



PRINCIPLES FOR THE SAFE HANDLING AND DISTRIBUTION OF HIGHLY TOXIC GASES AND MIXTURES

AIGA 026/21

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Asia Industrial Gases Association

N0 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526

Tel: +65 67055642 Fax: +65 68633379

Internet: <http://www.asiaiga.org> | LinkedIn Profile: <https://www.linkedin.com/company/asiaigaorg>



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Note: The technical changes from the previous edition 026/13 are underlined.

1 Introduction

1.1 Scope and purpose

The purpose of this document is to set out basic principles for the safe handling and distribution of highly toxic gases and mixtures. These principles are in addition to those, which are normally applied to the handling of gases and containers.

It is recommended that these principles should apply to all highly toxic gases. Appendix A gives examples of such gases.

In addition, it is recommended, as far as it is reasonably practicable, to extend the application of the principles set out in this document to all toxic gases.

Whilst this document is primarily aimed at gas suppliers and distributors, it is recommended that gas users also observe the principles.

1.2 Definitions

Highly toxic gases: For this document, highly toxic gases are gases classified as Acute Toxic Cat.1 according to EC Regulation 1272/2008 on Classification, labelling and packaging (CLP). See Appendix A.

Toxic gases: For this document, toxic gases are gases classified as Acute Toxic Cat.2 and Cat.3 according to EC Regulation 1272/2008 on Classification, labelling and packaging (CLP). See Appendix A.

Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

Should

Indicates that a procedure is recommended.

May

Indicates that the procedure is optional.

Will

Is used only to indicate the future, not a degree of requirement.

Can

Indicates a possibility or ability.

2 Principles

2.1 Principle 1 – Training

All personnel handling highly toxic gases shall be trained. It is important to ensure that all personnel are trained to a level which is commensurate with their involvement with highly toxic gases. The minimum requirements is that all personnel (including vehicle drivers) handling highly toxic gases

- shall be able to recognise the gases they are handling,
- be aware of the appropriate properties and hazards and the action to take in the event of an emergency.

Such personnel should be provided with appropriate safety equipment and training in its use.

Those manufacturing, distributing and using toxic gases should be trained in the safe handling and use of highly toxic and/or gases. The training should include:

- Procedures for the safe use of toxic gases such as container connection and disconnection
- Procedures for the recovery or disposal of highly toxic and /or gases in the event of an emergency and liaison with the relevant emergency services.

- Driver Training will meet the International Carriage of Dangerous Goods by Road and appropriate local or national requirements.

For more information, see the following EIGA and AIGA documents:

EIGA Doc.No	AIGA Doc No	Title of Document
23	AIGA 009	Safety training of employees
30	AIGA 083	Disposal of gases
39	AIGA 047	The Safe preparation of gas mixtures
69	AIGA 039	Transport emergency instructions
78	AIGA 070	Leak detection fluids - gas cylinder packages
80	AIGA 004	Handling gas container emergencies
81	-	Road vehicle emergency and recovery
103	-	Transporting gas cylinders or cryogenic receptacles in "enclosed vehicles"
129	AIGA 025	Pressure receptacles with blocked or inoperable valves
136	AIGA 066	Selection of personal protective equipment
161	-	Gas compatibility with Aluminium alloy cylinders
188	-	Safe transfer of toxic liquefied gases
199	AIGA 018	Safe handling of electronic specialty gases
913	AIGA 043	Transport security guidelines

2.2 Principle 2 – Supplier responsibilities

Suppliers shall take reasonable steps, typically as part of a responsible care programme, to ensure that highly toxic gases are only supplied to competent users. Users must be aware of the hazardous properties of the gases they are handling and should have trained personnel and adequate facilities and procedures for safe handling and dealing with emergency situations. Users should be provided with appropriate gas data and safety information and it is recommended that they are asked to confirm that they have the necessary facilities and procedures in place before they are supplied with highly toxic gases.

2.3 Principle 3 – User responsibilities

The users of toxic gases shall do a risk assessment of the conditions under which these gases are used in the actual working environment. They shall take into account the information contained in the safety data sheets (SDS) received from their suppliers. In particular, they shall verify that their conditions of use are covered by the conditions of use described in the SDS and in the attached exposure scenarios if any.

The user shall have an emergency plan in place and consider the maximum quantity of highly toxic gas stored and used on-site. Users should return unused toxic gases to the supplier or dispose of the toxic gases as hazardous waste when the toxic gases are no longer required.

For more information on the handling of specific toxic gases, see the following EIGA and AIGA Documents:

EIGA Doc.	AIGA Doc.	Title of Document
140	053	Code of Practice - Compressed fluorine and mixtures with inert gases
162	051	Code of Practice – Phosphine
163	050	Code of Practice – Arsine
204	096	Code of Practice – Hydrogen Selenide

2.4 Principle 4 – Storage and use considerations

All toxic gas containers/cylinders should be visually inspected to ensure:

- An absence of excessive wear, rust or damage
- Valve protection and dust caps are intact and in place
- Cylinder labels are legible and list the contents, potential hazards, and precautions
- The cylinder is within test, i.e. the test date has not expired prior to filling

And

- Should be tested for the absence of a gas leak, by the customer, immediately following delivery.

Cylinders that do not meet incoming inspection requirements should be quarantined for return to the supplier and emergency plans activated if there is a possibility of danger.

All areas where highly toxic gases are filled into containers, used or stored shall be well ventilated. It is important to ensure that the ventilation is adequate. Ventilation requirements will be determined by the operation, for example:

- Storage of highly toxic gas containers in the open air or where this is not possible, with forced ventilation of at least 10 air changes per hour.
- Filling and use of highly toxic gas receptacles normally requires additional localised extraction, such as that provided by a fume cubicle, gas cabinet or ventilation hood.
- The other hazards of the toxic gases shall also be considered when determining the separation distances in the storage areas. See dedicated COPs for silane, arsine, phosphine, etc. for more guidance

The specification and design of ventilation systems shall be undertaken by competent personnel who take into account the toxicity and physical / chemical properties of the gas and the potential risks and possible magnitude of any gas leakage. Operators handling highly toxic gases should wear portable gas detectors when no fixed gas detector is installed. In enclosed storage areas there should be gas detectors with automatic alarm systems to detect any leaks. When completing maintenance work in the storage areas a permit to work system shall be used.

For more information, see the following EIGA document:

Doc. N°	Title of Document
189	The calculation of harm and no-harm distances for the storage and use of toxic gases in transportable containers.

2.5 Principle 5 – Valve protection

Highly toxic gas containers shall be checked to ensure that they are free of leaks, shall have their valve outlets fitted with a gas tight cap nut or plug and shall have their valves protected against mechanical damage. The fitment of a gas tight cap nut or plug to the gas container valve outlet significantly reduces the risk of leakage. Such a device should be fitted at all times unless the gas container is in use. Any gasket materials used must be compatible with the gas and suitable for the service pressure.

It is recommended that for additional safety, the nut or plug should be provided with a bleed hole (or other suitable arrangement) that allows gas discharge (of gas accumulated in the valve outlet) before complete removal of the cap nut or plug. The provision of bleed holes etc. must not affect the ability of the cap nut or plug to provide a leak-free seal on the valve outlet when correctly fitted and tightened.

It is also recommended that such devices are made “captive” by securing to the container valve with a chain. This ensures that the device is not lost whilst the container is in use and is immediately available for refitting when the container is disconnected from the equipment after use.

Highly toxic gas container valves should be protected against mechanical damage at all times. When gas containers are in use, they should be properly secured to prevent them falling. A valve protection device such as a valve cover or guard should be fitted at all other times. (Note: where this is not practicable, e.g. for lecture bottles, an adequate ventilated packaging for the gas container must be provided).

Note: The installation of a flow limiting device in the valve outlet may be considered as a means of providing additional safety, however such devices are unsuitable for certain types of gases and applications e.g. liquefied corrosive gases and/or requiring high flow.

2.6 Principle 6 – Security of highly toxic gases

Highly toxic gases shall be stored securely in locked cages, compounds or stores. In addition to ensuring ventilation requirements are adequate for the storage of highly toxic gases, it is important that access to the store is restricted to authorised and competent personnel only. This will necessitate the provision of lockable storage areas to minimise the risk of unauthorised persons gaining access.

For more information, see the following EIGA /AIGA documents:

EIGA Doc.	AIGA Doc	Title of Document
922 (Note 1)	003 (Note 1)	Site Security Guidelines

Note 1: for EIGA and AIGA members only

2.7 Principle 7 – Transportation

Toxic gases shall only be transported on well ventilated vehicles. Good ventilation at all times is of paramount importance when handling toxic gas containers. Such containers shall only be transported on suitable vehicles where the load space is well ventilated and separated from the driver's compartment by a gas tight bulkhead. Open vehicles are recommended, however, where closed vehicles must be used, the load space must be provided with adequate ventilation and there must be a procedure for entering the load space (e.g. the use of additional ventilation before the load space is entered).

It is recommended that the following notice is displayed on the doors into the load space "WARNING NO VENTILATION OPEN WITH CAUTION"

Toxic gases must never be transported in closed vans, private cars, etc. where the vehicle load space communicates with the driver's compartment. The security of the containers must be considered and maintained during transport.

For more information, see the ADR and the following EIGA /AIGA documents:

EIGA Doc.	AIGA Doc.	Title of Document
913 (Note 1)	043 (Note 1)	Transport Security Guidelines

Note 1: for EIGA and AIGA members only

2.8 Principle 8 – Inventory requirements

An inventory of all highly toxic gases shall be kept. Any losses in storage or transport shall be immediately identified and investigated. It is important to closely monitor the storage and movement of highly toxic gases to ensure that they do not get into the wrong hands (e.g. through theft, mistaken delivery, falling off a vehicle in transit, etc.)

The system for controlling the storage and movement of highly toxic gases shall be audited periodically to ensure its correct operation.

2.9 Principle 9 – Safety management (Audit, inspection, risk assessment)

Perform periodic audits to determine compliance with applicable regulations, codes of practice and work instructions.

Such audits shall include:

- Ventilation testing - to ensure that gas cabinets, fume extraction cabinets and storage areas meet the minimum requirements for safe operation.
- Gas detector testing – to ensure detectors and alarms work in line with vendors specifications.
- The inspection of security systems, such as access control, locked storage areas, lighting and other related requirements, to ensure that the area is protected from unauthorized entry.
- Records of the inspections.

For more information, see the following EIGA/AIGA document:

EIGA Doc.N°	AIGA	Title of Document
102	AIGA 014	Safety audit guidelines

**Appendix A - List of toxic gases
according to their CLP Classification for acute toxicity**

Acute Toxicity Cat.1 (LC50_{rat.1h} < 200 ppm)		Acute Toxicity Cat.2 (LC50_{rat.1h} < 1000 ppm)		Acute Toxicity Cat.3 (LC50_{rat.1h} < 5000 ppm)	
Name	LC50/rat.1h	Name	LC50/rat.1h	Name	LC50/rat.1h
Hydrogen telluride	2	Chlorine	293	Hexafluoro-1,3-Butadiene	1300
Hydrogen selenide	2	Chlorine trifluoride	299	Methyl mercaptan	1350
Phosgene	5	Dichlorosilane	314	Carbonyl sulphide	1700
Arsenic pentafluoride	20	Phosphorus trifluoride	320	Chlorotrifluoroethylene (R1113)	2000
Arsine	20	Cyanogen	350	Sulphur dioxide	2520
Phosphine	20	Carbonyl fluoride	360	Boron trichloride	2541
Stibine	20	Boron trifluoride	387	Hexafluoroisobutene	2650
Nitrosyl chloride	35	Silicon tetrafluoride	450	Hydrogen chloride	2810
Sulphur tetrafluoride	40	Hexafluoroacetone	470	Hydrogen bromide	2860
Selenium hexafluoride	50	Germane	620	Hydrogen iodide	2860
Cyanogen chloride	80	Hydrogen sulphide	712	Ethylene oxide	2900
Diborane	80	Bromomethane	850	Sulphuryl difluoride	3020
Nitric oxide	115	Hydrogen fluoride	966	Carbon monoxide	3760
Nitrogen dioxide	115			Ammonia	4000
Chlorine pentafluoride	122				
Tungsten hexafluoride	160				
Fluorine	185				
Phosphorus pentafluoride	190				