried out at the installation.

f. The name and address of the planning authority covering the installation.

g. The type of product to be stored [e.g. propane, butane], the maximum quantity to be stored, and the maximum storage capacity including pipelines.

3.9.2.05 Where the quantity of a controlled substance reaches the lower tier threshold (in this case 50 tonnes of LPG), those responsible for the project must ensure that the requirements of the *Control of Major Accident Hazard Regulations, (COMAH), 1999*; the *Control of Major Accident Hazard (Amendment) Regulations, 2005*; and the *Town and Country Planning, England and Wales - Planning (Control of Major-Accident Hazard) Regulations 1999, SI No. 981* are met (separate, but comparable Town Planning regulations exist for Scotland and for Northern Ireland). This requires the preparation of a

Major Accident Prevention Policy (MAPP). In addition, sites holding quantities above the top tier threshold (in this case 200 tonnes of LPG) must also submit a Safety Report in which they demonstrate that all measures necessary have been taken to prevent major accidents and limit their consequences.

3.9.2.06 The COMAH Regulations, which are the UK implementation of an European Union Directive, do not apply to Military Forces and Defence Establishments of European Union Member States. The equivalent MOD Regulations are the *Major Accident Control Regulations – JSP 498* and these regulations are enforced by the MACR Controlling Authority (MACR CA). MAPPs and Safety Reports for Military Forces and Defence Establishments must therefore be submitted in accordance with the requirements of *JSP 498*.

Part 3

Chapter 10 (Sponsor – FSAT SAFETY 3)

MEASUREMENT OF LPG IN BULK VESSEL INSTALLATIONS

SECTION 1 – SCOPE

3.10.1.01 This chapter details the requirement to measure the capacity of LPG tanks and the means for doing so.

SECTION 2 – GENERAL

3.10.2.01 LPG may be measured by volume of liquid or by weight. In cylinders, for example, it is measured by deducting the empty tare weight of the cylinder from the total weight of the cylinder once filled.

3.10.2.02 LPG supplied into fixed vessels is usually measured by volume of liquid. The amount of vapour in a vessel is disregarded. The liquid volume filled is measured by a meter on the LPG delivery vehicle. Should LPG vapour be passed through a meter, e.g. when the vehicle vessel is empty of liquid, the volume of vapour may be recorded in the same manner as liquid and must be disregarded. The amount of liquid in the fixed vessel, as recorded by the vehicle's meter is to be checked by the vessel gauge reading before and after the delivery.

3.10.2.03 The amount of LPG in the vessel is measured by the contents gauge. Only accurate and reliable gauges are to be used, such as magnetic float gauges. Vessels must be calibrated so that the liquid level can be translated into units of volume.

3.10.2.04 The maximum liquid level device provides indication of the maximum amount of LPG that can be contained in any vessel. The *UKLPG Code of Practice 1, Part 1, Section 7, Para 7.4* refers.

Part 3

Chapter 11 (Sponsor - FSAT SAFETY 3)

ABOVE GROUND INSTALLATIONS

SECTION 1 – SCOPE

3.11.1.01 This chapter details the requirements for the design and construction of above ground bulk LPG tanks.

SECTION 2 – GENERAL

3.11.2.01 In countries outside of the UK, the standards specified in Part 3 shall be applied unless the host nation requires a higher standard in which case that standard must be applied. In Germany, where the Status of Forces Agreement (SOFA) has precedence, all facilities must be constructed to German Standards irrespective of the standards specified in this manual.

3.11.2.02 UK*LPG Code of Practice 1 'Bulk LPG Storage at Fixed Installations' Part 1: 'Design, Installation and Operation of Vessels Located above Ground'* applies in full unless modified by the following paragraphs.

SECTION 3 – DESIGN AND CONSTRUCTION

3.11.3.01 Please note where subject areas are covered in *UKLPG Codes of Practice* and in JSP 319.

Table 3.11.1:

Subject	UKLPG Code of Practice	JSP 319
Pipework	22	Part 3, Chapter 15
Periodic Inspection and Testing	1:Part 3	See JSP 375, Volume 3
LPG Central Storage and Distribution Systems for Multiple Consumers	25	Part 3, Chapter 15
Flowmeter	19	Part 3, Chapter 10

3.11.3.02 **Older Installations**. (UK*LPG Code of Practice 1:Part 1, 1.3.2*) Refer to Part 3, Chapter 8, Section 3.

3.11.3.03 **Notification**. (UK*LPG Code of Practice 1:Part 1, 1.3.3*) Refer to Part 3, Chapter 9 (Notification).

3.11.3.04 **Installation Located Overseas**. (UK*LPG Code of Practice 1:Part 1: 2.7*) An additional notice is to be provided in the language relevant to the local civilian operators.

3.11.3.05 **Fire Instruction and Training**. (UK*LPG Code of Practice 1:Part 1, 4.7*) Refer to Part 3, Chapter 6.

3.11.3.06 **Commissioning of Plant**. (UK*LPG Code of Practice 1:Part 1, 6.1.1*) Shall be under the control of Defence Estates (see Part 3, Chapter 1 and JSP 375, Volume 3).

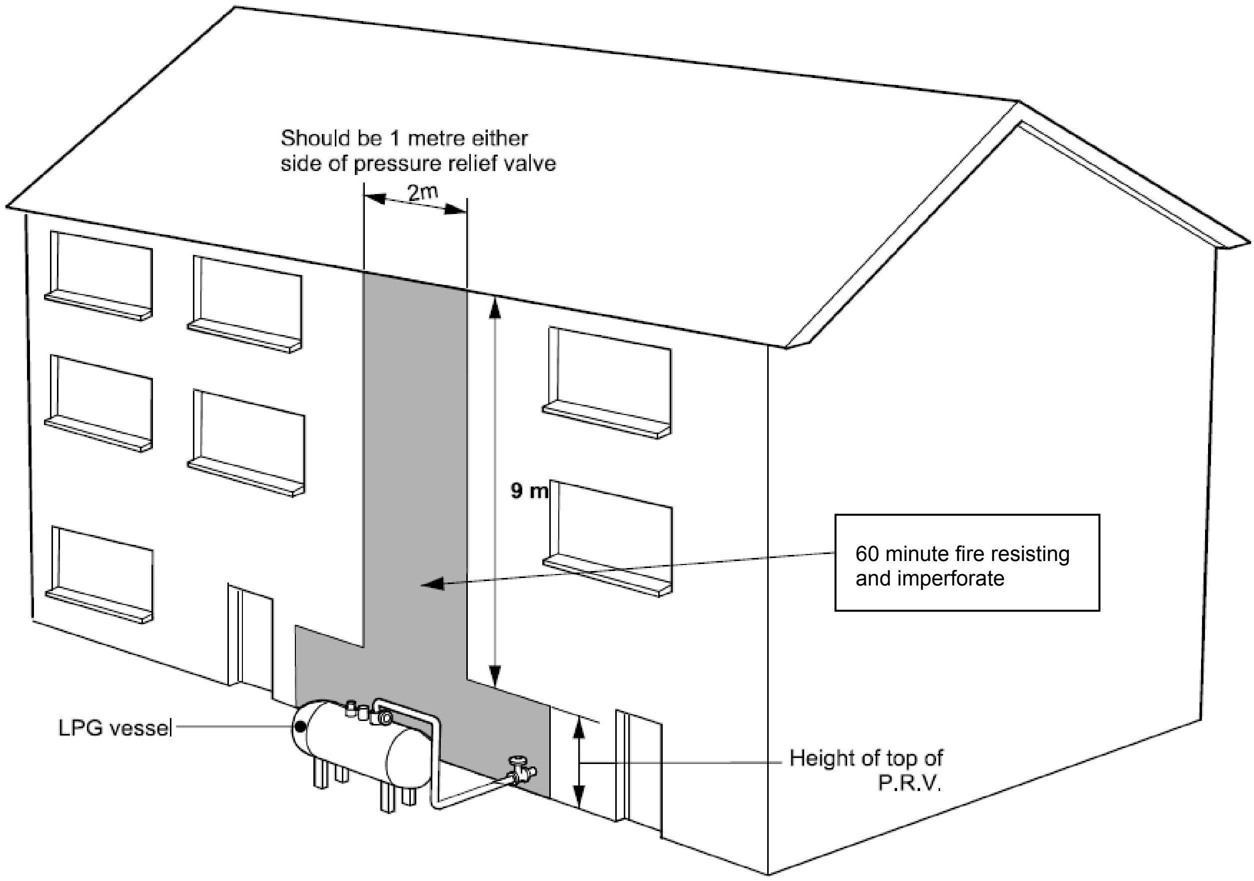
3.11.3.07 Refer to Table 3.8.A1 for the applicable safety distances.

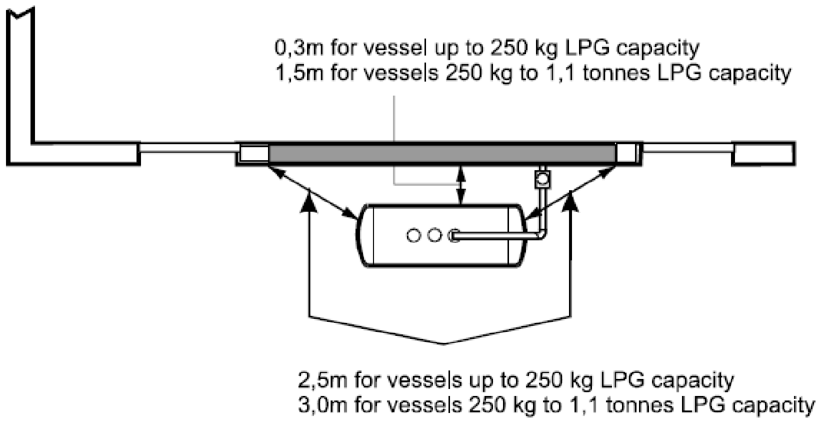
3.11.3.08 Annex A provides guidance for a small bulk LPG vessel adjacent to a building.

ANNEX A

Small bulk LPG vessel adjacent to a building.

Figure 3.11.A1





Part 3

Chapter 12 (Sponsor -)

This chapter is currently not in use

Part 3

Chapter 13 (Sponsor - FSAT SAFETY 3)

UNDERGROUND AND MOUNDED TANKS

SECTION 1 – SCOPE

3.13.1.01 This chapter details the requirements for the design and construction of underground and mounded bulk LPG tanks.

SECTION 2 – GENERAL

3.13.2.01 In countries outside of the UK, the standards specified in Part 3 shall be applied unless the host nation requires a higher standard in which case that standard must be applied. In Germany, where the Status of Forces Agreement (SOFA) has precedence, all facilities must be constructed to German Standards irrespective of the standards specified in this publication.

3.13.2.02 *UKLPG Code of Practice 1 'Bulk LPG Storage at Fixed Installations' Part 4: 'Buried/Mounded LPG Storage Vessels'* applies in full unless modified by the following paragraphs.

SECTION 3 – DESIGN AND CONSTRUCTION

3.13.3.01 Please note where subject areas are covered in *UKLPGA Codes of Practice* and in *JSP 319*.

Table 3.13.1

Subject	**UKLPG Code of Practice**	**JSP 319**
Bulk LPG Storage at Fixed Installations	1: Part 1	Chapters 8 & 11
Periodic Inspection and Testing	1: Part 3	See JSP 375, Volume 3
LPG Piping System – Design and Installation	22	Chapter 15
LPG Central Storage and Distribution Systems	25	Chapter 15

3.13.3.02 **Bunded Areas**. (*UKLPG Code of Practice1: Part 4, 2.2.7*) Buried or mounded LPG storage vessels should not be located within bunded areas.

3.13.3.03 **Fencing**. (*UKLPG Code of Practice 1: Part 4, 2.5.2a.b.c*) A fence will always be required at the installation.

3.13.3.04 **Installations Located Overseas**. (*UKLPG Code of Practice 1: Part 4, 2.6.1*) An additional notice is to be provided in the language relevant to the local civilian operators.

3.13.3.05 **Safety distances**. Refer to Table 3.13.2 for the applicable safety distances.

Table 3.13.2 Minimum Separation Distances (MSD)

Maximum tank water capacity **(litres)**	**MSD for above ground vessels and the valve assemblies of buried vessels from:** **buildings, property line or fixed source of ignition** **(m)**	**MSD for buried vessels from:** **buildings, property line or fixed source of ignition** **(m)**
150 to 500	2.5	1
>500 to 2500	3	1
>2500 to 4500	7.5	3
Notes: 1. A fixed source of ignition is a flame off or flare and is unlikely to be applicable on the Defence Estate. 2. Tanks should not be installed in buildings or pits. 3. The distances may be reduced if fire-walls are provided for and the design concept is approved by the Defence Fire & Rescue Service after a risk assessment has been conducted.		

Part 3

Chapter 14 (Sponsor - FSAT SAFETY 3)

AUTOMOTIVE LPG MECHANICAL TRANSPORT FUELLING INSTALLATION

SECTION 1 – SCOPE

3.14.1.01 This chapter details the specific requirements for Automotive LPG Mechanical Transport Fuelling Installations.

SECTION 2 – GENERAL

3.14.2.01 This chapter is an abridged version of the *UKLPG Code of Practice (CP) N° 20: 2001*. It is to be used as guidance for those responsible for the design, construction and operation of LPG Automotive Mechanical Transport Fuelling Installation (MTFI) intended to dispense Liquefied Petroleum Gas (LPG) to vehicles. In countries outside of the UK, the standards specified in Part 3 shall be applied unless the host nation requires a higher standard in which case that standard must be applied. In Germany, where the *Status of Forces Agreement (SOFA)* has precedence, all facilities must be constructed to German Standards irrespective of the standards specified in this manual.

3.14.2.02 The source document for any unit intending to construct a LPG MTFI is *UKLPG CP N° 20: 2001* (plus Amendment 1, February 2004). Project managers are to ensure that the *CP N° 20* is the extant version issued by the UKLPG. Reference must also be made to Defence Estates publications *SRP CER, SRP 02* and *SRP 03* (see Part 3, Chapter 1). As systems for delivering LPG in liquid form, they will fall within the scope of SRP 03; and come under the control of AP (Petroleum).

3.14.2.03 Anyone involved in the design, installations are to be aware of the properties and potential hazards of LPG, as detailed in Part 3, Chapters 2, 3 and 4.

3.14.2.04 Under the *Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)* all hazardous areas, i.e. an area where an explosive atmosphere may occur, are to be Zoned (see Chapter 6, Annex A). LPG leakages from a MTFI should be low and the likelihood of an ignition extremely low provided that adequate precautions are taken and the necessary warning signs are display.

SECTION 3 – FIRE PROTECTION, SECURITY AND EMERGENCY PROCEDURES

3.14.3.01 **General**. Reference is to be made to *UKLPG CP 3 - Recommendations for Prevention or Control of Fire involving LPG* and the Fire Precautions section within the UKLPG CP 1. The key precautions to prevent fire and other related incidents are:

a. The effective containment of LPG.

b. The effective management of releases of LPG (includes the provision of necessary equipment and safety devices).

c. Controlling potential ignition sources, such as banning smoking, prevention of naked lights, and suitably Zoned electrical equipment.

d. Effective training of all staff involved in the daily operation of the installation.

The possibility of a major fire, leading to direct flame impingement on the storage vessel, can be minimised by sound design and layout of the installation. Good operating practices and training of all personnel in normal operations the actions to be taken in the event of an emergency incident.

3.14.3.02 See also Part 3, Chapters 3, 4, 5 and 6.

3.14.3.03 **Portable Extinguishers**. Fire fighting equipment must be selected and installed in accordance with the *Crown Fire Standards*. However, the UKLPG recommend that at least 2 x 9 litre dry powder extinguishers to *BS EN 3* or equivalent, suitable for LPG fires with a test fire rating of at least 21A and 183B as defined in *BS EN 3-7*, are to be located at the installation control point. In the event that the dispensers are separated from the control point by more then 15 m an additional extinguisher is to be located at the dispenser.

3.14.3.04 **Security**. Adequate steps are to be taken to prevent the unauthorised interference with vessels, dispenser and ancillary equipment. If fencing is to be used, at least two means of exit are to be provided. The exit gates are not to be adjacent to each other and all gates must open outward (see Part 3, Chapter 8, Section 4).

3.14.3.05 A system to protect vessels and dispensers from vehicular damage is to be installed (see Chapter 8, Section 4). The installation, when closed is to be protected against interference and unauthorised operation by:

a. Isolation of all electrical supplies is to be by means of a mains switch, to be readily visible and within easy reach for quick operation in an emergency.

b. All ancillary equipment is to be contained within a lockable well ventilated cabinet.

c. Where pumps switches are external to the dispenser cabinet, the cabinet doors are to be secured when not in use.

d. A means of securing the refuelling nozzle to the dispenser holster is to be supplied.

3.14.3.06 **Safety signs and warning notices**. Appropriate signs and notices are to be displayed in-line with Part 3, Chapter 6, paragraphs 3.6.3.18 to 3.6.3.22. In addition the following signs shall be displayed:

HIGHLY FLAMMABLE – PROPANE
NO SMOKING

Figure 3.14.1: Signage at the LPG dispenser

3.14.3.07 The following sign is to be displayed at the installation dispensing pump emergency isolator switch.

Figure. 3.14.2: Signage at the master switch

LPG PUMP – SWITCH OFF HERE

SECTION 4 – OPERATIONS

3.14.4.01 **Written Procedures**. Standard Operating Procedures (SOPs) are to be established so all personnel understand their duties during normal operations, the closing of the refuelling installation and the duties required upon a receipt of LPG from a delivery tanker. SOPs are to be put in place to ensure all personnel are aware of the actions to be taken in the event of an emergency incident occurring. For reporting of incidents/accidents see Part 1, Chapter 7.

3.14.4.02 **Self Service - Vehicle Refuelling by Vehicle Driver**. Self service refuelling of LPG vehicles shall only be permitted if a fully trained competent person, conversant with the procedures for emergency shut down is in attendance.

3.14.4.03 The installation manager shall display adequate notices giving instruction on how to operate the dispenser, this notice is to be displayed on or as near as possible to the refuelling island. The instruction shall include the following warning:

> If an adapter is required, it must be connected to the vehicle fuel coupling first – not the filling nozzle. If you do not have a correct adapter, request assistance from the attendant:
>
> **DO NOT USE FORCE TO MAKE A CONNECTION**

3.14.4.04 **Daily Closedown**. Installations that operate restricted opening times, must be shut down with all electrical supplies to dispensers and pumps isolated at the master switch. Security arrangements are to be put in place to prevent any unauthorised operation or interference.

SECTION 5 – TRAINING

3.14.5.01 **Scope of Training**. Training is vital to prevent incidents and to minimise the consequences should an incident occur. All personnel employed within the installation must have adequate training in the proper use, and the action drills in the event of a malfunction of equipment and the ability to deal with any emergency (see Part 3, Chapter 5).

3.14.5.02 The training may take many forms, including the giving of instructions (verbal and written) and a formal training course. The training should ensure that those who are trained understand:

a. The hazards of LPG (see Part 3, Chapter3), including knowledge of the contents of the Safety Data Sheet.

b. The risks within the installation.

c. The measures to be put in place to deal with the risks.

d. The correct use of the filling coupling, and the provision of adapter use.

e. The emergency procedures relevant to the installation (see Part 3, Chapter 5).

f. The action required if a drive away with the filler hose connected occurs and the procedure for reinstating breakaway couplings.

g. The use of all fire equipment applicable to the installation.

h. Their duties in accordance with local Standard Operating Procedures (see Section 3).

SECTION 6 – EMERGENCY ACTIONS

3.14.6.01 **Action in the Event of Fire**. A fire caused by ignited LPG may be brought under control by means of isolating valves at the storage vessel or in the system to cut off the supply of LPG to the fire.

3.14.6.02 Dry Powder extinguishers are to be used to extinguish ignited LPG, but it is only to be attempted if the source can be cut off. The personnel within the installation are not to put themselves at risk.

3.14.6.03 The emergency services are to be contacted as soon as possible, all non essential personnel are to be evacuated immediately (see Part 3, Chapter 5).

3.14.6.04 **Emergency Action (other then fire)**. In the event of a spillage or leak of LPG, carry out the actions below and follow the actions detailed in Part 3, Chapter 5.

a. Isolate electrical supply to all fuel dispensers, by activating the master isolator switch.

b. Remove or extinguish any source of ignition. Do not attempt to start vehicle engines.

3.14.6.05 **Medical emergency**. In the event of an accident/incident resulting in a case of injury from LPG, qualified medical assistance is to be called immediately (see Part 3, Chapter 4).

SECTION 7 – INSPECTION AND MAINTENANCE

3.14.7.01 **Routine Examination**. The installation operator is to carry out the following daily checks of the installation:

a. All warning signs are legible and in place.

b. There is no visual damage to the vessel, pumps, pipework or dispensers.

c. No damage to hoses, breaks coupling and hose end nozzles.

d. No sign of leak's (smell of gas).

e. All valves are in the correct position prior to commencement of operations.

f. Physical securities, i.e. vessel hood, perimeter fence are in good condition.

g. Fire extinguishers are in place and fully operational.

h. Barriers in place as required.

i. The local area is clear of combustible products.

Part 3

Chapter 15 (Sponsor - DFG FHE3)

PIPING SYSTEMS

SECTION 1 – SCOPE

3.15.1.01 This chapter details the requirements for the design, construction and distribution of LPG from the bulk storage site to the point of use.

SECTION 2 – GENERAL

3.15.2.01 In countries outside of the UK, the standards specified in Part 3 shall be applied unless the host nation requires a higher standard in which case that standard must be applied. In Germany, where the *Status of Forces Agreement (SOFA)* has precedence, all facilities must be constructed to German Standards irrespective of the standards specified in this manual.

3.15.2.02 There are two UKLPG Codes of Practice relating to piping systems for LPG use:

a. *UKLPG Code of Practice 22 - LPG Piping System – Design and Installation*.

b. *UKLPG Code of Practice 25 - LPG Central Storage and Distribution Systems for Multiple Consumers*.

3.15.2.03 *LPG pipe work and protective devices are classed as pressure systems and are required to comply with the Pressure Systems Safety Regulations, 2000. JSP 375, Volume 2, Leaflet 30* refers. All work on LPG systems is also governed by Defence Estates Safety Rules and Procedures (see Part 3, Chapter 1).

3.15.2.04 *UKLPG CP 25* is to be used for the distribution systems from bulk storage vessel(s) to multiple metered consumers; whilst *UKLPG CP 22* is to be used for pipework from bulk storage vessel(s) or cylinder(s) to a single consumer. In addition, *UKLPG CP 25* is solely for commercial propane using natural vaporisers; whilst *UKLPG CP 22* is applicable for both commercial propane and commercial butane, in liquid and vapour phases.

3.15.2.05 After the decision has been made as to which Code of Practice is applicable, Section 2, should be followed to determine the requirements. The respective Codes of Practices apply in full unless modified by the following paragraphs. The numbers in brackets refer to the paragraph number *UKLPG Code of Practice 22 (2002 Edition)* or *UKLPG Code of Practice 25 (1999 Edition)*, as applicable.

SECTION 3 – DESIGN AND CONSTRUCTION

UKLPG CP 22 - LPG Piping System - Design and Installation

Table 3.15.1: Subject coverage.

Subject	UKLPG Code of Practice	JSP 319
Examination and Inspection	1: Part 3	Not covered

3.15.3.01 (2.1.3.2(d)). Addition: for installations located overseas an additional notice is to be provided in the language relevant to the local civilian operators.

3.15.3.02 (5.7). Clarification: the use of Polyethylene (PE) pipework is recommended due to its intrinsic corrosion resistant properties and as it does not require a cathodic protection system.

UKLPG CP 25 - Central Storage and Distribution Systems for Multiple Consumers

Table 3.15.2: Subject coverage.

Subject	UKLPG Code of Practice	JSP 319
Examination and Inspection	1: Part 3	Not covered
Bulk LPG Storage at Fixed Installations	1: Part 1	Part 3, Chapters 8 & 11
Small Bulk Propane Installations	1: Part 2	Part 3, Chapters 8 & 12
Buried/Mounded LPG Storage Vessels	1: Part 4	Part 3, Chapters 8 & 13

3.15.3.03 (6.6). Addition: for installations located overseas an additional notice is to be provided in the language relevant to the local civilian operators.

SECTION 4 – INSPECTION AND MAINTENANCE OF LPG PIPEWORK INSTALLATIONS.

3.15.4.01 There have been incidents where LPG pipes, especially those located underground, have failed, typically as a result of corrosion, in part because of a lack of awareness of responsibilities with respect to inspection and maintenance of LPG installations.

3.15.4.02 Industry inspection practice in the past relied mainly on pressure tests to assess the condition of buried pipework and this alone is insufficient to ensure its continued integrity. Pressure testing provides only a pass or fail result and is limited in that it does not identify the location of a leak if the pipework fails, nor provides sufficient evidence of condition required to determine remaining life if the outcome of the test is successful.

3.15.4.03 LPG installations will normally consist of storage tanks and associated fittings, which will include service pipework, an emergency control valve, safety valve and a pressure regulator, that are connected to the users premises by installation pipework. All LPG pipework, whether buried or not, is to be inspected, maintained and when necessary replaced.

Notes:

1. Disturbing buried LPG pipework could increase the risk of any leak(s) and this must be minimised.

2. Any work on LPG systems is to comply with requirements within JSP 375, Volume 3. Work is only to be undertaken by competent persons.

3.15.4.04 The Provision and Use of Work Equipment Regulations 1998 (PUWER) places duties on employers to ensure that work equipment exposed to conditions causing deterioration that is liable to result in dangerous situations is inspected at suitable intervals. This definition will extend to underground pipework forming part of an installation.

3.15.4.05 The Gas Safety (Installation and Use) Regulations 1998 (GSIUR) includes duties on employers to ensure that installation pipework at relevant premises is maintained in a safe condition.

3.15.4.06 Responsibility for ownership of all, or part of, a LPG system is to be clearly understood and any demarcation points are to be defined. In the case of leased storage tanks the responsibility for discharging the duties of the user under the provisions of the Pressure Systems Safety Regulations 2000 (PSSR) will usually rest with the supplier of the leased equipment. See also JSP 375, Volume 2, Leaflet 30. The formal agreement in writing with the supplier of leased equipment is described in Schedule 2 of the PSSR, “Modification of duties in cases where pressure systems are supplied by way of lease, hire or other arrangements”. This written agreement should contain the point of demarcation for the system and be available to relevant site personnel. The responsibility for the remainder of the system including the installation pipework will usually rest with the Maintenance Management Organisation (MMO).

3.15.4.07 The MMO, or any other person responsible for the inspection and maintenance of LPG installations, on MoD sites is to ensure that a competent person establishes a permanent safety regime governing the installation, maintenance, monitoring and replacement of LPG systems. This shall include an inspection and maintenance strategy which is to be implemented for all existing systems. This is to be based on a risk assessment of the complete system. The strategy is to identify when the pipework was last checked, what action was taken and when the next check is due. In the case of steel pipework this should be prepared by a person who is competent to assess corrosion in LPG pipework.

Notes:

1. This should not be confused with the Statutory Written Scheme of Examination for a pressure system required under the PSSR which relates to risks associated with pressure.

2. Competence in this respect has been determined by the HSE to be the qualification known as Pipelines Coating Inspector– Level 2, issued by the Institute of Corrosion.

3.15.4.08 The inspection plan for underground metallic pipework is to include the following actions by a competent person:

a. A visual inspection to establish its condition and that of any associated protection.

b. An assessment of the ground conditions and their likely effect on the pipework and associated protection.

c. An assessment of the required frequency of inspection.

d. A statement of what examinations, tests and measurements should be performed at each inspection.

3.15.4.09 The UKLPG User Information Sheet 015 "Inspection & Maintenance of LPG Pipework at Commercial & Industrial Premises" is available as a free download (http://www.uklpg.org/lpg_property/UIS015.pdf) and can be used to assist with the risk assessment.

3.15.4.10 Pipework may run above or below ground or a combination of the two but:

a. Ideally pipework should be run above ground.

b. Where pipework needs to be buried it should be inherently resistant to corrosion e.g. certain grades of polyethylene or proprietary systems.

c. Metallic pipework should only be run below ground where this is unavoidable.

d. Polyethylene pipework should not be used above ground

3.15.4.11 Buried metallic pipework is to be adequately protected from corrosion at the time of installation by sleeving or by the provision of a suitable coating and a trench prepared with non-aggressive backfill or in some cases by cathodic protection.

CHAPTER 16

BIBLIOGRAPHY

1. JSP 317 - *Joint Service Safety Regulations for the Storage and Handling of Fuels and Lubricants*.

2. JSP 375 - *MOD Health and Safety Handbook*.

3. JSP 434 - *Defence Construction in the Built Environment*.

4. JSP 498 - *Major Accident Control Regulations*.

5. JSP 414 - *MOD Hazardous Stores Information System*.

6. Crown Fire Standards

7. UKLPG CP 1 - *Bulk LPG storage at Fixed Installations*.

8. UKLPG CP 3 - *Prevention or Control of Fire Involving LPG*.

9. UKLPG CP 20 - *Automotive LPG Refuelling Facilities*.

10. UKLPG CP 22 - *LPG Piping System, Design and Installation*.

11. UKLPG CP 25 - *LPG Central Storage and Distribution Systems for Multiple Consumers*.

12. UKLPG GN 3 - *A Guide to the Preparation of Major Accident Prevention Policies (MAPPs).*

13. *Control of Major Accident Hazards Regulations (COMAH),* 1999

14. *Control of Major Accident Hazard (Amendment) Regulations*, 2005

15. *Dangerous Substances (Notification and Marking of Sites) Regulations*, 1990.

16. *Gas Safety (Installation and Use) Regulations*.

17. *Health and Safety (Safety Signs and Signals) Regulations*, 1996.

18. *Health and Safety at Work etc. Act* 1974.

19. *Planning (Hazardous Substances) Act*, 1990

20. *Planning (Hazardous Substances) Regulations*, 1982

21. *Potentially Explosive Atmospheres Regulations*, 1996.

22. *Pressure Systems Regulations*, 2002.

23. *Reporting of Industrial Diseases and Dangerous Occurrences*, 1995 (RIDDOR)

24. *The Management of Health and Safety at Work Regulations*.

25. *The Notification of Installations Handling Hazardous Substances Regulations*, 1982.

26. *The Dangerous Substances and Explosive Atmospheres Regulations* (DSEAR).

27. *Town and County Planning, England and Wales – Planning (Control of Major Accident Hazard) Regulations*, 1999, SI No. 981.

28. BS 4250 - *Specification for Commercial Butane or Commercial Propane*.

29. BS EN 3 - *Portable Fire Extinguishers*.

30. BS 5378 - *Safety Signs and Colours*. (Replaced by BS 5499-5)

31. BS 5499-5 - *Graphic Symbols and Signs. Safety Signs, including Fire Safety Signs Signs with Specific Safety Meanings*.

32. BS 5501 - *Electrical Apparatus for Potentially Explosive Atmospheres*. (Replaced by BS EN 50014)

33. BS 6651 - *Code of Practice for Protection of Structures Against Lightning*. (Replaced by BS EN 62305)

34. BS EN 50014 - *Electrical Apparatus for Potentially Explosive Atmospheres. General requirements*. (Replaced by BS EN 60079)

35. BS EN 60079 - *Electrical Apparatus for Explosive Gas Atmospheres*.

36. BS EN 62305 - *Protection Against Lightning*.

37. BS EN 589 - *Automotive Fuels. LPG. Requirements and Test Methods*.

38. Energy Institute IP15 - *Model Code of Safe Practice (Part 15, Area Classification Code for Installations Handling Flammable Fluids)*.

39. JSP 426 – MOD Fire Safety Policy