



CODE OF PRACTICE 38

**IN-SERVICE REQUIREMENTS FOR
REFRIGERATED GAS
TRANSPORTABLE PRESSURE
EQUIPMENT**

REVISION 1: 2018

British Compressed Gases Association

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PREFACE

The British Compressed Gases Association (BCGA) was established in 1971, formed out of the British Acetylene Association, which existed since 1901. BCGA members include gas producers, suppliers of gas handling equipment and users operating in the compressed gas field.

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

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

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

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

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

This document has been prepared by BCGA Technical Sub-Committee 1. This document replaces BCGA Code of Practice 38: 2010. It was approved for publication at BCGA Technical Committee 156. This document was first published on 07/03/2018. For comments on this document contact the Association via the website www.bcgaco.uk.

CONTENTS

Section		Page
	TERMINOLOGY AND DEFINITIONS	1
1.	INTRODUCTION	3
2.	SCOPE	4
3.	PUTTING INTO SERVICE REQUIREMENTS	6
3.1	Commissioning	9
4.	INSPECTION AND MAINTENANCE REQUIREMENTS	10
4.1	Inspection requirements	10
4.2	Maintenance requirements	12
4.3	Marking and identification	12
4.4	Associated equipment	13
5.	CHANGE OF GAS SERVICE	13
6.	REPAIRS AND MODIFICATION	14
6.1	Repair	14
6.2	Modification	14
7.	REVALIDATION	15
7.1	Stage 1: A design documentation review	16
7.2	Stage 2: Individual pressure equipment service condition and history review	17
7.3	Stage 3: Production of a revalidation report	18
8.	OUT OF SERVICE REQUIREMENTS	18
8.1	Decommissioning, storage and re-introduction into service	18
8.2	Transportation and lifting	19
8.3	Retirement from service	19
8.4	Disposal	20
9.	INFORMATION, INSTRUCTION AND TRAINING	20
10.	DOCUMENT AND RECORD KEEPING	21
10.1	Asset register	22
11.	REFERENCES *	23

APPENDIXES:

Appendix 1	IN-SERVICE INSPECTION – EXAMPLE CHECKLIST	26
Appendix 2	REVALIDATION REPORT – EXAMPLE	27

* Throughout this publication the numbers in brackets refer to references in Section 11. Documents referenced are the edition current at the time of publication, unless otherwise stated.

TERMINOLOGY AND DEFINITIONS

Appointed Inspection Body	An independent inspection and testing body approved by the competent authority (in the UK the Department for Transport).
Competent Engineer	A person or persons with sufficient theoretical and practical knowledge of pressure equipment combined with an appropriate level of experience who will be responsible for the revalidation.
Transportable cryogenic pressure equipment	<p>For the purpose of this document this includes:</p> <ul style="list-style-type: none">• Tanker A vehicle built to carry liquids, gases or powdery or granular substances and comprising one or more fixed tanks. In addition to the vehicle proper, or the units of running gear used in its stead, a tank-vehicle comprises one or more shells, their items of equipment and the fittings for attaching them to the vehicle or to the running-gear units.• Tank - Container An article of transport equipment meeting the definition of a container, and comprising a shell and items of equipment, including the equipment to facilitate movement of the tank-container without significant change of attitude, used for the carriage of gases, liquid, powdery or granular substances and, when used for the carriage of gases (as defined in ADR (5) 2.2.2.1.1) having a capacity of more than 0.45 m³ (450 litres).• Tank – Demountable A tank, other than a fixed tank, a portable tank, a tank-container or an element of a battery-vehicle or a MEGC which has a capacity of more than 450 litres, is not designed for the carriage of goods without breakage of load, and normally can only be handled when it is empty.• Tank – Fixed A tank having a capacity of more than 1000 litres which is permanently attached to a vehicle (which then becomes a tank-vehicle) or is an integral part of a frame of such vehicle.• Tank – Portable A multimodal tank having, when used for the carriage of gases (as defined in ADR (5) 2.2.2.1.1), a capacity of more than 450 litres in accordance with the definitions in ADR (5) Chapter 6.7 or the IMDG Code (6) and indicated by a portable tank instruction (T-Code) in ADR (5), Chapter 3.2, Table A, Column (10). Which are used to transport refrigerated gases.
Dangerous goods	Those substances and articles the carriage of which is prohibited by ADR (5) or authorised only under the conditions prescribed within ADR (5).
Design life	Calculated life expectancy of the tanker.

Inspection	A focussed activity that may form part of an inspection or maintenance regime.
Maintenance	Repairs or replacement of components or rectification of operational parameters.
May	Indicates an option available to the user of this Code of Practice.
Multiple element gas container (MEGC)	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 multiple-element gas container: cylinders, tubes, pressure drums or bundles of cylinders as well as tanks for the carriage of gases (as defined in ADR (5) 2.2.2.1.1) having a capacity of more than 450 litres.
Refrigerated gas	A gas which is partly liquid because of its low temperature, i.e. is below 0 °C.
Shall	Indicates a mandatory requirement for compliance with this Code of Practice and may also indicate a mandatory requirement within UK law.
Should	Indicates a preferred requirement but is not mandatory for compliance with this Code of Practice.
Tank	A shell, including its service and structural equipment. When used alone, the term tank means a tank-container, portable tank, demountable tank or fixed tank as defined in this section including tanks, forming elements of battery-vehicles or MEGCs.
UK Tank – (Old tank)	<p>A UK tank is a tank, including pressure receptacles forming the elements of a battery vehicle or battery-wagon constructed and used, or intended to be used, for the carriage of dangerous goods which are liquid, gaseous, powdery or granular material; and which:</p> <ul style="list-style-type: none"> a. was not constructed to provisions of ADR (5) or the Transportable Pressure Equipment Directive (TPED) (10) or subsequently reassessed and certified to ADR (5) or TPED (10); and b. constructed before 10 May 2004, or, in Northern Ireland, before 31 July 2006 to the requirements of UK legislation in force at the time of construction; or c. constructed on or after 10 May 2004, or, in Northern Ireland, on or after 31 July 2006 to EN 12493 (15) Annex C as permitted under the transitional provisions with regards to the reference temperature in Directive 2008/68/ EC (9); and is suitable for use in the UK only. <p><i>As defined in the DfT document ‘Carriage of Dangerous Goods: Approved derogations and transitional provisions’ (12), Section 3.</i></p>
Revalidation	Indicates the endorsement of a tank as fit for continued service based upon a review of documentation for design, operation and examinations.
Vessel	A pressure vessel, which may or may not be insulated.

CODE OF PRACTICE 38

IN-SERVICE REQUIREMENTS FOR REFRIGERATED GAS TRANSPORTABLE PRESSURE EQUIPMENT

1. INTRODUCTION

The carriage of refrigerated gases comes within the scope of *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (4). These regulations implement the provisions of the *European Agreement Concerning the International Carriage of Dangerous Goods by Road* (ADR) (5). ADR (5) provides a framework for dangerous goods to be carried internationally by road vehicles subject to compliance with standards for the packaging and labelling of the dangerous goods, and appropriate construction and operating standards for the vehicles and crew. Gases are principally classified as Class 2 dangerous goods.

NOTE: This document will reference ADR (5) unless there are specific regulatory requirements under *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (4).

All refrigerated gas transportable pressure equipment (henceforth called pressure equipment) requires periodic examination, refer to Section 4.

This British Compressed Gases Association (BCGA) Code of Practice is specifically concerned with the in-service requirements of pressure equipment from the point of first use. Irrespective of the operating conditions, for example, pressure, environment and stored energy, it is essential that the continuing integrity and safety of that equipment is verified. To achieve this it is necessary that:

- all equipment is designed and manufactured to recognised standards and design codes;
- its use is in accordance with the relevant regulations, standards, industry documents and manufacturer's recommendations and instructions;
- all persons involved with pressure equipment have received all necessary information, instruction and training to allow them to carry out their work safely and in an appropriate way;
- there is an appropriate on-going examination, maintenance and inspection regime to ensure the equipment remains safe throughout its in-service life;
- all pressure equipment is safely and correctly taken out of service for storage, or disposal when it is no longer required.

The Health and Safety at Work etc. Act (1), places duties on organisations and employers to protect the health and safety of employees and / or members of the public. The duties include

the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health. This includes the use of pressure equipment.

All equipment, including gaseous pressure equipment, is subject to the *Provision and Use of Work Equipment Regulations* (PUWER) (2) which requires that work equipment should not result in health and safety risks, regardless of its age, condition or origin. The PUWER (2) requires that the employer selects suitable equipment and carries out appropriate maintenance, inspection, identifies any specific risks and provides suitable information, instructions and training.

The Health and Safety Executive (HSE) provide further guidance on the PUWER (2) within HSE L22 (14), *Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance.*

The primary responsibility for compliance with these regulations lies with the operator of the pressure equipment and it is his responsibility to enlist the assistance he requires to comply with the Regulations.

The intention of this document is to provide guidance to allow the continued safe use of pressure equipment and to prevent serious injury from equipment failure, the unintentional release of refrigerating gases, for example, stored energy, fire, explosion, extreme cold and asphyxiation.

This code of practice is in line with advice from the Department for Transport (DfT) and is intended for use in conjunction with current guidance and information produced by the Health and Safety Executive (HSE), other related bodies and Trade Associations.

2. SCOPE

The scope of this document is the management of in-service pressure equipment, from cradle to grave, to ensure that it is serviceable for the safe transportation of gases without unintended release during the complete journey. The equipment covered is Transportable cryogenic pressure equipment (as defined). It also covers tanks used for the operation of special equipment used during transport, for example, cooling systems fitted to or used by road vehicles that maybe excluded from ADR (5).

This code of practice assists operators, owners and carriers to comply with the requirements of ADR (5) by providing guidance on the actions to be taken to keep pressure equipment in a serviceable condition. It focuses on managing the integrity of the pressure equipment as the primary means of keeping the product contained. Hazards resulting from product release may include extremes of temperature, toxicity, flammability, asphyxiation or corrosive properties. These hazards need to be appropriately managed, but are not addressed specifically in this document.

This code of practice is applicable from the point of first use, until the point in time that the pressure equipment is subject to retirement from transportable duty or final disposal, when reference should be made to Section 8.

In support of ADR (5) this code provides additional requirements for:

- a risk based methodology for developing maintenance requirements;
- repairs and modifications;
- revalidation;
- change of product service;
- associated equipment;
- retirement from transportable duty or final disposal;
- information, instruction and training requirements;
- keeping of records.

NOTE: There may be further specific requirements within other modal transport regulations, for example, for transport by sea the *International Maritime Dangerous Goods (IMDG) Code* (6) or for transport by rail the *Regulations concerning the International Carriage of Dangerous Goods by Rail (RID)* (7), which are not covered in ADR (5) or this code of practice.

Certain pressure equipment is exempt from ADR (5), such as cryogenic based ancillary systems, for example, where used for cooling. For this equipment it is recommended that the requirements of this code of practice are followed to ensure their continued serviceability.

PUWER (2) applies to all workplaces and work situations where the Health and Safety at Work etc. Act (1) applies. Compliance with the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (4) and this code will normally be enough to comply with the more general requirements in PUWER (2). For guidance on the other requirements within PUWER (2) refer to HSE L22 (14).

This code does not cover:

- The loading, unloading and associated carriage operations of pressure equipment which is to be in compliance with the relevant modal transport regulations, such as ADR (5), RID (7), IMDG (6) and the *International Civil Aviation Organization (ICAO) Technical Instructions* (8).
- Statically installed equipment used for the loading and unloading of pressure equipment. Refer to the *Pressure Systems Safety Regulations (PSSR)* (3) and BCGA CP 39 (23), *In-service requirements of pressure equipment (gas storage and gas distribution systems)*.
- The initial design, manufacture and commissioning, refer to ADR (5).
- Closed cryogenic receptacles, refer to BCGA CP 27 (21), *Transportable vacuum insulated containers of not more than 1000 litres volume*, and ADR (5) [4.1.4.1 P203].

- Pressure equipment that has been permanently retired from transport service and is being used in a static application, refer to BCGA CP 39 (23).
- Pressure equipment that is used in a static application without intent to use for carriage, refer to BCGA CP 39 (23). If there is an intention to subsequently use the pressure equipment for the carriage of products, the inspection and test regime required under ADR (5), shall be implemented prior to its first re-use for carriage.
- Tanks and equipment used for the carriage of Liquefied Petroleum Gas (LPG). Refer to publications produced by the UK LPG Trade Association (UKLPG).
- Tanks and equipment, including their contained gases, used as a fuel for propulsion or for the operation of any of its equipment used or intended to be used during carriage.
- The chassis and automotive inspection of the vehicle the pressure equipment is mounted on.
- Open cryogenic receptacles, refer to ADR (5) [4.1.4.1 P203].

NOTE: Not all open cryogenic receptacles are designed for transport. Check with your manufacturer before transporting (when containing a cryogenic liquid).

- The carriage of gases in cylinders and pressure drums, refer to ADR (5) and BCGA Guidance Note (GN) 27 (26), *Guidance for the carriage of gas cylinders on vehicles*.
- The carriage of bulk compressed gases in Multiple Element Gas Containers (MEGC), refer to ADR (5) and BCGA CP 33 (22), *The bulk storage of gaseous hydrogen at users' premises*.
- Static pressure systems. For the examination, maintenance and inspection of static pressure systems refer to BCGA CP 39 (23).

3. PUTTING INTO SERVICE REQUIREMENTS

Before using an item of pressure equipment for the carriage of dangerous goods, such as refrigerated gases, check that it has been designed and manufactured in accordance with an appropriate transport code.

For 'UK Tanks' which were constructed before 10 May 2004 and which are not to the provisions of ADR (5) or the *Transportable Pressure Equipment Directive* (TPED) (10), the UK Competent Authority, the Department for Transport (DfT), has published the *Carriage of Dangerous Goods: Approved derogations and transitional provisions* (12), which sets out specific requirements for the UK.

For 'old pressure receptacles' which were constructed on or before 30th June 2003 and which are not to the provisions of ADR (5) or the TPED (10), the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (4), sets out specific requirements for the UK.

Some pressure equipment is exempt from ADR (5) [1.1.3.2], such as cryogenic based ancillary systems, for example, the operation of cooling equipment necessary during transport. It is recommended that all pressure equipment, including these exempt items, are designed and constructed following the principles laid out in ADR (5), and any other appropriate transport design codes.

The rationale for this is that pressure equipment used on vehicles is subject to many dynamic stresses and strains, such as fatigue, vibration, g-forces, hydraulic stressing etc. which would not normally be considered if following a design code for static pressure equipment. They are also more likely to encounter extremes of weather and the effects of road conditions and treatments, for example, gritting and salting. All of these factors need to be given consideration during the design of the pressure equipment.

Before putting an item of pressure equipment into operation (including re-using equipment) the operator shall ensure all necessary documentation is in place and that safe systems of work are implemented. This should include, but is not limited to:

- Technical documentation:
 - An operating manual or instructions covering safe operation and care of the installation, including emergency and shut-down procedures.
 - Drawings (electrical, process and instrumentation diagram (P&ID)).
 - Test certificates.
 - Where applicable, Declaration of Conformity, such as CE marking, Pi marking, UN marking, etc.
- For tank containers, that the frame has been designed, manufactured and certified to meet relevant codes.
- For road tankers, that the chassis (running gear) has been designed, manufactured and certified to meet relevant codes.
- The pressure system and ancillary items have been installed correctly and instrumentation and controls are accessible by the operators.
- Exhaust ports, for example, pressure relief devices, tri-cock, main gas vent, drain valves etc. discharge to a safe location, such that adjacent equipment on the tank or vehicle is not damaged by cold embrittlement. Particular care is required to direct the exhaust from relief devices such that their discharge will not impact other near-by tanks, vehicles, items and people when in storage, parking, or when being carried as cargo.
- Safe operating limits shall have been established and communicated as required.
- The pressure equipment is suitable for the intended product(s) and incorporates the correct product filling connections.

- The pressure equipment is compatible with the expected associated equipment and operating conditions, such as filling and discharge.
- All equipment is correctly marked and identified, for example, a data-plate, valve tags, connection tags, etc. Refer to Section 4.3.
- Appropriate warning labels, safety signs and instructions are posted.
- Applicable Risk Assessments to meet legal duties have been completed and a safe system of work has been implemented.
- The service history of the equipment is known, has been checked and confirmed as safe to operate, and a maintenance log is available for future use. Refer to Section 4.2.
- Adequate knowledge and understanding of what the ADR (5) periodic inspection requirements are.
- An assessment to determine the inspection and maintenance requirements, over and above that required by ADR (5). This is recommended to take into account the expected operating conditions and the environment in which it will be used. Record the results in the inspection and maintenance schemes, as appropriate.
- Produce and maintain an Asset Register. All pressure equipment should be registered to ensure in-service requirements are managed. Refer to Section 10.1.
- Identify and understand the availability of appropriate spare parts, including the determination of any expiry lives.
- All personnel have received suitable and sufficient information, instruction and training. Refer to Section 9.
- Standard operating procedures have been developed, are available and have been communicated to all relevant personnel.
- Emergency procedures are established, communicated and implemented.
- Contact information and emergency contact number(s) are available.

It is expected that for existing pressure equipment all of the above is in place.

Operators and owners of pressure equipment have legal responsibilities and a duty of care to ensure the equipment is maintained and operated safely. Where gas suppliers are requested to fill third party owned equipment, the gas supplier will require evidence of compliance with these responsibilities, including revalidation. Refer to BCGA GN 17 (24), *BCGA policy and guidance for the safe filling of third-party owned and/or maintained tanks*, and BCGA Leaflet 12 (28), *Liquid gas storage tanks. Your responsibilities*.

3.1 Commissioning

Prior to first fill the person overseeing the commissioning shall check the suitability of the pressure equipment for commissioning and ensure a suitable written procedure is in place.

NOTE: Before commissioning the pressure equipment ensure the whole assembly is serviceable, for example, ISO frame, wheels, attachment points, etc. and, where applicable, the vehicle is suitable for the carriage of dangerous goods and is in a roadworthy condition. Seek specialist advice as necessary.

Commissioning shall then be carried out by competent personnel and in accordance with the written procedure. The written procedure will ensure that:

- Appropriate pressure and leak tests have been carried out and documented.
- A check has been made that the pressure equipment conforms to the process and instrumentation diagram.
- A check has been made that refrigerated gas cannot become trapped in any part of the system not protected by thermal relief devices or reach parts of the system not designed for low temperature use.
- A check has been made that the correct safety devices are fitted.
- A check has been made that all warning labels, safety signs and instructions are clearly displayed and that they are correct for the product.
- The pressure equipment is suitable for the product.
- The pressure equipment is in-date for its inspection and maintenance requirements.
- Where applicable, check that the tank frame or vehicle is in-date for its inspection and maintenance.

In addition, procedures shall be in place to ensure the following significant risks are addressed:

- Thermal shock.
- Rapid pressure rise.
- Contamination in oxygen systems, which may result in auto ignition.
- Noise.
- Gas release.

4. INSPECTION AND MAINTENANCE REQUIREMENTS

To ensure pressure equipment remains safe and serviceable throughout its operational life a documented inspection and maintenance regime shall be established and implemented. Such a regime will enable compliance with the following regulations.

The PUWER (2) requires that work equipment that is in-service is inspected and maintained at regular intervals to ensure that it is safe for continued use and remains in good repair regardless of its age, condition or origin. Equipment shall be maintained in efficient working order so that its performance does not deteriorate to the extent that people, property and the environment are put at risk.

ADR (5) requires that the operator ensures that the pressure equipment is properly maintained in good repair, so as to prevent danger. Pressure equipment that is used for the carriage of refrigerated gases shall undergo periodic inspection in accordance with the requirements set out in ADR (5).

Precautions are necessary to ensure that pressure equipment is not subject to over or under-pressure at any time. It shall not be permitted to isolate pressure / vacuum relief devices unless adequate precautions have been taken to prevent the possibility of unacceptable pressure conditions occurring, or unless alternative facilities are provided for relief.

An essential part of the management of equipment is an awareness of the operating and environmental conditions that over a period of time are very likely to affect the performance and serviceability of the pressure equipment as well as the factors that influence the onset, evolution and mitigation of its degradation. It is recommended that an assessment is carried out to determine the inspection and maintenance requirements, over and above that required by ADR (5). Record the results in the inspection and maintenance schemes, as appropriate. The methodology for carrying out a similar type of assessment is detailed in BCGA CP 39 (23).

Where pressure equipment is exempt from the requirements of ADR (5) (refer to Section 3), the inspection and maintenance requirements shall take account of the expected conditions under which the equipment is being used. This is particularly important for pressure equipment which is not designed in accordance with transport codes. Therefore an enhanced inspection and maintenance regime may be required.

4.1 Inspection requirements

It is a legal requirement to ensure that appropriate inspections are carried out as applicable; any remedial work shall be carried out in consultation with the owner.

Inspection activities should be carried out by a person who has had sufficient instruction, information and training, such that they are competent to undertake the inspection task.

An inspection will allow the detection of any deterioration (for example, defects, damage, wear or environmental degradation) to be remedied as necessary before it results in unacceptable risks.

4.1.1 Periodic inspection requirements

Mandatory periodic inspection requirements for each type of pressure equipment are detailed in ADR (5).

Where a ‘UK Tank’ (as defined in *The Carriage of Dangerous Goods: Approved derogations and transitional provisions* (12), Part 3) remains in service, the periodic inspection shall be conducted in accordance with the Vehicle Certification Agency (VCA) document *Procedures for Inspection Bodies: Testing and Inspection of UK Tanks* (13).

Where an ‘old pressure receptacle’ (as defined in *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (4), Clause 14) remains in service, the periodic inspection shall be conducted in accordance with the standard relevant to the construction and testing of the receptacle.

Inspection of ADR (5) and / or TPED (10) pressure receptacles and tanks shall be conducted in accordance with the relevant standard specified in ADR (5), Chapter 6.2 or 6.8 respectively.

These inspections shall be carried out or shall be witnessed by an inspection body accredited to BS EN ISO / IEC 17020 (16), *Conformity assessment. Requirements for the operation of various types of bodies performing inspection*, and appointed by the VCA Dangerous Goods Office. In the case of ADR (5) and / or TPED (10) pressure receptacles and tanks, inspection bodies shall be of the independence type specified in Chapter 6.2 or 6.8 of ADR (5) and, in the case of TPED (10), shall be notified to the European Commission for the purpose (a Notified Body).

4.1.2 Additional inspection requirements

In addition to the periodic inspections required by *The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (4) and ADR (5), refer to Section 4.1.1, further inspections are required to identify whether the equipment is operating correctly and safely including a visual assessment before each filling operation.

As well as following mandatory standards, best practice is to follow current standards, industry documents and manufacturer recommendations when conducting inspections. It is recognised that standards and industry documents evolve over time, as will operating practices and manufacturers’ recommendations. The inspection regime should be revised periodically to reflect these changes.

All inspections shall be carried out under a documented process. The inspection requirements should take into account the outcome from the assessment to determine the inspection and maintenance requirements, manufacturers’ recommendations, any previous maintenance history, knowledge of similar pressure equipment, defect reports and environmental effects, such as weathering.

Additional inspections will vary from a simple visual external inspection to a detailed comprehensive inspection, which may include some dismantling and / or testing. An inspection should always include those safety-related parts necessary for safe operation of equipment, for example, pressure relief devices.

As an example Appendix 1 details a typical check list that can be used during an inspection. This check list is not exhaustive and each organisation should develop their own checklists for particular types of pressure equipment.

4.2 Maintenance requirements

Maintenance is the day-to-day management of equipment to ensure it remains in a serviceable and safe condition. It can include for example, replacement of like-for-like components, rectification of operational parameters or the replacement of protective coatings. Maintenance is required under various regulations and it is a legal requirement to ensure that this is carried out. Consultation with the owner is strongly recommended for any maintenance planning and activity.

Maintenance activities should be carried out by a Competent Engineer (or nominated technician).

The maintenance regime shall be carried out under a documented process and records shall be kept.

The maintenance requirements should take into account the outcome from the assessment to determine the inspection and maintenance requirements (refer to Section 4), manufacturers recommendations, any previous maintenance history, knowledge of similar pressure equipment, defect reports and the effects of weathering.

As part of the maintenance regime, a functional or other test may be necessary to check that the safety-related parts, for example interlocks, protection devices, controls etc. are working as intended and that the work equipment and relevant parts are structurally sound. In the case of tanks, certain maintenance operations shall be followed by an Exceptional Check performed by an appointed inspection body.

4.3 Marking and identification

All receptacles containing dangerous goods being transported shall comply with the marking requirements of ADR (5) or the appropriate modal transport regulations.

All tanks shall be marked and labelled to show the product they contain.

All transportable cryogenic pressure equipment shall have been permanently marked in compliance with the Regulations in force at the time the equipment was manufactured, to correctly identify the manufacturer, the safe operating limits and the original specification against which the vessel was designed. This should be on a corrosion resistant metal plate permanently attached to the equipment in a place readily accessible for inspection. In addition, all valves and operating equipment shall be adequately marked and identified to allow safe maintenance and operation. The operator shall periodically check that the required marking and labelling remains legible, in good condition, visible and kept up to date.

Where the dataplate is either partly or wholly missing or defaced, a duplicate dataplate shall be appropriately sourced, approved (by the Notified Body) and fixed to the equipment. If there is no dataplate, or the information on the dataplate is illegible or incomplete, then the vessel shall not be used or filled.

NOTE: Using equipment with no approved dataplate, or for which the dataplate has incorrect or incomplete information is an illegal activity.

4.4 Associated equipment

All associated equipment, such as piping, valves and pumps, which are permanently attached to the tank will be subject to the requirements of Section 4.1. and Section 4.2.

Other associated equipment, which may be used for loading and unloading, that is not permanently attached, such as hoses, couplings, hose restraints etc. shall be:

- suitable for the service conditions (such as, temperature, pressure and product);
- maintained to a serviceable condition;
- subject to a documented inspection regime.

5. CHANGE OF GAS SERVICE

Where pressure equipment is designed and certified as being compatible with the carriage of a number of different gases, a change in gas service shall be subject to a documented procedure and recorded. Special considerations regarding cleanliness and chemical compatibility, are required, for example, when converting to oxygen service. Change of service from industrial to food grade or medical gases will require additional quality control measures. A change of service will necessitate changes to the content marking and labelling of the equipment, fill couplings, etc.

Where pressure equipment is only designed and certified for one product a change of service to another product shall only be undertaken following a full engineering and technical review in conjunction with an Appointed Inspection Body. Any change shall be formally authorised and documented, for example, by a management of change system, prior to any alteration taking place. For further information refer to the European Industrial Gases Association (EIGA) Document 51 (18), *Management of change*.

Where independent associated equipment is carried on the vehicle, this shall also be subject to a change of service procedure.

Different gases have unique filling couplings, hoses and hose connections to prevent cross-connection of different gases and therefore contamination.

The carriage and use of adaptors that allow for the cross-connection of different gases is generally prohibited. The use of adaptors should be avoided where possible by ensuring the correct couplings are fitted to the pressure equipment. If to facilitate the change in service an adaptor is required, it may only be used under strict control.

For oxygen service further information is available in EIGA Document 87 (19), *Conversion of cryogenic transport tanks to oxygen service*.

6. REPAIRS AND MODIFICATION

Before carrying out any repair or modification work it is strongly advised that agreement is sought from the relevant Inspection Body to ensure continuing compliance with the Type Approval and to determine what is acceptable. In many cases repairs and modifications are forbidden so involvement of the Inspection Body at an early stage is essential.

6.1 Repair

A repair or replacement restores the pressure equipment or service equipment back to its intended specification (like for like). Any repairs carried out shall not affect its integrity or the operation of any protective devices. Repairs shall only be undertaken by suitably qualified, experienced and competent persons. All repairs shall be recorded and should be in-line with the manufacturer's guidance.

Where repairs are required to any part of a pressure vessel up to the primary isolation, or when the safety of the tank or of its equipment may have been impaired, an exceptional check shall be carried out by the Inspection Body.

Repairs carried out due to normal wear and tear which do not directly affect the integrity of the pressure equipment would normally be completed as part of a routine maintenance regime, refer to Section 4.2.

Where the operator of the pressure equipment is not the owner, he shall not repair the equipment without the consent of the owner.

Repairs are not always possible or cost effective and a modification to the existing specification may be a suitable alternative, refer to Section 6.2.

Repairs should not affect the cleanliness of the equipment or compatibility with the intended gases. Particular attention should be paid to equipment for oxygen, food and medical service where additional quality control procedures are required.

6.2 Modification

A modification is a change in the range or scope of an existing specification. It may include alteration of the pressure equipment or changes to process operating conditions.

The pressure system shall not be modified in such a way as to give rise to danger or impair the operation of any protective device or any inspection facility.

Where modifications are undertaken to any part of the pressure equipment covered by the initial Type Approval, further approval and re-certification shall be carried out by the Inspection Body.

Any proposed modification shall be formally authorised and documented, for example, by a management of change system, prior to any alteration taking place. For further information refer to EIGA Document 51 (18).

Where the operator of the pressure equipment is not the owner, he shall not modify the equipment without the consent of the owner. It is recommended that the manufacturer is consulted before any modification takes place.

7. REVALIDATION

For pressure equipment, the suitability for continued service is achieved by periodic inspection in accordance with ADR (5). However, pressure equipment has the potential to fail in service from, for example, fatigue from excessive pressure cycling, which cannot always be detected by formal inspection. To allow pressure equipment to continue in service, in addition to the ADR (5) requirements, a review (known as revalidation) is required to determine its suitability for further service.

Pressure equipment has a validated design for a prescribed set of defined operating conditions. Changes can occur to the operating regimes of the pressure equipment, or to their physical structure, over the many years that the equipment may be in service. These changes may be considered as step changes imposed on equipment through the operating regime. Subtle incremental changes to operating conditions can progressively move an operating regime outside design conditions. Changes occur to the physical structure of the equipment itself through repairs and modifications as well as deterioration. The service life of some gaseous pressure equipment is measured in tens of years during which the potential for incremental change increases.

At the time of the ADR (5) periodic inspection the revalidation shall be carried out. The Competent Engineer may decide additional revalidations are required which are supplementary to the periodic inspection interval.

Revalidation is a formal process that shall be carried out by a Competent Engineer and any changes resulting from the revalidation shall be included in the operational procedures, inspections and maintenance regimes as appropriate.

In the event of a significant change of service conditions the fatigue design life shall be re-evaluated by the Competent Engineer.

Following an incident that could affect the pressure equipment integrity or its operational safety, an assessment of fitness for continued service shall be undertaken by the Competent Engineer and as necessary verified by the Appointed Inspection Body.

The revalidation process consists of three distinct stages:

Stage 1: A design documentation review. Refer to Section 7.1.

- i) Review of design documentation.
- ii) Review / evaluation of fatigue design life
- iii) Review of experience of similar pressure equipment, including consultation with the manufacturer.

Stage 2: Individual service condition and history review. Refer to Section 7.2.

- i) Review of service history records.
- ii) Review of inspection records.

- iii) Review of repairs and modifications.

Stage 3: Production of a revalidation report. Refer to Section 7.3.

A revalidation report shall be produced and all conclusions recorded.

7.1 Stage 1: A design documentation review

7.1.1 Review of design documentation

A review based upon the available design information, preferably based on the pressure equipment construction dossier and the original construction drawings. As a minimum, the design and test data / certificates in conjunction with information from the vessel nameplate are required.

Where there are similar vessels in service made to the same family of designs by the same manufacturer, of a similar age, then common design documentation and experience of similar pressure equipment, including from destructive examinations (i.e. type approval), may be used to assess any specific vessel from that group. In extreme cases an internal examination of the vessel, or of a similar vessel, may be necessary to establish base line data for this and future revalidations.

Where the original design documents and records are incomplete the Competent Engineer shall assess the feasibility of revalidating the equipment.

The review shall:

- Verify the design standard to which the pressure equipment was constructed is still applicable for the current / expected service conditions.
- Establish that the design and construction was approved and witnessed by an Inspection Body.
- Confirm that any modifications or repairs to the pressure equipment have been correctly designed and approved and have been implemented properly.
- Assess the impact of any code developments on design parameters, materials, design calculations, examination and testing since the construction of the pressure equipment. The assessment shall include the inner pressure vessel and outer jacket, together with their protection and control devices.
- Assess the impact of any design or technological changes to any ancillary pressure equipment, for example, a filling system.
- Assess the consequences of operational excursions outside the design limits identified in the service history review.

Any calculations generated to endorse the design review shall be incorporated into the revalidation report.

7.1.2 Review / evaluation of fatigue design life

The Competent Engineer shall evaluate the fatigue design life based on the actual service conditions. This should include both cyclic pressure loading and externally applied structural loads for example those at inner vessel supports. Where the evaluation indicates the life is shorter than the next scheduled revalidation, the Competent Engineer shall state on the report the date of the next revalidation.

7.1.3 Review of experience

Check that any recorded problems with pressure equipment of similar design have been addressed, including consultation with the manufacturer.

7.2 Stage 2: Individual pressure equipment service condition and history review

7.2.1 Review of service history records

The individual service history of a pressure equipment shall be reviewed, including:

- Previous and current operating conditions.
- Changes of product service since new or the last revalidation.
- Previous corrective action or rectification reports.
- Any repairs or modifications.
- Reports of operational problems, such as:
 - Reports of ice build-up and analysis of cause.
 - Records of under or over pressure and temperature excursions and corrective actions. Assess the consequences of operational excursions outside the design limits.
 - Reports of loss of interspace vacuum.
- Periods and condition when out of service.
- Maintenance records.
- Review details of any road traffic accidents, including assessment of excess G loadings.

When a major overhaul and re-pressure test has been undertaken the Competent Engineer shall decide the extent to which previous service history records need to be reviewed, dependent upon the relevance of such records to the future service of the pressure equipment.

Where information is missing from the service history the Competent Engineer shall assess the feasibility of revalidating the pressure equipment.

7.2.2 Review of inspection records

The current and previous periodic inspection report shall be reviewed to establish any deterioration in service.

The previous revalidation report, if applicable, shall be reviewed to understand why any restrictions placed on service have been imposed. A check shall be carried out to ensure they have been observed.

7.2.3 Review of repairs and modifications

Check any defect and rectification reports, and ensure that any repairs or modifications have not affected the design life of the pressure equipment.

7.3 Stage 3: Production of a revalidation report

The Competent Engineer shall produce a revalidation report. The revalidation report shall contain a statement detailing the conclusions reached and a summary of the review carried out. This revalidation report shall define the latest date at which the next revalidation shall take place together with any conditions or corrective actions the Competent Engineer considers appropriate. The revalidation report shall be signed and dated by the Competent Engineer and included with the records for the pressure equipment. A suggested format is given in Appendix 2.

The owner shall maintain a record of the due date for revalidation.

Where end of life examination reports are available (refer to Section 8.4) which can support the revalidation, they should be referenced on the revalidation report.

8. OUT OF SERVICE REQUIREMENTS

8.1 Decommissioning, storage and re-introduction into service

Equipment in storage should be kept in a secure area.

Decommissioned pressure equipment shall be safely drained, depressurised and isolated. It is good practice to purge with an inert gas at a pressure that is both suitable for the pressure equipment design conditions and does not give rise to danger. Typical purge pressures may be 0.5 bar or 10 % of the design pressure, whichever is the lower.

All pressure equipment stored out-of-service should be sealed to prevent contamination and moisture ingress. Pressure equipment should be maintained at a residual positive pressure (up to 0.5 barg). Appropriate warning notices of the pressure equipment's condition should be displayed in a prominent position.

Where a special pressure gauge is fitted specifically to monitor the residual positive pressure charge, then this shall be recorded in the pressure equipment documentation. Sufficient steps shall be taken to ensure that over-pressurisation cannot occur.

Where necessary, equipment in storage may require ongoing maintenance.

For pressure equipment stored out-of-service, with a residual pressure maintained below 0.5 barg, it is not necessary to continue formal inspections. Similarly, there is no requirement to carry out a revalidation.

Prior to reintroduction into service, pressure equipment shall be assessed for its serviceability, this may require refurbishment, inspection, revalidation, as applicable, or testing to a documented procedure.

Appropriate records of the equipment's condition i.e. previous service, pressure and contents should be maintained.

8.2 Transport and lifting

Transport and any lifting operations shall be in accordance with the manufacturer's recommendations and the relevant regulations.

8.3 Retirement from service

The owner may make a decision that the pressure equipment is no longer appropriate for their business needs and may decide to sell the pressure equipment, convert to a static application or take disposal action.

8.3.1 Change of owner as transportable pressure equipment

For pressure equipment to be sold for continued transport operations all the relevant documentation shall be made available and the equipment identifiable, for example, by the tank serial number.

The seller of the pressure equipment shall remove his owner details from the dataplate. The new owner shall ensure that:

- The correct owner details are displayed on the relevant dataplate where applicable.
- The pressure equipment is brought back into service in accordance with Section 3.

8.3.2 Equipment no longer fit-for-purpose as transportable pressure equipment

Once equipment has been assessed, for example, by the Inspection Body or a Competent Engineer, as no longer fit-for-purpose for transport use the possible options include:

- Where suitable, convert into use for a static application;

Where the pressure equipment is converted into use for a static application refer to BCGA CP 39 (23).

- Disposal, refer to Section 8.4.

8.3.3 Equipment no longer fit for pressure service

Equipment which is assessed, for example, by the Inspection Body or a Competent Engineer, as no longer fit for transport or static use or which has reached the end of its operational life, shall be disposed of. Refer to Section 8.4.

8.4 Disposal

Equipment shall be disposed of in an appropriate manner and shall not be placed back into any form of operational service. Strict control measures shall be in place to ensure that any equipment disposed of is rendered safe and beyond-use by:

- Removal of the hazards, for example, pressure and product.
- Removing the data plate.
- Piercing or cutting the pressure equipment in such a way as to prevent any possible repair and pressurisation.

The disposal of all waste products shall conform to current national and local safety and environmental legislation.

The disposal of electrical equipment shall comply with the *Waste Electrical and Electronic Equipment (WEEE) Directive* (11).

Insulation materials, such as Perlite, requires careful handling and specialist disposal action.

NOTE: Perlite contains crystalline silica, which, if it enters the eyes or respiratory tract, can cause serious irritation. For further information refer to EIGA Document 146 (20), *Perlite management*.

When disposing of tanks or equipment, a suitable risk assessment shall be carried out and written work instructions used to ensure that a safe system of work is in place to cover work activities, for example, purging, hot work, perlite removal, etc.

Disposing of equipment provides an opportunity to conduct an internal inspection providing information on service condition which can be used to support the future revalidation of similar designs.

NOTE: Throughout the history of the BCGA, member companies have periodically destructively and non-destructively examined inner vessels of tanks to verify the case for the '*absence of recognised potential causes of failure*'. Results of a number of these examinations are recorded in BCGA TIS 23 (27). The BCGA will continue to collect this information in support of this policy and, where appropriate, encourages member companies to contribute their data.

9. INFORMATION, INSTRUCTION AND TRAINING

All personnel directly involved with pressure equipment shall receive suitable information and instruction regarding the hazards associated with pressure, the various gases used in pressure

systems and appropriate training as applicable for the safe operation, inspection and maintenance of pressure equipment. The information, instruction and training, shall also cover the actions to take in an emergency.

All personnel should have the necessary skills and knowledge to carry out their job safely and shall receive appropriate information, instruction and training, including induction and continuation / refresher training. Such training shall be both theoretical and practical. It is the duty of the employer to ensure their persons are adequately trained and to establish competency. It is recommended that a training programme is carried out under a formalised system where an acceptable level of competency has to be achieved. Records shall be kept of the information, instruction and training provided and of the competence level achieved. The programme shall make provision for periodic competence re-assessment.

General recommendations for the training of personnel are described in EIGA Document 23 (17), *Safety training of employees*. BCGA GN 23 (25), *Identifying gas safety training requirements in the workplace*, provides information on the topics that should be covered when considering gases safety training.

10. DOCUMENT AND RECORD KEEPING

The following documents and records shall be kept:

On the vehicle:

The *Certificate of approval for vehicles carrying certain dangerous goods* [ADR (5), 9.1.3] as issued.

For the tank:

- Type approval certificate for the pressure equipment [ADR (5), 6.8.2.3] – usually issued by the Competent Authority of the country of manufacturer to an inspection body authorised by them;
- Initial inspection certificate – issued by the Competent Authority of the country of manufacturer to an inspection body authorised by them;
- Intermediate or periodic inspection certificate (if applicable) – issued by an Inspection Body appointed in the country of service.

Essential safety information, such as operating and emergency instructions, shall be maintained to enable equipment to be operated and maintained safely, including:

- Records of any repairs or modifications carried out and where applicable, certification thereof;
- Reports of any significant excursions outside of the normal operating parameters;
- Records of any significant mechanical damage or corrosion;

- Records of any change of gas service;
- A Revalidation Certificate;
- Any documents required in accordance with other legislation.

The following records should be accessible:

- Pressure equipment construction dossier and the original construction drawings;
- The original construction design standard;
- Records of any out-of-service period and storage conditions, where appropriate;
- The most recent maintenance records.

Previous inspection reports can assist in identifying trends in the service history of the equipment. It is recommended that such reports be retained for the life of the equipment. This information will also assist the Competent Engineer in evaluating any ageing mechanisms affecting the equipment.

These records shall be readily available.

Records for transportable cryogenic pressure equipment shall be maintained throughout the life of the tank and retained for a further period of 15 months after the tank is taken out of service.

The records may be kept within a computer system as long as a printed copy can be produced when required. Records of similar equipment may also be useful in terms of ‘fleet management’ of sister assets.

10.1 Asset register

An Asset Register of all pressure equipment operated should be kept and reviewed periodically. The register should include the following:

- Type and description of the pressure equipment;
- Location of pressure equipment documents and records;
- Date of next inspection, maintenance or revalidation.

The Asset Register may be kept within a computer system as long as a printed copy can be produced when required.

11. REFERENCES

Document Number	Title
1.	The Health and Safety at Work etc. Act 1974.
2. SI 1998: No. 2306	The Provision and Use of Work Equipment Regulations 1998 (PUWER).
3. SI 2000: No. 128	Pressure Systems Safety Regulations 2000 (PSSR).
4. SI 2009: No. 1348	Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations, 2009 (as amended).
5. ECE/TRANS/242	European agreement concerning the international carriage of dangerous goods by road (ADR) (as amended).
6. IMO 1H200E	International Maritime Organization. International Maritime Dangerous Goods (IMDG) Code (as amended).
7. OTIF	Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) (as amended).
8. ICAO	International Civil Aviation Organization (ICAO), Technical Instructions (as amended).
9. European Directive 2008/68/EC	Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods.
10. European Directive 2010/35/EU	Directive 2010/35/EU of the European Parliament and of the Council of 16 June 2010 on transportable pressure equipment. The Transportable Pressure Equipment Directive (TPED).
11. European Directive 2012/19/EUC	Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE). The Waste Electrical and Electronic Equipment Directive.
12. DfT	Carriage of Dangerous Goods: Approved derogations and transitional provisions (as amended).
13. DfT, VCA	Procedures for Inspection Bodies: Testing and Inspection of UK Tanks (as amended).
14. HSE L22	Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance.
15. EN 12493	LPG equipment and accessories. Welded steel pressure vessels for LPG road tankers. Design and manufacture.

Document Number	Title
16. BS EN ISO / IEC 17020	Conformity assessment. Requirements for the operation of various types of bodies performing inspection.
17. EIGA IGC Document 23	Safety training of employees.
18. EIGA IGC Document 51	Management of change.
19. EIGA IGC Document 87	Conversion of cryogenic transport tanks to oxygen service.
20. EIGA IGC Document 146	Perlite management.
21. BCGA Code of Practice 27	Transportable vacuum insulated containers of not more than 1000 litres volume.
22. BCGA Code of Practice 33	The bulk storage of gaseous hydrogen at users' premises.
23. BCGA Code of Practice 39	In-service requirements of pressure equipment (gas storage and gas distribution systems).
24. BCGA Guidance Note 17	BCGA policy and guidance for the safe filling of third-party owned and/or maintained tanks.
25. BCGA Guidance Note 23	Identifying gas safety training requirements in the workplace.
26. BCGA Guidance Note 27	Guidance for the carriage of gas cylinders on vehicles.
27. BCGA Technical Information Sheet 23	BCGA policy regarding internal examination and proof pressure testing of static cryogenic liquid storage tanks.
28. BCGA Leaflet 12	Liquid gas storage tanks. Your responsibilities.

Further information can be obtained from:

UK Legislation	www.legislation.gov.uk
Health and Safety Executive (HSE)	www.hse.gov.uk
Department for Transport (DfT)	www.gov.uk/government/policies/providing-effective-regulation-of-freight-transport/supporting-pages/safe-carriage-of-dangerous-goods
Vehicle Certification Agency (VCA)	www.dft.gov.uk/vca
International Maritime Organisation (IMO)	www.imo.org
Intergovernmental Organisation for International Carriage by Rail (OTIF)	www.otif.org
International Civil Aviation Organization (ICAO)	www.icao.int
United Nations Economic Commission for Europe (UNECE)	http://www.unece.org/trans/danger/danger.html
European Industrial Gases Association (EIGA)	www.eiga.eu
British Compressed Gases Association (BCGA)	www.bcgga.co.uk
The UK LPG Trade Association (UKLPG)	www.uklpg.org

IN-SERVICE INSPECTION – EXAMPLE CHECKLIST

Refer to Section 4.1.2

Item	Check
Tank	ADR placard and markings. Legible and clean. Data plate in place and legible. Protective coatings in place. No abnormal ice patches. Condition of insulation (for conventionally insulated tanks). No abnormal venting. Outer jacket protective devices intact. Outer jacket condition.
Pipework	No unauthorised modifications. Correctly supported. No damaged pipework. Insulation condition. Excessive ice build-up. Leakage. Fill and discharge couplings. Identification marking.
Gauges	Pressure Gauge. Contents Gauge.
Protective devices	Correct setting. Suitably supported. Pipework free from obstructions. <ul style="list-style-type: none"> • Inlet. • Outlet.
Valves	Hand-wheels in place. Operating condition. Correctly identified.
Vaporiser pressure build	Supports. Protective device.
Attachment arrangements	For example, securing bolts, ISO frame, skid bulkheads.
Ancillary equipment	Hoses. Controlled equipment (e.g. adaptors). Pump control system.

REVALIDATION REPORT – EXAMPLE

Tank type No:	
Tank serial No: <i>Unique identification number</i>	
Type Approval No:	
Design code:	
Date of manufacture:	<i>(Date)</i>
Manufacturer: <i>Name and contact details.</i>	
Capacity (Litre),	
Temperature limits:	
Pressure limits:	
Approved products:	Argon, carbon dioxide, helium, hydrogen, LNG, nitrogen, nitrous oxide, oxygen.
COMPETENT ENGINEER STATEMENTS	
Review of design documentation:	
Service history review:	
Inspection records review:	
Repairs and modifications review:	
Review of fatigue design life:	
Experience of similar tanks:	

APPENDIX 2

Sheet 2 of 2

Any conditions for revalidation:		
Revalidation conclusion: <i>Revalidation statement</i>		
Revalidation period:	<i>years from (Date)</i>	
Next revalidation:	<i>(Date)</i>	
Competent Engineer:	<i>Name (Capitals):</i>	<i>Signature:</i>
Position: <i>Within company or details of contracting company</i>		
Date of issue:	<i>(Date)</i>	



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