



SAFETY AUDIT / ASSESSMENT TOOL INDUSTRIAL GAS CYLINDER FILLING

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Amendments to Doc 102/08

All	Complete revision of Doc.102/08 Appendix C2
All	New format of Safety Audit / Assessment Tool

1 Introduction

Auditing is a proactive management tool for use by an organisation or activity as a part of its management responsibilities. It is used to proactively confirm compliance, detect potential issues and facilitate future improvement

EIGA Doc. 102 *Audit Guidelines* provides an overview of audit and self-assessment processes, identifies different types of audits and lists the key points for ensuring success.

Sections 8.2 and 8.4 of Doc. 102 refers to EIGA's audit tools document series that can be used in verification of findings and evidence collection and in action plans and follow up to audits.

This publication is part of that series.

2 Scope and purpose

2.1 Scope

This publication provides a checklist focusing on a specific area of safety, health and environment, management systems and technical practices within the industrial and medical gas industry.

This checklist does not incorporate all the requirements of local or national legislation. These should be taken into consideration when planning any audit or developing audit checklists.

The tool or combination of tools used can depend upon the type of audit and the organisation, location or site characteristics.

2.2 Purpose

Each Safety Audit / Assessment tool contains a list of questions that may be used by the auditor in the format shown in 3.1. Each question has a sequential reference number, the question itself and where relevant a reference to the EIGA publication or external publication that provides guidance on that specific topic.

These question sets may then be use at different stages of the audit process, by combining them with additional information columns in a manual or automated audit system, depending on company systems.

Section 3.2 shows the format of how the question set may be used for collection of evidence and development of findings.

Section 3.3 shows the format of how the question set may be used for management of actions arising from the audit.

Forms may be adapted or combined depending on audit and action monitoring systems used by a company.

The Auditor should not ask the questions on this list in isolation but should read them in conjunction with EIGA Doc 102 and the referenced technical document.

3 Formats for Audit Checklists

3.1 Format for Audit / Assessment Tool Questions

Question reference	Question	Document Section Reference
<i>Use sequential numbering system within each section. E.g. 1.2, 1.3. Try to avoid multiple clustered questions under the same number, but describe them as separate questions.</i>		<i>In EIGA reference document or external reference document</i>

3.2 Typical Format for collection of evidence and development of findings

Question reference	Question	Document Section Reference	Yes No N/A	Description of Evidence / Comments (Ref...)	Findings (Ref...)	Recommendations for improvement (Ref Doc xxx 8.2.6)	Action Required Yes/No
<i>Use sequential numbering system within each section. E.g. 1.2, 1.3. Try to avoid multiple clustered questions under the same number, but word them as separate questions.</i>		<i>In EIGA reference document or external reference document</i>	<i>Answer is yes or no or question is not applicable</i>				

3.3 Typical format for management of actions arising from the audit

Question reference	Findings	Action(s)	By Whom	Dates	
				Target	Complete
<i>Use sequential numbering system within each section. E.g. 1.2, 1.3. Try to avoid multiple clustered questions under the same number, but word them as separate questions.</i>					

4 Industrial Gas Cylinder Filling – Question Set

- 1 General precautions
- 2 Liquid storage
- 3 Liquid pumps, vaporisers, heaters
- 4 Gasholders, balloons
- 5 Compressors
- 6 Pipes, separators, dryers
- 7 Filling manifolds and related equipment
- 8 Handling and storage of cylinders/bundles
- 9 Cylinder maintenance testing

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
1.0	General – Precautions								
1.1	Are updated layout drawings available								
1.2	Is an up-to-date flow scheme available and does it cover all pipework, pumps and vacuum systems								
1.3	Is it posted and kept legible								
1.4	Are 'No Smoking' signs displayed on oxygen storage docks, cylinder filling areas, oxygen tanks and gasholders								
1.5	Are 'Flammable Gas – No Smoking' displayed on storage docks for flammable gases								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
1.6	Are personnel wearing appropriate protective clothing/glasses etc for the safety zone in which they work								
1.7	Are signs 'No admittance for unauthorised persons; displayed at access to filling areas								
1.8	Are function tests of machinery and equipment carried out after repair and are they recorded								
1.9	Are safety devices tested at regular intervals and results recorded for: safety valves high pressure shut-off devices emergency stop buttons alarm functions etc								
1.10.1	Are exposed belts, pulley drives/couplings or similar provided with enclosing guards								
1.10.2	Are they adequate								
1.11	Are handrails installed on stairs								
1.12	Is combustible waste stored in self-closing metal bins								
1.13	Is adequate electrical protection provided for electrical tools								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
1.14	Is the personal safety equipment mandatory for visitors								
1.15	Is a pressure gauge calibration record maintained								
1.16.1	Are gauges 'For Oxygen Service' properly marked								
1.16.2	Is there a written specification for the purchase of oxygen pressure gauges and is it followed								
1.17	Is a procedure for testing pressure gauges available and followed								
1.18.1	Are all oxygen spares purchased to written cleanliness specifications								
1.18.2	Are they maintained in this condition until used								
1.19	Are floors in good condition, eg where cylinders are stored/filled								
1.20	Are ventilation openings free from obstructions								
1.21	Are stairs kept in good condition								
1.22	Are storage areas/routes of handling equipment clearly marked and kept free from obstructions								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
1.23	Are pedestrian walkways clearly marked and rules communicated to personnel								
2.0	Liquid Storage (vacuum insulated tanks)								
2.1	Is area free from combustible/ flammable material, eg oil, grease, tar								
2.2	Are liquid gas transfer procedures in force and posted								
2.3	Are precautions taken to avoid kinking of transfer hoses								
2.4	Are transfer hoses protected against the entry of foreign matter								
2.5.1	Are transfer hoses checked/ maintained regularly								
2.5.2	Are adequate records/ identification systems maintained								
2.6	Are tanks protected against mechanical damage by vehicles								
2.7	Are precautions taken to avoid towaway accidents								
2.8	Is there an emergency shower provided near oxygen tank and kept in good working condition								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
2.9	Is tank flowsheet posted, up-to-date and legible								
2.10	Are adequate warning and product identification signs posted								
2.11	Are there established procedures for inspection and overhaul of tank safety devices								
2.12	When changeover valves upstream of safety valves are provided, are they checked and maintained regularly								
2.13	Are vent pipes from safety valves kept free from obstruction such as ingress of foreign material, water etc.								
2.14	Do vent pipes lead to a safe area								
2.15	Are supports for safety valves/ vent pipes adequate								
2.16	Is the shut-off valve on tank liquid outlet tested at regular intervals								
2.17	Are liquid level indicators checked/ calibrated at regular intervals								
2.18	Is the vacuum checked at regular intervals if covered by regulations								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
2.19	Are thermal relief valves on all live sections where cold gas/liquid product can be trapped checked and maintained at regular intervals								
2.20	Is valve identification maintained in good condition and kept legible								
2.21	Is the automatic tanker pressure control system checked and maintained regularly								
2.22	Is instrument air system checked and maintained at regular intervals								
2.23	Is the manual vent valve easily accessible								
2.24	Are safety devices for avoiding over-pressure of vacuum space in good condition								
3.0	Liquid Pumps, Vaporisers, Heaters								
3.1	Are pump suction filters checked and cleaned regularly								
3.2	Are liquid oxygen centrifugal pumps free from material non-compatible with oxygen, eg aluminium alloys (see IGC Document 11/82)								
3.3	Is centrifugal pump cavitation protection maintained in good working condition								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
3.4	Is there a special maintenance procedure available for overhauling oxygen pumps in accordance with oxygen cleanliness standards								
3.5	Are manufacturer's and company regulations regarding lubrication strictly observed								
3.6	If pumps are installed in confined space, are ventilation openings free from obstructions								
3.7	Are operating instructions posted and strictly followed, particularly for pump cool-down.								
3.8	Is area around liquid oxygen pumps free from combustible/flammable material, eg oil, grease, tar etc								
3.9	Do vent pipes lead to a safe area								
3.10	Is the remote emergency stop device for liquid pumps tested regularly								
3.11	Are emergency stop buttons located both in the filling area and adjacent to the pumps								
3.12	Are all liquid lock and high pressure relief valves tested and maintained at stipulated intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
3.13	Are low temperature devices on vaporiser outlets regularly checked								
3.14	Are adequate guards around piping and vaporisers near vehicle movement areas in good condition								
3.15.1	Is a permit to work system used when carryout out maintenance on pumps								
3.15.2	Within this system are pumps totally isolated, both electrically and physically								
3.16	Is the type of lubrication oil/grease used in accordance with company recommendations								
4.0	Gasholders, Balloons								
4.1	Are safety devices regularly tested eg alarm min/max level								
4.2	Are level indicators in good working condition								
4.3	Are leak tests regularly carried out								
4.4	Is the water level of gasholders regularly checked								
4.5	In case of gasholders being external to building, are precautions taken to prevent freezing								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
4.6	Are guards installed around gasholders near vehicle movement areas in good condition								
4.7	Do vent pipes lead to a safe area								
4.8	Are maintenance instructions established and applied								
4.9.1	Are drain pot overflow pipes free from obstruction								
4.9.2	Are they also free from the entry of foreign matter								
5.0	Compressors								
5.1	Is the area free of tripping/slipping								
5.2	Is the emergency stop button tested at regular intervals								
5.3	Are operating instructions posted nearby and followed								
5.4	Are inter-cooler/after-cooler vents, drains, safety valve outlets and bursting discs piped to a safe area								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
5.5	Is there a preventive maintenance system in use for regular inspection/calibration of: pressure gauges all instrumentation alarm/trip functions temperature indicators major machine components filters and valves electric motor electrical system safety devices etc								
5.6	Is technical data provided by compressor manufacturer available								
5.7	Does the supervisor record all unusual events								
5.8	Are maximum operating pressures marked on interstage pressure gauges								
5.9	Are temperature gauges marked with alarm/trip levels								
5.10	Are alarm/trip functions provided on compressor suction and discharge lines regularly tested								
5.11	Are inter- and after-cooler vessels, including pipes connecting to compressor, internally inspected/pressure tested at regular intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
5.12	Are drain valves fitted to the bottom of each condenser and water separator operated at regular intervals								
5.13	Is the automatic stop device of water lubricated compressors in case of water failure tested at regular intervals and maintained in good working condition								
5.14	Is water used for lubrication purposes quality checked at regular intervals								
5.15	Is cooling water system maintained in good working condition								
5.16	Are types of lubricants used in accordance with company recommendations								
5.17	Are interstage valves checked at regular intervals								
5.18	Are piston clearances checked at regular intervals								
5.19	Are alarm/trip functions on oil/cooling water system checked at regular intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
5.20	If one compressor is used for oxygen/nitrogen/compressed air service, is a suitable safety device used to avoid cross connections and keep product integrity								
6.0	Pipes, Separators, Dryers								
6.1	Is protection of high pressure pipes against external sources of heat, mechanical damage and excessive vibration adequate								
6.2	Are leak tests regularly carried out								
6.3.1	Do filter materials conform with company specifications								
6.3.2	Are filters inspected and cleaned regularly								
6.4	Are non-return valves tested at regular intervals								
6.5.1	Do vent valves lead to a safe area								
6.5.2	Are they free from obstruction								
6.6	Are all pipes correctly identified								
6.7	Are operating instructions for separators and dryers posted nearby and followed								
6.8	Are separators drained at regular intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
6.9	Does purchase of drying material meet written specifications								
6.10	Are separator and dryer vessels inspected/tested in accordance with legal/company requirements at stipulated intervals								
6.11	Is moisture content downstream of dryers checked at regular intervals								
6.12	Is hot piping of dryers properly insulated								
6.13	Is the gas temperature downstream of the dryers monitored								
6.14	Is the pressure drop across the dryers checked at regular intervals								
7.0	Filling Manifolds & Related Equipment								
7.1	Is each filling manifold pressure gauge and recorder inspected/ tested at regular intervals								
7.2	Is there a cylinder segregation procedure to ensure that lower pressure cylinders are not connected to a higher pressure cylinder filling manifold								
7.3	Are automatic control systems set at correct pressure according to ambient temperature, filling rate etc								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
7.4	Are filling procedures corresponding to filling system clearly defined, posted and followed								
7.5	Are copper pigtails (if used) annealed regularly according to company standards								
7.6	Is annealing date marked/recorded								
7.7	Are copper pigtails free of twisting or deformation								
7.8	Are high pressure hoses in good working condition and inspected, tested/replaced at stipulated intervals								
7.9	Are provisions strictly applied to avoid pigtails and hoses from flapping in case of hose or pigtail rupture								
7.10	Are provisions made to secure pigtails, hoses and fittings not in use								
7.11	Are the couplings/fittings to cylinder/bundle valves in safe working condition								
7.12	Are the filling manifolds allocated to one gas only and identified by product name								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
7.13	Is the piping of filling manifolds labelled with flow direction for product, vacuum and venting								
7.14	Are vent pipes free from obstructions and piped to a safe area								
7.15	Is the over-pressure filling rack switch regularly adjusted and tested to follow ambient temperature								
7.16	Are lubricants used in vacuum pumps for oxygen approved for oxygen service								
7.17	Is vacuum pump protection against over-pressure by maloperation maintained in safe operating condition								
7.18	Are precautions taken to avoid towaway accidents in bundle/ trailer filling stations								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
7.19	Are instructions given/followed for inspection of cylinders/bundles before filling as: colour code test date physical damage of valves condition of neck ring labels odour test damage to cylinder shell stranger cylinders								
7.20	Are instructions posted/followed on segregation of rejected cylinders								
7.21	When venting cylinders in an enclosed room, are the residual gases vented to a safe area								
7.22	Is data available for proper control of filling of cylinders, ie pressure, temperature, compressibility, mixture etc								
7.23	Are all cylinders checked during filling for temperature differential to ensure admission of product to each cylinder								
7.24	Is a leak test performed on valve packing while there is full pressure on pigtail/hose								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
7.25	Is a leak test done at valve outlet and cylinder to valve connection at final pressure								
7.26	Are pressure checks on filled cylinders carried out at regular intervals to verify correct filling pressure at reference temperature (eg 15°C)								
7.27	Are oxygen cylinders that may have been used offshore hammer-checked for corrosion before filling								
7.28	Are proper procedures available for inspection/filling of all cylinders/bundles that have been used offshore								
7.29	Is responsibility for product integrity clearly defined								
7.30	Are instructions given/followed for method and frequency of tests per product filled								
7.31	Are results recorded								
7.32	Do vent pipes of analysing equipment lead to a safe area								
7.33	Is calibration of instruments made at regular intervals								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
7.34	Are chemicals stored according to company/legal requirements								
7.35	<u>Are O-Rings checked regularly and replaced as needed (especially important for oxygen filling!)</u>								
8.0	Handling & Storage of Cylinders/ Bundles								
8.1	Are full and empty cylinder storage areas segregated								
8.2	Are all storage areas identified for the various gases and are they segregated from each other								
8.3	Are cylinders kept away from sources of heat								
8.4	Are storage areas kept clean and tidy								
8.5	Are walkways kept free from cylinders								
8.6	Are provisions made to prevent loose cylinders from falling								
8.7	Are transport devices (forklift trucks, handlifts etc) checked and maintained regularly according to company/legal regulations								
8.8.1	Are battery charging stations located in a safe and well-ventilated area								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
8.8.2	Is the area clearly marked								
9.0	Cylinder Maintenance/Testing								
9.1	Are instructions posted and legible for: residual gas handling eg including highly flammable/toxic gases (see IGC Doc 30/84) check procedures before doing maintenance on cylinder valves inspection of cylinders external/ internal frequency of periodic test procedures per type of gas/ cylinder pressure test procedures colour codes labelling valves approved per type of gas scrapping of cylinders removal of inoperable cylinder valves etc								
9.2	Is adequate inspection of new valves and spare parts carried out before issue for use								
9.3	Are signs posted 'face shields or goggles required' near grinding wheels								
9.4.1	Are valving machines regularly inspected and checked								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
9.4.2	Are torque loadings specified for use with valving machines, eg for different cylinder materials								
9.4.3	Is there a procedure for the maintenance and fitting of cylinder valves, eg sealing medium								
9.5	Is water source properly controlled to prevent entry of oil or foreign matter into cylinders being tested								
9.6	Are pressure gauges on hydrostatic testing equipment calibrated at stipulated intervals and records kept								
9.7	Are guards on hydrostatic test equipment in good condition and in use								
9.8	Are stamping tools in good condition								
9.9	If inert gas for drying of cylinders is used, is ventilation sufficient								
9.10	Are paint removers, paint materials, paint thinners and chlorinated solvents stored and used according to company/legal requirements								
9.11	Is colour spraying equipment (cabinet) in condition according to company/legal requirements								

	Question	Yes	No	N/A	Comment	Agreed Action	By Whom	Dates	
								Target	Compl
9.12	Is compressed air supply system maintained regularly								
9.13	Is paint removing/sandblasting equipment in good condition								
9.14	Does the sandblasting equipment meet the requirements of national legislation								
9.15	Is an approved internal cylinder inspection lamp/lighting system in use								