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UoN Guidance on Servicing and Maintenance of Vacuum Insulated Cryotanks

SAF-GUI-Cryotank

SAF-GUI-Cryo



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**Approved
Document**

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UoN Guidance on Service and Maintenance of Vacuum Insulated Cryotanks

1. Scope

The British Compressed Gas Association (BCGA) provides detailed guidance on the safe use of gases and associated equipment.

The BCGA Code of practice 39: In-service requirements of pressure equipment (gas storage and gas distribution systems) Revision 2: 2017 provides detailed guidance on the service and maintenance of cryogenic vessels.

This guidance highlights the key 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 should be read in conjunction with the BCGA guidance which can be downloaded from the BCGA website and the Health and Safety Department website.

2. Putting into service requirements (Section 3 BCGA CP39)

ACTION: 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.

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

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 or UKCA Marking, where applicable.
- Agreements in place with a suitable competent engineer to ensure the following are undertaken when required:
 - A Written Scheme of Examination, as required by the PSSR, shall have been produced and all initial pre-use examinations completed as required.

- 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.
- Documentation and processes to ensure the safe use of the system, and this will include:
 - Risk Assessments for the usage of the pressure system within which the safe operating limits shall have been established and communicated, as required.
 - Safe System of Work/Standard Operation Procedures.
 - Suitable and sufficient information, instruction and training for all personnel who will use the equipment.
 - Emergency procedures established, communicated and implemented.
- Suitable management of the equipment, with its hazards clearly identified, communicated, and controlled. This should include:
 - Registration of pressure equipment on an Asset Register to ensure in-service requirements are managed.
 - All equipment correctly marked and identified e.g. a nameplate.
 - Contact information and emergency contact number(s) are available.
 - Appropriate warning notices, safety signs and instructions are posted around the installation.
 - Routine inspection and maintenance requirements, over and above that required under the PSSR Written Scheme of Examination, have been identified and included in inspection and maintenance schedules. This must include the identification and availability of appropriate spare parts.
- 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.
- 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.
- 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.

3. In-service requirements (Section 4 BCGA CP39)

Examination and Maintenance requirements (Section 4 BCGA CP39)

ACTION: Arrange that work equipment is inspected and maintained at regular intervals to ensure it is safe for continued use and remains in good repair regardless of its age, condition or origin.

The PUWER 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.

PSSR also 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 as to prevent danger.

Pressure system types are defined within PSSR, and those typically applicable to the use of cryogenic tanks are:

- Systems comprising a pressure vessel its associated pipework and protective devices.
- Pipework with its protective devices to which a transportable pressure receptacle is, or is intended to be, connected.

Ageing pressure equipment assessment (APEA) (Section 4 BCGA CP39)

ACTION: Arrange as appropriate an APEA to ensure gas pressure equipment remains safe during its in-service life. [It is recommended that you speak to the supplier of the cryo-tank to ascertain when a APEA is required for a specific tank and its conditions of use.](#)

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, but what you know about its condition and how that will change 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.

Thorough examination (Section 4 BCGA CP39)

ACTION: Register relevant gas pressure systems with the university's competent person to ensure a Written Scheme of Examination is in place and that the thorough examinations are taking place in line with the WSE.

PSSR requires pressure systems to undergo a thorough examination in accordance with a Written Scheme of Examination, unless a specific exclusion applies.

Inspection requirements (Section 4 BCGA CP39)

ACTION: Ensure routine inspections are being undertaken and are recorded

ACTION: For vacuum insulated cryogenic tanks, ensure user checks on are in place as per BCGA Leaflet 11.

The purpose of an inspection is to identify whether the equipment is operating correctly, safely and within a safe environment.

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 by a Competent Person.

An inspection should always include checks to the safety-related parts that are necessary for safe operation of equipment, such as pressure relief devices.

As examples, Appendix 1 of BCGA CP39 details a typical check list that can be used for an inspection of a bulk cryogenic installation. This check list is not exhaustive, and other checks that are relevant to the type of installation/ equipment should be considered. There is also a guide to the inspection of O-ring seals.

For users of vacuum insulated cryogenic tanks, BCGA Leaflet 11 outlines some daily safety checks that users responsible for vacuum insulated cryogenic tanks are to carry out.

Maintenance requirements (Section 4 BCGA CP39)

ACTION: Arrange maintenance of assets (repairs, replacement of components, manufacturer-recommended and APEA findings) to a documented process and keep records.

Maintenance encompasses, for example, repairs or replacement of components and shall be carried out under a documented process with the records maintained.

The maintenance requirements should consider 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.

Repair and Modification (Section 5 BCGA CP39)

ACTION: Arrange for repairs and modifications to be carried out to a documented process and keep records of such.

All repairs or modifications to a system must 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.

A modification is a change to an existing specification. It may include alteration of the pressure system or changes to process operating conditions. Any proposed modification shall be formally authorised and documented. Following modification the APEA and the Written Scheme of Examination must be reviewed or revised as necessary.

Revalidation (Section 6 BCGA CP39)

ACTION: Arrange for revalidation of vacuum insulated pressure vessels where the examination of internal parts is not possible.

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 because of repair/modifications and/or deterioration. Subtle incremental changes to operating conditions can progressively move an operating regime outside design conditions.

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.

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 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.

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.

- Review of design documentation.
- Review of experience of similar pressure equipment, including consultation with the manufacturer.

Stage 2: Individual tank service condition and history review.

- Review of service history records
- 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.

4. Record Keeping (Section 9 BCGA CP39)

ACTION: Ensure an Assets Register is in place and that full and robust records are kept in relation to the actions in the previous sections.

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.
- 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.
- 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.

Asset register (Section 9 BCGA CP39)

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

- If no longer used, date removed from service (maintain on asset register for a minimum of 6 years).

The asset register may be kept within a computer system as long as a printed copy can be produced when required. The asset register may be a simple spreadsheet as long as it contains the relevant information and is kept up to date.

5. Guidelines for written schemes and replacement of protective devices (Appendix 3 BCGA CP39)

Tanks - Vacuum insulated	5 years	<ol style="list-style-type: none"> 1. Visual external examination including tank foundations. 2. Confirm tank identity and nameplate markings, check that the tank is working within declared safe operating limits. 3. Check if relief devices are in-test, if not carry out examination in accordance with Appendix 3, Table 3.
Relief valves - Protecting cryogenic liquid storage tank <ol style="list-style-type: none"> 1. Non-vacuum insulated 2. Vacuum Insulated 3. Vacuum Insulated with bursting discs 	<ol style="list-style-type: none"> 3 Years 3 Years 5 Years 	<ol style="list-style-type: none"> 1. Visual, external examination, including vent pipe and supports. 2. Check that the relief valve is of the correct size, set pressure, material and in the correct orientation. 3. Check vent pipes are unobstructed, are in a satisfactory condition and vent to a safe location. 4. As applicable, check drain holes are clear. 5. Either: <ol style="list-style-type: none"> a. Replace with new or refurbished valves; or b. 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; c. 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. <p>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</p>
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).
Bursting Discs – Cryogenic Liquid Storage	5 Years	Visual, external examination

For additional information see the full appendix 3 BCGA CP3

6. Actions Compliance Table – Checklist for Business Units

Actions Compliance Table - For the detail on each item, see relevant section above. *Y – Yes , compliant with few or no exceptions *P – Partial , some compliance but a significant proportion non-compliant *N – No , nothing or very little in place		
Item	Action	Complete *Y / P / N
Business Unit H&S Arrangements (Consult with HSC)	Responsible person to ensure arrangements for cryo tank safety are incorporated as relevant to the BU arrangements.	
Putting into service requirements (Section 3 BCGA CP39)	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.	
	Ensure the above is in place for existing pressure equipment.	
Examination and Maintenance requirements (Section 4 BCGA CP39)	Arrange that work equipment is inspected and maintained at regular intervals to ensure it is safe for continued use and remains in good repair regardless of its age, condition or origin.	
Ageing pressure equipment assessment (APEA) (Section 4 BCGA CP39)	Arrange as appropriate an APEA to ensure gas pressure equipment remains safe during its in-service life.	
Thorough examination (Section 4 BCGA CP39)	Register relevant gas pressure systems with the university's competent person to ensure a Written Scheme of Examination is in place.	
	Check that thorough examinations are taking place in line with the WSE and resulting actions are resolved.	
Inspection requirements (Section 4 BCGA CP39)	Ensure routine inspections are being undertaken and are recorded	
Inspection requirements (Section 4 BCGA CP39)	For vacuum insulated cryogenic tanks, ensure user checks on are in place as per BCGA Leaflet 11.	
Maintenance requirements (Section 4 BCGA CP39)	Arrange maintenance of assets (repairs, replacement of components, manufacturer-recommended and APEA findings) to a documented process and keep records.	
Repairs and Modification (Section 5 BCGA CP39)	Arrange for repairs and modifications to be carried out to a documented process and keep records of such.	
Revalidation (Section 6 BCGA CP39)	Arrange for revalidation of vacuum insulated pressure vessels where the examination of internal parts is not possible.	
Asset Register	Maintain an Assets Register of all cryo tanks.	
Record Keeping (Section 9 BCGA CP39)	Maintain full and robust records in relation to the above actions.	