CODE OF PRACTICE 39

IN-SERVICE REQUIREMENTS OF PRESSURE EQUIPMENT (GAS STORAGE AND GAS DISTRIBUTION SYSTEMS)

REVISION 2: 2017

British Compressed Gases Association

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BRITISH COMPRESSED GASES ASSOCIATION

Registered office: 4a Mallard Way, Pride Park, Derby, UK. DE24 8GX
Company Number: 71798, England

Website:
www.bcga.co.uk

ISSN 2398 - 9440

PREFACE

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

The main objectives of the Association are to further technology, to enhance safe practice, and to prioritise environmental protection in the supply and use of industrial, 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 39: Revision 1: 2016. It was approved for publication at BCGA Technical Committee 156. This document was first published on 08/09/2017. For comments on this document contact the Association via the website www.bcga.co.uk.

CONTENTS

* Throughout this publication the numbers in brackets refer to references in Section 10. Documents referenced are the edition current at the time of publication, unless otherwise stated.

TERMINOLOGY AND DEFINITIONS

Competent Person *Refer to Note 3.*	These terms are defined in the *Pressure Systems Safety Regulations* (PSSR) (5).
Danger	
Installed system	
Mobile system	
Owner	
Pipeline	
Pipework	
Pressure system	
Protective device	
Relevant fluid	
Safe operating limits	
Transportable pressure receptacle *Refer to Note 1.*	
User	In addition to the definition within the PSSR (5) for the purpose of this code the user may also refer to the owner of a mobile system.
Ageing	Any time-related mechanism that affects the integrity of and may make equipment unfit for service.
Ageing pressure equipment assessment (APEA)	A risk assessment that identifies any potential age related failure mechanisms that may affect the integrity of the system.
Competent Engineer *Refer to Note 3.*	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 ageing pressure equipment assessment and revalidation.
Cryogenic Receptacle *Refer to Note 2.*	A transportable thermally insulated pressure receptacle for refrigerated liquefied gases with a capacity not exceeding 1,000 litres.

Cylinder *Refer to Note 2.*	A transportable pressure receptacle with a water capacity not exceeding 150 litres.
Current	A term used to recognise that through the life of equipment it may be used by different users and/or owners in different locations for different applications, in a variety of pressure systems. For the purpose of this Code of Practice it refers to the present user, location or application.
Employer	For the purpose of this Code of Practice the term employer has the same meaning as the User.
Examination	For the purpose of this Code of Practice the term examination has the same meaning as examination in PSSR (5) and inspection in the *Provision and Use of Work Equipment Regulations* (PUWER) (4).
Gas	For the purpose of this Code of Practice the term gas refers to gases that are cryogenic, liquefied, dissolved or compressed.
Inspection	A focussed activity that may form part of an examination 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.
Modification	Changes to the system that may affect the design and/or operating conditions and system integrity.
Pressure container	A transportable pressure receptacle that has not been used for carriage of dangerous goods and is installed as part of a fixed installation.
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	An assembly for product storage, complete with a piping system, of an inner vessel and an outer jacket to contain insulation. The insulation space will normally be subject to a vacuum.
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.

NOTES:

1. The *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (6), use the term 'transportable pressure equipment' whereas the PSSR (5) use the term 'transportable pressure receptacle' for the same items of equipment.

2. The definitions of cryogenic receptacle and cylinder are taken from the *European agreement concerning the international carriage of dangerous goods by road* (ADR) (9), which is implemented in the UK by the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (6).

3. The Competent Person is a defined role within the PSSR (5), and is exclusively referred to in this context in this document. The role of the Competent Engineer is used to differentiate from the Competent Person. The Competent Engineer is the person designated to conduct the ageing pressure equipment assessment and revalidation, as detailed in this document and to comply with other legislation, for example, PUWER (4).

CODE OF PRACTICE 39

IN-SERVICE REQUIREMENTS OF PRESSURE EQUIPMENT (GAS STORAGE AND GAS DISTRIBUTION SYSTEMS)

1. INTRODUCTION

This British Compressed Gases Association (BCGA) Code of Practice (CP) is specifically concerned with the in-service requirements of gas pressure equipment from the point of first use at its current operational location. Irrespective of the operating conditions, for example, pressure, environment and stored energy, it is necessary to verify the continuing integrity of equipment and the safety of people using that pressure equipment. 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 gas pressure equipment, is subject to the *Provision and Use of Work Equipment Regulations* (PUWER) (4) which requires that work equipment should not result in health and safety risks, regardless of its age, condition or origin. The PUWER (4) 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 (4) within HSE L22 (13), *Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance*.

Gas pressure equipment operating above 0.5 bar is regulated by the *Pressure Systems Safety Regulations* (PSSR) (5). The PSSR (5) requires such equipment to be examined and maintained. It should be noted that the overall intention of the PSSR (5) is to prevent serious injury from the hazard of stored energy, as a result of the failure of a pressure system or one of its component parts.

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

The HSE provide guidance on the PSSR (5) in document HSE L122 (14), *Safety of pressure systems. Pressure Systems Safety Regulations 2000. Approved Code of Practice and guidance*, and provide additional guidance on the safety of pressure systems in document HSE INDG 261 (17), *Pressure systems. A brief guide to safety*.

The application of the principles of this code demonstrate best practice in relation to managing pressure equipment on all sites, additionally, depending on the hazardous properties of the gases, compliance may be required with the *Control of Major Accident Hazards Regulations* (COMAH) (7).

The European Industrial Gases Association (EIGA) provides guidance on process plant integrity management in EIGA Document 190 (22), *Plant integrity management.* This publication provides a different approach to managing pressure equipment, particularly for gas industry production sites managed under the COMAH (7) regulations. In this respect, either BCGA CP 39 or EIGA Document 190 (22) shall be adopted for any specific installation, however the EIGA Document 190 (22) does not include any references to specific UK regulatory requirements, such as the PSSR (5), for which BCGA CP 39 should be consulted.

The Safety Assessment Federation (SAFed) provide guidance on managing the mechanical integrity of pressure equipment, refer to SAFed IMG 1 (42), *The mechanical integrity of plant containing hazardous substances. A guide to periodic examination and testing.*

The content of this publication is in line with advice from the HSE.

2. SCOPE

The scope of this document is the management of in-service pressure equipment to prevent a failure that may result in a hazardous release of stored energy (pressure). Other hazards associated with product release, such as temperature, toxic, flammable or corrosive substances whilst may be applicable and do need to be appropriately managed, are not addressed specifically in this document. Reference shall be made to appropriate legislation and as necessary safe systems of work set up.

This Code of Practice is applicable for all new, re-used, existing and relocated pressure equipment. It is applicable from the point of first use, until the point in time that the pressure equipment is subject to final disposal.

This code covers the principles and a risk based methodology for developing the following in-service requirements:

- Written Schemes of Examination and the examinations carried out in accordance with them.

- Maintenance requirements.

This document provides guidance on the PSSR (5) and PUWER (4) requirements for examination, maintenance, repair and modification of gas pressure systems. For guidance on the other requirements within PSSR (5) refer to HSE L122 (14) and for PUWER (4) refer to HSE L22 (13).

This Code identifies the periodic assessment for revalidation for continued safe use. It also identifies the information, instruction and training requirements necessary to ensure safe operation.

It then provides guidance on the storage of pressure equipment when not in use and for final disposal.

This Code does not cover the initial design, manufacture, installation, commissioning and handover of equipment to the user. For guidance on these topics reference shall be made to the following BCGA documents:

- BCGA CP 4 (23) – *Industrial gas cylinder manifolds and gas distribution pipework (excluding acetylene).*

- BCGA CP 5 (24), *The design and construction of manifolds using acetylene gas from 1.5 – 25 bar*.

- BCGA CP 6 (25), *The safe distribution of acetylene in the pressure range 0 - 1.5 bar.*

- BCGA CP 26 (28), *Bulk liquid carbon dioxide storage at user premises*.

- BCGA CP 33 (29), *The bulk storage of gaseous hydrogen at users' premises*.

- BCGA CP 34 (30), *The application of the pressure equipment regulations to customer sites.*

- BCGA CP 36 (31), *Bulk cryogenic liquid storage at user premises.*

- BCGA CP 41 (33), *The design, construction, maintenance and operation of filling stations dispensing gaseous fuels*.

- BCGA CP 46 (34), *Bulk storage of cryogenic flammable gases*.

Gas pressure equipment which is covered by the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (6), for example, road tankers, gas cylinders, cargo transportable unit, and transportable pressure equipment, are not included within the scope of this Code of Practice. Further information is available in BCGA CP 38 (32), *In-service requirements for refrigerated gas transportable pressure equipment.*

However, this code applies in such cases where an item of equipment that is designed and manufactured in accordance with the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (6), is then either:

- incorporated into a static gas pressure system, for example, for use as an accumulator; or

- used in static or mobile applications, i.e. not used for transport on the public highway.

If it is required to retain any transport approvals or if there is an intention to subsequently use the pressure equipment for the transportation of products, the inspection and test regime required under the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (6), shall be implemented prior to its first use in this mode. These requirements should be included in an enhanced Written Scheme of Examination in accordance with the PSSR (5).

This Code does not cover pressure systems supplied by individual portable or mobile cylinder gas supplies, where each gas is controlled by a cylinder-mounted regulator, these are covered by:

- BCGA CP 7 (26), *The safe use of oxy-fuel gas equipment (individual portable or mobile cylinder supply).*

- BCGA GN 7 (35), *The safe use of individual portable or mobile cylinder gas supply equipment*.

This code does not cover Liquefied Petroleum Gas (LPG) pressure systems. The UKLPG (the Trade Association for LPG) issue their own publications, for example, refer to UKLPG CP 1, Part 3 (41), *Bulk LPG storage at fixed installations. Examination and inspection*.

3. PUTTING INTO SERVICE REQUIREMENTS

Before putting an item of pressure equipment into operation (including re-using equipment) the user 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.

    - Declaration of Conformity – CE Marking, where applicable.

- An Ageing Pressure Equipment Assessment, which shall have been carried out and the results from which shall have been included in the inspection, maintenance and examination schemes, as appropriate. Refer to Section 4.1.

- A Written Scheme of Examination, as required by the PSSR (5), shall have been produced and all initial pre-use examinations completed as required. Refer to Section 4.2.

- Safe operating limits shall have been established and communicated as required.

- Applicable Risk Assessments to meet legal duties have been completed and a safe system of work has been implemented.

- All personnel have received suitable and sufficient information, instruction and training. Refer to Section 8.

- 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 6.2.

- The pressure system and ancillary items have been installed correctly and instrumentation and controls are accessible by the operators, for example, without the need to climb through pipes or struggle through structures to gain access.

- Routine inspection and maintenance requirements, over and above that required under the PSSR (5) Written Scheme of Examination, have been identified and included in inspection and maintenance schedules. This to include the identification and availability of appropriate spare parts.

- All pressure equipment should be registered on an Asset Register to ensure in-service requirements are managed.

- All equipment is correctly marked and identified e.g. a nameplate. Refer to Section 4.5.

- Standard operating procedures have been developed, are available and have been communicated to operating personnel.

- Emergency procedures are established, communicated and implemented.

- Contact information and emergency contact number(s) are available.

- Appropriate warning notices, safety signs and instructions are posted around the installation.

- The pressure equipment is suitable for its intended purpose, it is compatible with associated equipment and the expected service and environmental conditions. Safe operating limits have been set for all pressure systems connected to that equipment.

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

Users and owners of liquid gas storage tanks 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 (36), *BCGA policy and guidance for the safe filling of third-party owned and/or maintained tanks,* and BCGA Leaflet 12 (40), *Liquid gas storage tanks. Your responsibilities.*

4. EXAMINATION AND MAINTENANCE REQUIREMENTS

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

The PUWER (4) 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.

The PSSR (5) requires that the user of an installed system and the owner of a mobile system shall ensure that the system is properly maintained in good repair, so as to prevent danger. PSSR (5) requires pressure systems to undergo a thorough examination in accordance with a Written Scheme of Examination, unless a specific exclusion applies. Pressure system types are defined within PSSR (5), those typically applicable to the gases industry being:

- Systems comprising of a pressure vessel its associated pipework and protective devices.

NOTE: Pressure systems which incorporate a pressure vessel whose total pressure volume is less than 250 bar litre are excluded from certain regulations within the PSSR (5), including the requirement for a Written Scheme of Examination and a thorough examination, but will still require inspection in accordance with a documented scheme under PUWER (4). This does not apply to systems containing steam.

- Pipework with its protective devices to which a transportable pressure receptacle is, or is intended to be, connected.

NOTE: Where a pressure system is connected to a transportable pressure receptacle, then this receptacle is excluded from the requirements of PSSR (5) as it will be inspected and tested in accordance with the *Carriage of Dangerous Goods Regulations and Use of Transportable Pressure Equipment Regulations* (6). They are not considered as pressure vessels and therefore should not be considered when assessing any exclusions, however the rest of the pressure system will still need to comply with the requirements of the PSSR (5).

SAFed IMG 1 (42) provides guidance on managing the mechanical integrity of pressure equipment.

NOTE: Precautions are required to ensure that vessels are 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. An ageing pressure equipment assessment (APEA) is a

process that assists you to identify the ageing characteristics that may lead to equipment degradation. Ageing is not about how old your equipment is; it's about what you know about its condition, and how that changes over time. Once the symptoms of ageing are understood a decision can be made on how to examine, maintain and inspect the equipment to ensure on-going safety.

It is strongly recommended that an APEA, or an equivalent ageing assessment process, is carried out on all gas pressure systems to ensure adequate examination and maintenance regimes are in place and the equipment remains safe during its in-service life.

For gas pressure systems that are subject to examination in accordance with the PSSR (6), an APEA shall be carried out on the whole gas pressure system prior to the first operation to ensure correct content of the written scheme of examination for all identified degradation mechanisms. In the case of systems already in service the APEA shall be carried out at the next thorough examination.

The principles referenced in the HSE Report RR509 (12), *Plant ageing. Management of equipment containing hazardous fluids or pressure,* are used to assess ageing characteristics.

4.1 Ageing pressure equipment assessment

Where an APEA is required the user shall ensure a Competent Engineer who has the necessary knowledge and experience of the pressure equipment and anticipated ageing mechanisms conducts an APEA. As appropriate, according to plant size and the complexity of the pressure system, a multi-disciplinary team approach of competent engineers, operators, process specialists and maintainers is recommended to support the APEA.

The Competent Engineer shall establish the timescales for the review of the APEA. However, the user shall ensure that the APEA is reviewed, for example, in the event of

- any significant change to the equipment or operating conditions;
- any change of use;
- a change to environmental conditions;
- repair or modification;
- a change of product;
- excessive deterioration;
- changes in legislation;
- technological advances.

These timescales may reduce as the equipment ages.

When examining pressure equipment in accordance with the PSSR (5) a check shall be made to ensure the equipment condition, site operating and environmental conditions have not changed in such a way as to affect the validity of the APEA, refer to Section 4.2.

Generic assessment. Where equipment with similar characteristics is in use in comparable operating and environmental conditions a single generic APEA may be carried out provided it covers all relevant conditions. Where this is the case a record shall be kept of the generic assessment reference to enable the APEA to be identified against the individual equipment. Where there are derogations from the generic APEA an amendment sheet shall be compiled and records kept for that individual equipment.

The steps involved in conducting an APEA are:

- Define the pressure system and operating conditions. Refer to Section 4.1.1.
- Identification of applicable ageing characteristics. Refer to Section 4.1.2.
- Carry out a risk assessment to identify adverse ageing characteristics. Refer to Section 4.1.3.
- Implement control measures to reduce unacceptable risks. Refer to Section 4.1.4.

BCGA has created a Spreadsheet providing a generic template which may be used to assist in recording the steps above. This is available as an electronic download on the BCGA website, alongside BCGA CP 39.

On completion of the APEA the control measures identified shall be incorporated into the examination, maintenance and inspection regime as appropriate.

The following sections explain the steps in detail.

4.1.1 Define the pressure system and operating conditions

A process and instrumentation diagram (P&ID) should be used to establish the extent of the pressure system being considered. This should identify each item of pressure equipment that operates as a functional whole within the pressure system, for example, cryogenic storage tank, vaporiser, pressure control unit, pump etc. Interconnecting pipework shall be considered within the risk assessment as individual components, or as part of the equipment to which it is connected if exposed to the same operating conditions and environment.

Individual items of pressure equipment may need to be divided into sub-assemblies if the ageing characteristics or operating conditions differ. For example a cryogenic storage tank would normally be broken down into the inner pressure vessel, inner vessel supports, pipework, outer jacket and support legs.

For each item of pressure equipment the impact of process and environmental conditions shall be established. For each item define:

- The pressure system and its components.

- Normal operating conditions, for example, pressure, temperature, flow, product, dew point, etc.

- Safe operating limits.

4.1.2 Identification of applicable ageing characteristics

The ageing characteristics are mechanisms that can affect the integrity of pressure equipment and are divided into four categories:

i) **Wall thinning** – General, localised and pitting corrosion; erosion corrosion, erosion and scouring; abrasion, wear and fretting; over-grinding.

ii) **Stress driven damage** - Fatigue damage & cracking; creep cavitation; stress corrosion cracking; hydrogen cracking; brittle fracture or cleavage; ductile tearing; cyclic conditions.

iii) **Physical deformation** - Dents & gouges; bulging; buckling; yielding.

iv) **Metallurgical & environmental damage** - Hydrogen embrittlement; temper embrittlement; strain age embrittlement; low temperature embrittlement; hydrogen induced cracking; hydrogen attack; Type IV cracking; reheat cracking; flame impingement; ageing of polymers; creep; corrosion under insulation.

Although the items above consider most types of ageing, the list is not exhaustive and consideration shall be given to any other types of ageing characteristics that may affect the individual items of pressure equipment.

In addition, consideration should also be given to the support mechanisms for locating pressure equipment, such as the concrete bases, support structures etc. in particular for long term damage from the effects of ice, vent streams and weathering.

All characteristics shall be considered for each item of pressure equipment and/or sub-assembly and those that are considered applicable shall then be included in the Risk Assessment, refer to Section 4.1.3.

4.1.3 Risk assessment (identifying adverse ageing characteristics)

The risk assessment method documented below is suitable and sufficient for simple pressure systems. For more complex pressure systems a more detailed risk assessment may be required, such as that detailed in HSE Contract Research Report CRR 363 (11), *Best practice for risk based inspection as a part of plant integrity management*.

For each item of pressure equipment carry out a risk assessment. The risk assessment should be carried out in the following order:

i) Identify the effect of applicable ageing characteristics on the equipment. Refer to Section 4.1.2.

ii) Identify the potential consequences arising from the effect of ageing.

iii) Conduct an assessment to identify the acceptable level of risk; using a suitable assessment matrix such as the one given in Figure 1.

iv) Specify any control measures that may be required.

v) Repeat the assessment with the control measures in place to ensure the necessary risk reduction has been achieved.

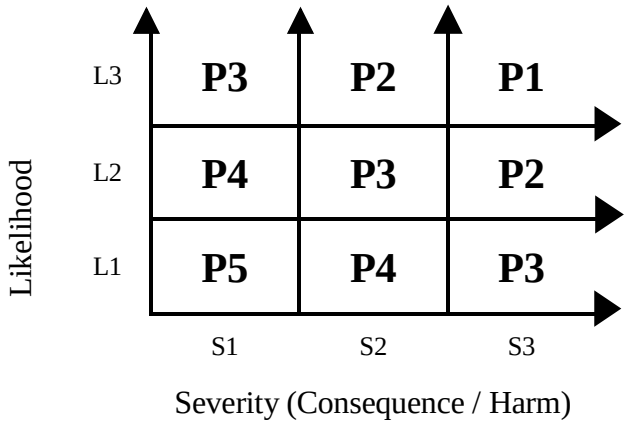

Figure 1: Risk assessment matrix

Where:

Likelihood
Where the likelihood is the time based probability of one of the identified ageing characteristics contributing to failure during the expected service life of the equipment.

L1. Low (where failure will seldom occur)

L2. Medium (where failure will often occur).

L3. High (where it is certain that failure will occur).

Severity
Where the severity is the magnitude of harm that may arise from the release of pressure energy (environmental, operational risk, product and other business risks are excluded).

S1. Minor injuries.

S2. Serious injuries requiring medical treatment and time off from work.

S3. Death or disabling injury.

Risk

P1. Intolerable risk. Work must not be started or continued until the risk has been reduced to an acceptable level.

P2. Substantial risk. Shall be improved through risk reduction methods.

P3. Moderate risk. Efforts should be made to reduce the risk within a defined time period.

P4. Tolerable risk. No additional controls required. Monitoring is required to ensure controls are maintained.

P5. No action required.

4.1.4 Implement control measures to reduce unacceptable risks

From the results obtained, identify and implement the measures that are necessary to control any unacceptable risks. These may result in modifications to examination, maintenance and inspection requirements.

All control measures identified shall be communicated to the Competent Person, for possible inclusion in the Written Scheme of Examination.

4.2 Examination requirements

For pressure equipment within the scope of the PSSR (5) the user of an installed system and owner of a mobile system shall not allow it to be operated in its current use without a Written Scheme of Examination, or without complying with any recommendations arising from an examination, for:

- All protective devices, refer to Appendix 3, Table 3.
- Every pressure vessel in which a defect may give rise to danger.
- Those parts of the pipework in which a defect may give rise to danger.

The Written Scheme of Examination shall:

- Specify the nature and frequency of the examination.
- Specify the measures necessary to prepare the system for safe examination.

HSE provide guidance on written schemes of examination content in HSE INDG 178 (16), *Written schemes of examination. Pressure Systems Safety Regulations 2000*.

The Written Scheme of Examination shall be drawn up, or certified, by the Competent Person. The Competent Person shall take account of the outcome of the APEA (refer to Section 4.1). The need for any testing (for example non-destructive testing of safety-critical parts) should be decided by the competent person.

The Competent Person may use a risk based inspection process to support and develop the Written Scheme of Examination, for example refer to HSE CRR 363 (11).

Each pressure system requires its own Written Scheme of Examination.

The Written Scheme of Examination may be held by the user or by the owner if written agreement has been reached on the application of PSSR (5), Schedule 2.

Pipework shall be included in the risk assessment process. Pipework will need to be included in the Written Scheme of Examination if:

- its mechanical integrity is liable to be significantly reduced by corrosion, erosion, fatigue or any other factors; and

- failure resulting in the sudden release of stored energy would give rise to danger.

NOTES:

1. Most gaseous pipework is manufactured using non-ferrous or stainless steel, and due to the properties of these materials, the relevant fluid (non-corrosive, non-erosive, dry) and the operating conditions (non-fatigue duties) have good mechanical integrity.

2. Over the years there have been failures of carbon steel pipes underneath the lagging caused by undetected external corrosion. Insulated carbon steel lines may require a Written Scheme of Examination. Cryogenic, insulated lines are not susceptible to corrosion underneath the lagging as they are constructed from non-ferrous or stainless steel material.

3. Transportable pressure receptacles (gas cylinders) used as a source supply are excluded from the requirements of PSSR (5) as they will be inspected and tested in accordance with the *Carriage of Dangerous Goods Regulations and Use of Transportable Pressure Equipment Regulations* (6), and should not be included in the Written Scheme of Examination.

Appendix 3 shows the guidelines for Written Schemes of Examination and preparatory precautions that are applicable to the various items used within pressure systems based on current industry practice. The guidelines in the appendices are minimum requirements for general application and the scope and frequency of specific examinations shall be determined by the Competent Person.

Where users wish to modify the Written Scheme of Examination, for example to extend examination intervals beyond their existing practices, they must have sufficient data to demonstrate that the change or extension will not give rise to danger. The Competent Person shall formally endorse any modifications. Changes shall only be implemented at the next scheduled examination.

The user shall ensure that a Competent Person undertakes the required examination in accordance with the Written Scheme of Examination and submits a report accordingly.

Under exceptional circumstances, it may be possible to postpone a scheduled examination. This shall be strictly in accordance with the procedures detailed in PSSR (5). Notification is required in advance of the scheduled examination.

If the Competent Person carrying out an examination is of the opinion that the pressure system will give rise to imminent danger without modification, repair or change in operating conditions, then it shall not be operated until the required changes have been made. The Competent Person shall also advise the enforcing authority in writing of this action.

The Competent Person undertaking the examination in accordance with the Written Scheme of Examination shall provide the user / owner with a written report within 28 days of completion of the examination. This report is to be stored on the premises, or at a site approved by the enforcing authority, until the next examination is completed. Reports that contain information that can materially assist in assessing whether the system is safe to operate or whether any repairs or modifications to the system can be carried out safely shall be retained for the life of the equipment. It is recommended that copies of all reports are retained for the life of the pressure equipment as it may help to determine future examination and maintenance requirements and to assess the future in-service life of the equipment.

4.3 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, repairs or replacement of components, rectification of operational parameters or the replacement of protective coatings. Maintenance is required under various regulations and it is the responsibility of the user to ensure that this is carried out, as applicable. Consultation with the owner is strongly recommended for any maintenance planning and activity.

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

The maintenance requirements should take into account the outcome from the APEA (refer to Section 4.1), manufacturers recommendations, any previous maintenance history, knowledge of similar installations and equipment, defect reports and the effects of weathering on the plant.

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.

4.4 Inspection requirements

The purpose of an inspection is to identify whether the equipment is operating correctly, safely and within a safe environment i.e. civil engineering requirements, security arrangements and minimum recommended separation distances by reference to the relevant documents.

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

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

Best practice is to follow current standards and industry documents when conducting inspections. It is recognised that standards and industry documents evolve over time, as will operating practices and manufacturers' recommendations. Where the requirements of current standards and industry documents are not fully complied with, provided that installations complied with the standards and industry documents applicable at the time of putting into service, a case by case risk assessment shall be carried out to determine continued safe and acceptable use. This is to be acceptable to all relevant parties.

All inspections shall be carried out under a documented process. The inspections should take into account the outcome from the APEA (refer to Section 4.1), manufacturers recommendations, any previous maintenance / inspection history and defect reports.

An inspection 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 examples, Appendix 1 details a typical check list that can be used for an inspection of a bulk cryogenic installation. This check list is not exhaustive and each organisation should develop their own checklists for particular types of installations and equipment. There is also a guide to the inspection of O-ring seals.

BCGA Leaflet 11 (39), *Safety checks for vacuum insulated cryogenic tanks*, outlines some daily safety checks that users responsible for vacuum insulated cryogenic tanks are to carry out.

4.5 Marking and identification

The user shall ensure appropriate signage, marking and labelling is applied, including valve identity tags. All should be legible, in good condition, visible and kept up to date.

All pressure vessels should be permanently marked to correctly identify the manufacturer, the safe operating limits and the original specification against which the vessel was designed. The following information is recommended:

- The manufacturer's name;
- A serial number to identify the vessel;
- The date of manufacture of the vessel;
- The standards to which the vessel was built; or type approval mark.
- The maximum allowable pressure of the vessel;
- The minimum allowable pressure of the vessel where it is other than atmospheric;

- The design temperature.

For vessels greater than 250 bar litres the PSSR (5) require that this information is displayed. The user shall ensure the information is marked on the vessel or on a nameplate permanently fixed to the pressure vessel and that the information remains visible and legible. Where the dataplate is missing, or any of the key information cannot be obtained from the equipment records, then the vessel shall not to be used or filled.

5. REPAIRS AND MODIFICATION

5.1 Repair

A repair restores the pressure system back to its intended specification. Any repairs carried out on a piece of pressure equipment shall not affect its integrity or the operation of any protective devices. All repairs shall be recorded.

Depending upon the nature of the repair it may require additional documentation and suitable authorisation, including, where required, a review by the Competent Person responsible for the Written Scheme of Examination.

Repairs should be in-line with manufacturer's guidance.

Where the user of a pressure system is not the owner, he shall not repair the system without the consent of the owner.

Repair or modification of non-pressure containing parts of the system should be carried out so that the integrity of the pressure system is not adversely affected. This should ensure that any repairs do not affect the operation of any protective devices.

Repairs are not always possible or cost effective and a modification to the existing specification may be a suitable alternative, refer to Section 5.2.

5.2 Modification

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

Where the plant is subject to legislative essential health and safety requirements, any modification should also conform to current legislation.

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 (20), *Management of change*. The user shall ensure the APEA and the Written Scheme of Examination are reviewed, or revised as necessary, to ensure they continue to be valid prior to allowing the equipment to be returned back into service.

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 the user of a pressure system is not the owner, he shall not modify the system without the consent of the owner. It is recommended that the manufacturer is consulted before any modification takes place.

6. REVALIDATION

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.

For pressure vessels, the suitability for continued service should be confirmed on a periodic basis. This is achieved by an examination of the pressure vessel, in accordance with the Written Scheme of Examination.

For vacuum insulated pressure vessels it is not possible to conduct a thorough internal examination as there is no means of access to the inner vessel and interspace pipework without affecting their integrity. To justify the continued use of these vessels, the elements that are not accessible for examination are subjected instead to a revalidation process. Refer to BCGA TIS 23 (38), *Policy regarding internal examination and proof pressure testing of static cryogenic liquid storage tanks*.

NOTE: The concepts of revalidation and examination are mutually exclusive, either one approach or another will be adopted for specific parts of any tank. For this reason it is usual not to include revalidation within the PSSR (5) Written Scheme of Examination.

The owner is responsible for ensuring revalidation takes place. 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, examinations, maintenance and inspection regimes as appropriate. These results shall also be communicated to the Competent Person for possible amendments to a Written Scheme of Examination.

The revalidation period shall be decided by a Competent Engineer. The first revalidation shall take place no later than 20 years from the date of manufacture. Data supporting this time period is presented in BCGA TIS 23 (38). There are many factors that will determine the revalidation period, for example, service history, operating conditions, age, etc.

More frequent revalidation may be necessary, for example, for mobile vessels not directly covered by Road Transport regulations that are subjected to fatigue through vibration and handling, or following an incident outside the design limits that could affect the vessels operational safety

The revalidation process consists of three distinct stages:

Stage 1: A design documentation review. Refer to Section 6.1.

i) Review of design documentation.

ii) Review of experience of similar pressure equipment, including consultation with the manufacturer.

Stage 2: Individual tank service condition and history review. Refer to Section 6.2.

i) Review of service history records.

ii) Review of examination records and the APEA; Ensuring the output is incorporated into the examination, maintenance and inspection regime.

Stage 3: Production of a revalidation report. Refer to Section 6.3.

Any conclusions shall be recorded in the revalidation report. A suggested format is given in Appendix 2.

6.1 Stage 1: A design documentation review

A review based upon the available design information, preferably based on the tank construction dossier and the original construction drawings. For vessels, 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:

i) Establish that the essential design and construction information is complete to the satisfaction of a Competent Engineer.

ii) Confirm that any modifications or repairs have been correctly designed and approved and have been implemented properly.

iii) Assess the impact of any code developments on design parameters, materials, design calculations, examination and testing. The assessment shall include the inner pressure vessel and outer jacket, together with their protection and control devices.

iv) Assess the impact of any design or technological changes to the tank or its associated equipment, for example, a filling system.

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

6.2 Stage 2: Individual tank service condition and history review

6.2.1 Review of service history records

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

- Operating conditions.
- Environmental conditions, for example, wind, earthquake, output from chemical processes and siting of adjacent facilities.
- Changes of service since new or the last revalidation.
- Previous corrective action or rectification reports.
- Any repairs or modifications.
- Reports of operational problems.
- 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.
- Periods and condition when out of service.
- Maintenance records.
- A review of the APEA; ensure the output is incorporated in the Written Scheme of Examination.
- Review proposed changes in service conditions.

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 tank.

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

6.2.2 Examination of records

The previous examination report that was prepared in accordance with the Written Scheme of Examination shall be reviewed. In the event that a recent survey has not

taken place, then a physical inspection to assess the current condition of the tank shall take place. A copy of this inspection shall be included in the revalidation report.

The records reviewed shall cover:

- Nameplate details or unique identification number.

NOTE: Where the unique identification number cannot be identified revalidation cannot proceed and the tank should be withdrawn from service and disposal action taken.

- Condition of nameplate and attachment.

- General external condition, including the checks detailed in BCGA Leaflet 11 (39).

- Mechanical damage to outer jacket supports and attachments.

- The condition of associated pipework and equipment. To include a check against the P&ID.

- Corrosion of outer jacket supports and attachments.

- Purge gas analysis records (where available).

- Relief devices and their functionality.

- The operation of the inter-space purge system (where applicable).

Where previous examination records do not exist an examination shall be made to establish the data listed above.

6.3 Stage 3: Production of a revalidation report

The revalidation report shall contain a statement indicating the conclusions reached and a summary of the design, service history and all inspection reviews. 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 tank. 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 7.3) which can support the revalidation, they should be referenced on the revalidation report.

7. OUT OF SERVICE REQUIREMENTS

7.1 Decommissioning, storage and re-introduction into service

Pressure systems may be decommissioned and specific components and sub-assemblies may be re-used in different systems, where this is applicable refer to BCGA CP 34 (30). To ensure the equipment remains safe and fit for purpose due regard shall be given to the decommissioning process, transport, storage and testing prior to re-use.

Decommissioned systems shall be isolated and depressurised. Ensure that any remaining product is disposed of in a safe manner. It is good practice to purge with an inert gas at a pressure that is both suitable for the tank 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.

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

Equipment in storage shall be kept in a secure area. Where necessary, equipment in storage may require ongoing maintenance.

All tanks stored out-of-service should be sealed to prevent contamination and moisture ingress. Tanks should be maintained at a residual positive pressure (up to 0.5 barg). Appropriate warning notices of the tank's condition should be displayed in a prominent position on the outer jacket. In the case where tanks are left in-situ the plant operating safety procedures shall be maintained, as appropriate.

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

For pressure equipment stored out of service, with a residual pressure maintained below 0.5 barg, it is not necessary to continue examinations in accordance with the Written Scheme of Examination (Section 4) (PSSR (5) usually does not apply in these circumstances). Similarly, there is no requirement to carry out a revalidation (Section 6).

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

7.2 Transportation and lifting

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

Tanks should be prepared for transportation in accordance with BCGA CP 16 (27), *The movement of static gas storage tanks by road*.

7.3 End of service life

Equipment that has reached the end of its serviceable life shall be disposed of in an appropriate manner. Strict control measures shall be in place to ensure that any equipment disposed of is rendered safe and beyond-use, for example:

- Pierce or cut 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. For example, perlite, can contain crystalline silica, which, if it enters the eyes or respiratory tract, can cause serious irritation. For further information refer to EIGA Document 146 (21), *Perlite management*.

- The disposal of electrical equipment shall comply with the Waste Electrical and Electronic Equipment (WEEE) Directive (10).

When disposing of tanks or equipment, suitable written work instructions must be used to ensure that safe system of works are in place to cover purging, hot work, perlite removal, etc.

Disposing of equipment provides an opportunity to conduct an internal inspection providing information on service condition.

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 (38). The BCGA will continue to collect this information in support of this policy and encourages member companies to contribute their data.

8. INFORMATION, INSTRUCTION AND TRAINING

All personnel directly involved in the commissioning, operation and maintenance of 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 and maintenance of pressure equipment. The information, instruction and training, shall also cover the actions to take in an emergency.

All staff 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 (19), *Safety training of employees*. BCGA GN 23 (37), *Identifying gas safety training requirements in the workplace*, provides information on the topics that should be covered when considering gases safety training.

9. RECORD KEEPING

9.1 Documentation

New equipment shall comply with the *Pressure Equipment (Safety) Regulations* (8) or any other applicable regulation and shall have all appropriate documentation. The owner shall retain this documentation for the life of the equipment.

Equipment put into service prior to the introduction of the *Pressure Equipment (Safety) Regulations* (8) shall have the documentation as required by the applicable regulations at the time of manufacture and this documentation shall be retained for the life of the equipment by the owner.

In addition to the above, copies of the most recent APEA, or equivalent assessment, and a revalidation report shall be kept.

All the above documentation shall be available to allow a Competent Person to produce or amend a Written Scheme of Examination and to determine the equipment's safe operating limits.

NOTE: This information will also be required to conduct an APEA and a revalidation, where applicable.

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

9.2 Records

The following records shall be kept:

- The last report of examination, in accordance with the Written Scheme of Examination and any previous reports if they contain key information.
- The last report of inspection in accordance with PUWER (4).
- Records of any repairs or modifications carried out.
- Any current postponement notification for an examination.
- Reports of any significant excursions outside of the normal operating parameters.
- Any documents required in accordance with other legislation.

The following records should be kept:

- Records of any significant mechanical damage or corrosion.
- Records of any out-of-service period and storage conditions, where appropriate.
- The most recent maintenance records.

- Training records.

Previous reports in accordance with the Written Scheme of Examination 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 at the premises where the equipment is installed, or at the office of the user or owner, when applicable. 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.

9.3 Asset register

An Asset Register of all pressure systems either owned or used should be kept and reviewed periodically. The register should include the following:

- Type and description of the pressure system.
- Location of record file.
- Location and site contact information.
- Date of next examination, 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.

NOTES:

1. Keeping an Asset Register within a computer system is the method preferred by enforcement agencies such as the HSE.
2. Pressure systems are registered on an Asset Register to ensure in-service requirements are managed.

10. REFERENCES

	Document Number	Title
1.		The Health and Safety at Work etc. Act 1974.
2.	SI 1996: No 825	The Pipelines Safety Regulations 1996
3.	SI 1997: No 1713	The Confined Spaces Regulations 1997.
4.	SI 1998: No. 2306	The Provision and Use of Work Equipment Regulations 1998 (PUWER).
5.	SI 2000: No. 128	Pressure Systems Safety Regulations 2000 (PSSR).
6.	SI 2009: No. 1348	Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations, 2009 (as amended).
7.	SI 2015: No. 483	Control of Major Accident Hazards Regulations 2015 (COMAH).
8.	SI 2016: No. 1105	Pressure Equipment (Safety) Regulations 2016.
9.	ECE/TRANS/257	European agreement concerning the international carriage of dangerous goods by road (ADR) (as amended).
10.	European Directive 2002/96/EC	The Waste Electrical and Electronic Equipment Directive (WEEE).
11.	HSE Contract Research Report CRC 363	Best practice for risk based inspection as a part of plant integrity management.
12.	HSE Research Report RR509	Plant ageing. Management of equipment containing hazardous fluids or pressure. 2006.
13.	HSE L22	Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance.
14.	HSE L122	Safety of pressure systems. Pressure Systems Safety Regulations 2000. Approved Code of Practice and guidance.
15.	HSE HSG 253	The safe isolation of plant and equipment.
16.	HSE INDG 178	Written schemes of examination. Pressure Systems Safety Regulations 2000.
17.	HSE INDG 261	Pressure systems. A brief guide to safety.

	Document Number	Title
18.	HSE EH 40	Workplace exposure limits.
19.	EIGA IGC Document 23	Safety training of employees.
20.	EIGA IGC Document 51	Management of change.
21.	EIGA IGC Document 146	Perlite management.
22.	EIGA IGC Document 190	Plant integrity management.
23.	BCGA Code of Practice 4	Industrial gas cylinder manifolds and gas distribution pipework (excluding acetylene).
24.	BCGA Code of Practice 5	The design and construction of manifolds using acetylene gas from 1.5 – 25 bar.
25.	BCGA Code of Practice 6	The safe distribution of acetylene in the pressure range 0 - 1.5 bar.
26.	BCGA Code of Practice 7	The safe use of oxy-fuel gas equipment (individual portable or mobile cylinder supply).
27.	BCGA Code of Practice 16	The movement of static gas storage tanks by road.
28.	BCGA Code of Practice 26	Bulk liquid carbon dioxide storage at user premises.
29.	BCGA Code of Practice 33	The bulk storage of gaseous hydrogen at users' premises.
30.	BCGA Code of Practice 34	The application of the pressure equipment regulations to customer sites.
31.	BCGA Code of Practice 36	Bulk cryogenic liquid storage at user premises.
32.	BCGA Code of Practice 38	In-service requirements for refrigerated gas transportable pressure equipment.
33.	BCGA Code of Practice 41	The design, construction, maintenance and operation of filling stations dispensing gaseous fuels.

	Document Number	Title
34.	BCGA Code of Practice 46	Bulk storage of cryogenic flammable gases.
35.	BCGA Guidance Note 7	The safe use of individual portable or mobile cylinder gas supply equipment.
36.	BCGA Guidance Note 17	BCGA policy and guidance for the safe filling of third-party owned and/or maintained tanks.
37.	BCGA Guidance Note 23	Identifying gas safety training requirements in the workplace.
38.	BCGA Technical Information Sheet 23	BCGA policy regarding internal examination and proof pressure testing of static cryogenic liquid storage tanks.
39.	BCGA Leaflet 11	Safety checks for vacuum insulated cryogenic tanks.
40.	BCGA Leaflet 12	Liquid gas storage tanks. Your responsibilities.
41.	UKLP Code of Practice 1, Part 3	Bulk LPG storage at fixed installations. Examination and inspection.
42.	SAFed IMG1	The mechanical integrity of plant containing hazardous substances. A guide to periodic examination and testing.
43.	SAFed SBG1	Guidelines. Shell Boilers. Guidelines for the examination of boiler shell-to-endplate and furnace-to-endplate welded joints.
44.	SAFed SBG2	Guidelines. Shell Boilers. Guidelines for the examination of longitudinal seams of shell boilers.
45.	SAFed PSG1	Pressure systems. Guidelines on periodicity of Examinations.

Further information can be obtained from:

UK Legislation	www.legislation.gov.uk
Health and Safety Executive (HSE)	www.hse.gov.uk
European Industrial Gases Association (EIGA)	www.eiga.eu
British Compressed Gases Association (BCGA)	www.bcga.co.uk
The UK LPG Trade Association (UKLPG)	www.uklpg.org
The Safety Assessment Federation (SAFed)	www.safed.co.uk

IN-SERVICE INSPECTION BULK CRYOGENIC INSTALLATION CHECKLIST - EXAMPLE

Item	Check
Fences	In place. Gates. Lockable. Not obstructed. Emergency gate (if fitted). In place and not obstructed.
Fence signs	In place. Suitable for the product.
Compound	Free of litter and extraneous debris. No flammable materials. Minimum recommended separation distances to other hazards.
Delivery area	Unobstructed for delivery vehicles. No tarmac for oxygen deliveries
Concrete base	Concrete in good condition. No cracks and spalling. No subsidence, listing or distortion. Ice damage.
Support structure and holding down bolts	Undamaged and in good condition. Bolts in place and tight, where applicable.
Tank	Product signage. Data plate in place. Paint condition. No abnormal ice patches. Condition of insulation and corrosion under insulation (for conventionally insulated tanks). No abnormal venting. Outer jacket protective devices intact. Outer jacket condition. Vessel external pipework: No unauthorised modifications. Correctly supported. No damaged pipework. Insulation condition. Excessive ice build-up. Corrosion under insulation. Incorrect sealing (especially around penetrations). Trapped liquid / gas between two valves without adequate protection. Fill coupling. Protective devices: Correct setting. Suitably supported. Pipework free from obstructions. Inlet. Outlet. Three way valve operational.

	Valves: Handwheels in place. Operating condition. Correctly identified. Earth bonding. Pressure Gauge. Contents Gauge. Telemetry.
Vaporiser pressure build	Supports. Ice build-up. Protective device. Valve operation.
Vaporiser process	Supports: Holding down arrangement. Ice build-up. Protective device. Valve operation.
Customer station	Regulator: Setting. Operation. Protective device. Pressure indication.

IN-SERVICE INSPECTION – O-RING SEALS

Some connections make use of O-ring seals to provide a gas tight seal.

All O-ring seals should be inspected prior to every connection to ensure that the seal is in a suitable condition for further use. Seals showing any signs of wear or damage shall be replaced before reconnecting. Typical types of damage to an O-ring are detailed in Figure A1-1.

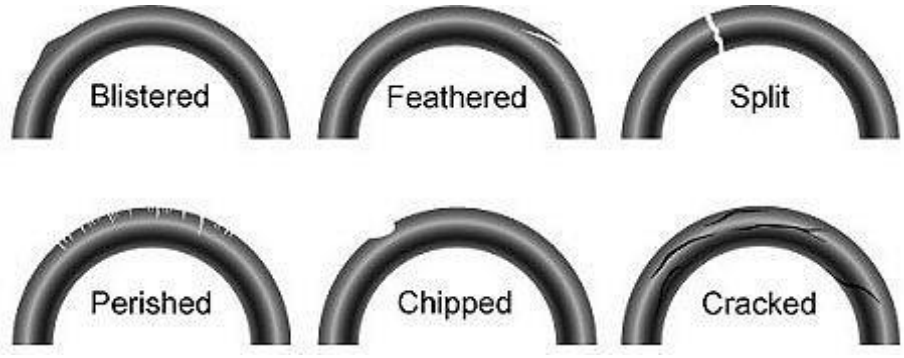

FIGURE A1-1: Typical types of seal damage

As an example, there are many valves of the 5/8″ BSP female connection type (BS 341 No. 3) which require a male nut and bullnose nipple fitted to the connecting equipment. Refer to Figure A1-2. The connecting nipple is fitted with a groove which holds an O-ring in position to prevent it from being displaced when the joint is pressurised. As the O-ring tends to be pushed into its groove each time it is pressurised, it tends to wear in use, causing damage.

FIGURE A1-2: BS 341 No.3 Bullnose connection

REVALIDATION REPORT - EXAMPLE

Tank type No:	
Tank serial No: *Unique identification number*	
Design code:	
Date of manufacture:	*(Date)*
Manufacturer: *Name and contact details.*	
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:	
Examination review:	
Experience of similar tanks:	
Any conditions for revalidation:	
Revalidation conclusion: *Revalidation statement*	
Revalidation period:	*years from* *(Date)*

Next revalidation:		*(Date)*
Competent Engineer:	*Name (Capitals):*	*Signature:*
Position: *Within company or details of contracting company*		
Date of issue:		*(Date)*

GUIDELINES FOR WRITTEN SCHEMES OF EXAMINATION

This appendix provides guidelines for the contents of a Written Schemes of Examination and some notes on the preparatory precautions that are applicable to the various items used within pressure systems based on current industry practice. The guidelines are the recommended requirements for general application and assume the equipment is operating under 'normal' UK conditions and environment.

This information is particular to the compressed gases industry and is not exhaustive. Where this guidance is in conflict with other published sources of guidance on examinations and their intervals, then the Competent Person shall decide the appropriate course of action for each individual pressure system.

Where the APEA, or equivalent ageing assessment, identifies adverse ageing mechanisms the general requirement will be to reduce the interval between inspections and may demand a more thorough inspection examination procedures.

The scope and interval of specific examinations shall be determined by the Competent Person taking into consideration actual operating conditions.

In order to assure the health and safety of all persons involved, or who could be affected by, the examination, it is essential that safety precautions appropriate to the examination technique(s) are observed prior to and throughout.

It is the responsibility of the owner / user to ensure that a safe system of work is established and followed.

The following tables provide top level guidance to aid the Competent Person. The Competent Person shall be required to provide the necessary level of detail appropriate to each individual system and the Written Scheme of Examination.

Table 1 Vessels

Table 2 Tanks

Table 3 Protective devices

Table 4 Heat exchangers & vaporisers

Table 5 Pipework

Table 6 Flexible hoses

Table 7 Steam-raising plant

Table 8 Pipelines

TABLE 1 - VESSELS

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
1. Vessels Air receivers	No more than 6 years, dependant on service conditions. Refer to Appendix 3, Table 1, Note 1.	a) Visual, external examination. b) Visual, internal examination. c) Pressure test or NDT to be carried out as required by the Competent Person. d) Confirm vessel identity and nameplate markings, check that vessel is working within declared safe operating limits. e) Carry out function check on all controls. f) For air receivers in wet service, check drains.
2. Vessels Steam receivers	No more than 4 years, dependant on service conditions.	a) Visual, external examination b) Visual, internal examination c) Confirm vessel identity and nameplate markings, check that vessel is working within declared safe operating limits. d) Pressure test or NDT to be carried out as required by the Competent Person.
3. Vessels Cryogenic process vessels (e.g. ASU cold box)	The remnant fatigue life should be used to establish the examination interval.	Scope of examination to be determined by the Competent Person. For cold boxes refer to EIGA Document 190 (22).
4. Vessels LPG storage		Refer to UKLPG CP 1, Part 3 (41)
5. Buffer storage systems comprising HP gas cylinders	Scope of examination to be determined by the Competent Person, with reference to the *Carriage of Dangerous Goods and the Use of Transportable Pressure Equipment* Regulations (6), as applicable.	

TABLE 1 - VESSELS

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
6. Vessels High temperature	Maximum period 6 years	Competent Person to review failure mechanisms and determine scope of examination.
7. Vessels Non-cryogenic vessel refrigeration system	4 years	Scope of examination to be determined by the Competent Person, taking account of the following factors: a) Vessels lagged or unlagged. b) Duty permanently below zero °C, or cyclic. c) Ammonia system is / is not oil free.
8. Vessels Non-cryogenic air separation equipment	4 years (Refer to Appendix 3, Table 1, Notes)	a) Visual, external examination. b) Visual, internal examination. c) Pressure test or NDT to be carried out as required by the Competent Person. d) Examination of all fittings. e) Confirm vessel identity and nameplate markings, check that vessel is working within declared safe operating limits.
9. Membrane vessels (Headers) Non-cryogenic air separation equipment	12 years (Refer to Appendix 3, Table 1, Notes)	a) Visual, external examination. b) Pressure test or NDT to be carried out as required by the Competent Person.
10. PSA vessels Non-cryogenic air separation equipment	6 years (Refer to Appendix 3, Table 1, Notes)	a) Visual, external examination. b) Pressure test or NDT to be carried out as required by the Competent Person. c) Cyclic inspection required at 50 % cycle life.

TABLE 1 - VESSELS

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
11. Dryer vessels Non-cryogenic air separation equipment	6 years (Refer to Appendix 3, Table 1, Notes)	a) Visual, external examination. b) Visual, internal examination.
12. Product storage vessels Non-cryogenic air separation equipment	12 years (Refer to Appendix 3, Table 1, Notes)	a) Visual, external examination. b) NDT to be carried out as required by the Competent Person. c) Examination of all fittings. d) Confirm vessel identity and nameplate markings, check that vessel is working within declared safe operating limits.
13. Vessels In corrosive and/or erosive and/or fatigue service	Examination intervals to be determined by local operating conditions, by specific degradation mechanisms, by specific ageing rates and the remnant fatigue life.	a) Visual external examination. b) Visual internal examination or wall thickness checks. c) NDT when specified by Competent Person. d) Hydrostatic test to be carried out if required. e) Confirm vessel identity and nameplate markings, check that vessel is working within declared safe operating limits. f) Carefully review and determine when the next due examination is required.
14. Vessels In non-corrosive and/or non-erosive and/or non-fatigue service	12 years	a) Visual external examination. b) Visual internal examination or wall thickness checks. c) NDT when specified by Competent Person. d) Hydrostatic test to be carried out if required. e) Confirm vessel identity and nameplate markings, check that vessel is working within declared safe operating limits.

TABLE 1 - VESSELS

NOTE 1: Scheme of examination for non-cryogenic air separation equipment

Some of the vessels may be subjected to high cyclic duty, this must be considered by the competent person who may require additional NDT or analysis to ensure the fatigue life of the vessels is not exceeded.

It is recommended that the examination frequency for the wet receivers is initially two years.

The intervals in this section are the maximum that can be considered when the corrosion rates have been firmly established.

New and relocated used equipment should be examined initially and then at an appropriate interval, dependent upon duty and local environment, to establish the rate of corrosion. This will provide the information to set subsequent examination intervals.

The above is of particular importance with respect to wet air piping and buffer vessels.

NOTE 2: Preparation of non-cryogenic air separation equipment for examination

In order to assure the health and safety of the public and persons involved in the examination of pressure vessels entry into the vessel shall comply with the requirements of the Confined Spaces Regulations (3).

It is essential that the following minimum safety precautions are observed prior to the internal examination of any vessel:

- Physical isolation, e.g. spading, of the vessel to prevent product entry.

  HSE provide guidance on how to isolate plant and equipment safely, and how to reduce the risk of releasing hazardous substances during intrusive activities such as maintenance and sampling operations in document HSG 253 (15), *The safe isolation of plant and equipment*.

- Depressurisation of the equipment by venting and checking to ensure that zero pressure is present prior to the opening of a manway.

- Displacement of nitrogen or oxygen-rich atmosphere by the introduction of air, either naturally or by forced ventilation.

- Use of forced ventilation and analytical atmospheric checks to ensure the atmosphere within the vessel is acceptable for entry. Alternatively, the use of breathing apparatus may be considered.

- For flammable gases, purging of the vessel to ensure the flammability hazard is eliminated and checking by means of atmospheric analysis.

- Physical disconnection of electrical supplies to the compressor and control equipment.

It is the responsibility of the owner/user to ensure that a safe system of work is established and followed.

TABLE 2 - TANKS

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
1. Tanks Vacuum insulated	5 years.	a) Visual external examination including tank foundations. b) Confirm tank identity and nameplate markings, check that the tank is working within declared safe operating limits. c) Check if relief devices are in-test, if not carry out examination in accordance with Appendix 3, Table 3.
2. Tanks Conventionally insulated	The first thorough examinations is required within 5 years of service, after which the Competent Person may extend the period up to a maximum of 10 years.	a) Visual external examination. b) Check integrity of insulation. c) Visual internal examination, including NDT as specified by the Competent Person. d) Check if relief devices are in-test, if not carry out examination in accordance with Appendix 3, Table 3. e) Check operation of purge systems. f) Confirm tank identity and nameplate markings, check that the tank is working within declared safe operating limits. g) Survey tank supports & civil foundations. h) Replica testing and other NDT as specified by a Competent Person (cyclic duty only). Refer to Appendix 3, Table 2, Note.

TABLE 2 - TANKS

NOTE: Preparation of conventionally insulated tanks for internal examination

In order to assure the health and safety of the public and persons involved in the examination of conventionally insulated tanks entry into the vessel shall comply with the requirements of the Confined Spaces Regulations (3).

It is essential that the following minimum safety precautions are observed prior to internal examination of any vessel:

- Physical isolation, e.g. spading, of the vessel to prevent product entry.

  HSE provide guidance on how to isolate plant and equipment safely, and how to reduce the risk of releasing hazardous substances during intrusive activities such as maintenance and sampling operations in document HSG 253 (15).

- Disposal of vessel contents by draining / venting operations and a check to ensure that zero pressure is present prior to opening of the manway.

- For storage tanks that contain flammable product they shall be purged with an inert gas to reduce the flammable concentration below the Lower Explosive Limit (LEL) or the lower flammability limit, prior to letting air (or any gas containing oxygen) enter the vessel.

- Displacement of any hazardous atmosphere by the introduction of air, either naturally or by forced ventilation. Check any residual product concentration is be below acceptable workplace exposure limits. (As an example, CO_2 storage tanks. Currently CO_2 is 0.5 % by volume (5000 ppm), calculated as an 8-hour time-weighted average. A short-term work exposure limit of 1.5 % by volume (15000 ppm), calculated as a 15 minute time weighted average concentration, is also given).

  NOTE: For further information on workplace exposure limits refer to HSE EH 40 (18), *Workplace exposure limits*.

- Check atmosphere in the vessel prior to entry to confirm it is safe to enter; the oxygen concentration shall be within the acceptable range of 19.5 % to 23.5 % v/v.

It is the responsibility of the owner/user to ensure that a safe system of work is established and followed.

TABLE 3 - PROTECTIVE DEVICES

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
1. Relief valves In air service	2 years	a) Visual, external examination, including vent pipe and supports (refer to Appendix 3, Table 3, Notes). b) Check that the relief valve is of the correct size, set pressure, material and in the correct orientation. c) Check vent pipes are unobstructed, are in a satisfactory condition and vent to a safe location. d) As applicable, check drain holes are clear. e) Either: (i) Replace with new or refurbished valves; or (ii) Dismantle and check all moving parts for damage, wear and freedom of movement. Re-assemble. Re-set valve to the required set pressure. Perform lift test using calibrated equipment. Attach a tag indicating the date of test; or (iii) Lift test using calibrated equipment. This should not be carried out more than once, thereafter the valve should be removed and replaced or refurbished. Attach a tag indicating the date of test. In the compressed gases industry it is established practice to replace a relief valve with a new valve (or a refurbished relief valve) on customer stations.
2. Relief valves Protecting carbon dioxide storage tanks	2 years	
3. Relief valves Protecting cryogenic liquid storage tank ~ non-vacuum insulated ~ vacuum insulated ~ vacuum insulated fitted with bursting discs	 3 years 3 years 5 years	
4. Relief valves Protecting process equipment	6 years	
5. Relief valves Cylinder filling systems	3 years	

TABLE 3 - PROTECTIVE DEVICES

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
6. Relief valves Protecting process and storage in: Hydrogen service Carbon monoxide service	 5 years 4 years	*As above.*
7. Relief valves Hydrostatic/thermal relief for pipework protection	10 years	
8. Relief valves Steam	In line with the examination of the associated equipment, subject to a maximum interval of 4 years.	
9. Relief valves Other duties	Examination intervals to be set by local operating conditions.	

TABLE 3 - PROTECTIVE DEVICES

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
10. Bursting discs Carbon dioxide	2 years	Bursting discs should be replaced in this function by pressure-relief valves (of an identical or greater flow capacity) at the earliest opportunity due to the hazards of uncontrolled release of CO_2 (solidification of contents).
11. Bursting discs Cryogenic liquid storage	5 years	Visual, external examination (refer to Appendix 3, Table 3, Notes, in line with relief valve frequency).
12. Non Return valves (when acting as a primary protective device against over-pressure)	4 years	a) Visual, external examination. b) Either: (i) Replace; or (ii) Complete 'as found' reverse flow leak test; or (iii) Disassemble and inspect all components, rectify or replace as necessary. Reassemble, complete functional test.
13. Low Temperature Protective Devices	6 years	a) Functional check to verify correct operation of device. b) Where practical, dismantle and check all moving parts for damage, wear and freedom of movement. Re-assemble and reset valve to set point.
14. Overflow devices Cryogenic liquid storage ~ non-vacuum insulated	3 years	Visual, external examination and functional test.
15. Slam shut valve Used to protect the tank from overpressure during filling.	In alignment with the tank being protected.	a) Where required, check fitted. b) Visual, external examination and functional test.

TABLE 3 - PROTECTIVE DEVICES

16. Regulators and their interstage / outlet integral protective devices. When in service as primary pressure control devices.	5 years. Due regard shall be given to the manufacturer's recommendations.	a) Replace with new or refurbished unit, or b) Locally refurbish with approved spare parts kit and functionally check. NOTE: Where a relief valve is installed downstream of a regulator, which is capable of discharging the failed regulator flow, then this becomes the protective device and the regulator need not be changed.
17. Flame arrestors	5 years. Due regard shall be given to the manufacturer's recommendations.	a) Replace with new or refurbished unit. b) Record details of replacement.
18. Vacuum interspace protection device	No more than 7 years, dependant on service conditions.	a) Visual, external examination. b) Record all details of examination.
19. Other protective devices Instrumentation / control equipment.	No requirement for regular periodic examination.	Recalibration and functional checks to be carried out during planned maintenance periods or main plant overhaul.
20. Relief device - Change over valve	In alignment with the relief valve being protected.	a) Functional check to verify correct operation of device. NOTE: Where replacement is required the new unit shall be of an appropriate specification.

TABLE 3 – NOTES - PROTECTIVE DEVICES

Protective devices
The importance of protective devices (i.e. relief valves and bursting discs) used in pressure systems and their influence on safety cannot be over emphasised.

The sizing of protective devices shall have been carefully considered during the design phase to ensure adequate relieving capacity. This information shall be made available on request to the Competent Person.

Unlike other parts of the system, the effectiveness of a relief system cannot be assessed by external examination. Therefore the scheme of examination requires some form of test to ensure the relief device(s) is set and operates correctly or is changed for a new or refurbished item of identical specification.

Sample testing, at the time of removal, may be carried out to support existing examination intervals or to determine different intervals. For example, if it is considered that relief valve examination intervals are to be varied, then testing of relief valves in the 'as found' condition becomes a major factor in assessing this. This is a key factor in appraising examination intervals in accordance with the APEA, refer to Section 4.

Protective devices should be formally examined in accordance with the Written Scheme of Examination at least at the same time and frequency as the plant to which they are fitted.

It must be stressed that all examination intervals are maxima-based on current practice and may need reduction due to other effects, for example, atmospheric conditions or unsatisfactory type-testing.

Bursting discs
In clean non-corrosive service there is no need to replace or examine bursting discs. In corrosive service conditions there may be a need to replace on a frequency, which is determined by the predicted service life.

Bursting discs normally fail to the burst condition in the event of erosion or corrosion, therefore, unless there are other operating or safety constraints, it is acceptable for them to fail and be replaced. In some installations, for example, corrosive, there may be a bursting disc fitted underneath a relief valve. In this case, the inter-space monitoring device should be checked to confirm that the bursting disc is still intact and that a safe system for work exists.

TABLE 4 - HEAT EXCHANGERS & VAPORISERS

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
1. **All heat exchangers and vaporisers** except steam, open systems	Requirement for periodic examinations to be determined by local operating conditions and the Competent Person. For heat exchangers in fatigue duty maximum period: 8 years. For fired types • Direct fired: 1 year • Non-direct fired: 5 years For steam / hot-water types (Closed systems): The first thorough and in-service examinations are required within 2 years of service, after which the Competent Person may extend the period up to a maximum of 4 years.	The following examinations will be undertaken on the part(s) containing the relevant fluids: a) Visual, external examination where accessible in-service. b) The Competent Person will determine if any of the following are required: (i) Internal examination and NDT. (ii) Strength test at a pressure defined by the Competent Person. (iii) Leak test. (iv) Direct-fired types only (e.g. LPG) – hydraulic test and check flame impingement areas. (v) Inclusion of a check that any integral relief valves are of the correct type and are in test. (vi) Inclusion of function check(s) on all controls. c) Check nameplate(s) are attached. d) Check the heat exchanger is operating within its design limits.

TABLE 4 - HEAT EXCHANGERS & VAPORISERS

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
2. Vaporisers Steam, open system	12 years	a) Visual, internal examination to check condition of steam sparge manifold, vaporiser coils and support structure b) NDT when specified by the competent person Providing the following are incorporated into an annual maintenance routine a) Check discharge vents for blockage b) Check maintenance of correct water level NOTE: It is recommended that where stainless steel coils are fitted the chloride content of the water should be checked at each annual maintenance.

TABLE 5 - PIPEWORK

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
1. Pipework Pipework in the following duties needs to be considered: ~ steam/condensate ~ subject to mechanical damage ~ subject to erosion ~ subject to corrosion ~ where a defect may give rise to danger	Requirement for periodic examinations to be determined by local operating conditions and the Competent Person.	a) Visual external examination. b) The Competent Person will determine if any of the following are required: (i) A check of the insulation for damage or water ingress. (ii) NDT. (iii) Leak and/or pressure test.
2. Pipework at elevated temperature (under creep conditions)	Requirement for periodic examinations to be determined by local operating conditions and the Competent Person subject to maximum interval of 6 years.	a) Visual external examination. b) NDT check of a sample of welds. c) NDT check of external surfaces at inside and outside of bends. d) Measurement of external diameter at hot end.
3. Reformer systems Reformer tubes	Examination intervals to be set by local operating conditions, subject to maximum interval of 6 years.	a) Visual external examination to check for straightness and lack of bowing or bulging. b) Measurement of tube external diameter at reference locations. c) Check tube surfaces for glazing. d) Check setting and freedom of movement of tube tensioning devices (where fitted).
4. Pigtail ~ Copper and copper alloy ~ Stainless steel (For high-pressure gas cylinders)	1 year	a) Visual, external examination. b) Anneal if work-hardened, or replace. c) Fit new seals where applicable.

TABLE 6 – FLEXIBLE HOSES

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
1. Hoses In gas service Inert and low pressure service	Examination periods to be determined by local operating conditions.	a) Visual examination. b) The competent person may require: • Hoses to be examined and re-certified for further use; or • Replaced on a time-expired basis.
2. Hoses In gas service Non-inert or high pressure service	Examination periods to be determined by local operating conditions. (typically this is 5 years)	a) Hoses to be examined and re-certified for further use; or b) Replaced on a time-expired basis.
3. Hoses Liquid service ~ Cryogenic ~ Liquefied	5 years	a) Visual examination. b) Check couplings for wear. c) Fit new seals, where applicable. d) Pressure test when specified by the Competent Person. e) Or, replace with new hose.
4. Hoses Hydrogen Reformer Tube inlet	1 year 6 years	Visual external examination to check for cracking, bulging, distortion or damage. Mandatory replacement.

TABLE 7 - STEAM-RAISING PLANT

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
1. Steam-raising plant Direct-fired heater	14 months. Also refer to SAFed PSG1 (45).	a) Visual, external examination. b) Visual, internal examination. c) NDT in accordance with SAFed SBG 1 (43). d) Peaking check in accordance with SAFed SBG 2 (44). e) Confirm nameplate is attached and check that equipment is working within design limits. f) Carry out function check on all controls.
2. Steam-raising plant Economisers / waste heat boilers / super heaters	The first thorough and in-service examinations are required within 2 years of service, after which the Competent Person may extend the period up to a 4 years. Also refer to SAFed PSG1 (45).	a) Visual, external examination. b) Visual, internal examination. c) NDT when specified by Competent Person. d) Confirm nameplate is attached and check that equipment is working within design limits. e) Carry out function check on all controls.
3. Blowdown vessels	In phase with associated boiler.	a) Visual external examination. b) Visual internal examination (as accessible). c) NDT when required by competent person.
4. Deaerators	4 years.	a) Visual external examination. b) Visual internal examination (as accessible). c) Mandatory internal crack detection after 5 years' service.

TABLE 8 - PIPELINES

Plant/equipment	Examination interval	Guidelines for Written Scheme of Examination
1. Pipelines All duties	First examination, 15 years after pipeline was first passed for service. Future examinations to be determined by the Competent Person.	a) Visual examination of exposed sections. b) Appropriate diagnostic checks of underground sections, including any protection mechanisms. c) Pressure test when specified by the Competent Person. d) Competent Person to determine date of the next examination. A Written Scheme of Examination is required for a pipeline under PSSR (5). The *Pipeline Safety Regulations* (2) also have to be complied with.

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