



# **PRINCIPLES FOR THE SAFE HANDLING AND DISTRIBUTION OF TOXIC GASES AND MIXTURES**

**Doc 130/24**

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***EUROPEAN INDUSTRIAL GASES ASSOCIATION AISBL***

AVENUE DE L'ASTRONOMIE 30 • B-1210 BRUSSELS

Tel: +32 2 217 70 98

E-mail: [info@eiga.eu](mailto:info@eiga.eu) • Internet: [www.eiga.eu](http://www.eiga.eu)





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Prepared by WG-4 Special Gases  
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### Table of Contents

1	Introduction .....	1
2	Scope and purpose .....	1
2.1	Purpose .....	1
2.2	Scope .....	1
3	Definitions .....	1
3.1	Publications terminology .....	1
3.2	Technical definitions .....	2
4	Principles .....	2
4.1	Principle 1 – Training .....	2
4.2	Principle 2 – Supplier responsibilities .....	2
4.3	Principle 3 – User responsibilities .....	3
4.4	Principle 4 – Storage and use considerations .....	3
4.5	Principle 5 – Valve protection .....	4
4.6	Principle 6 – Security toxic gases .....	4
4.7	Principle 7 – Road transportation .....	5
4.8	Principle 8 – Inventory requirements .....	5
4.9	Principle 9 - Safety management (Audit, inspection, risk assessment) .....	6
5	References .....	6
	Appendix A - Informative list of toxic gases according to CLP Classification for acute toxicity .....	8

### Amendments to 130/17

Section	Change
	The scope of this document has been extended to include the toxic gases as the principles for highly toxic gases also apply to toxic ones.
4.7	Section was totally rewritten to align on the requirements of the ADR related to the transport of toxic gases.

NOTE Technical changes from the previous edition are marked with a line in the left margin

## 1 Introduction

The safe handling of toxic gases has always been a concern for EIGA members. The first edition of this document was published as an EIGA Technical Note in 1990. Over the years the content of the document has been extended to cover new aspects of the safe handling of toxic gases such as “security” and “user responsibility”. Also the references to EIGA publications have been extended to include new publications relevant to the “principles” outlined in the document.

All the quoted EIGA publications are downloadable at <https://www.eiga.eu>

## 2 Scope and purpose

### 2.1 Purpose

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

### 2.2 Scope

It is recommended that these principles should apply to all toxic gases Acute Toxic Category 1, Category 2 and Category 3. Appendix A gives examples of such gases. Refer to Doc 169, *Classification, and Labelling Guide in accordance with EC Regulation 1272/2008 (CLP Regulation)* for classification [1].

In addition, it is recommended, as far as it is reasonably practicable, to extend the application of the principles set out in this document also to toxic gases Acute Toxic Category 4.

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

## 3 Definitions

### 3.1 Publications terminology

#### 3.1.1 Shall

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

#### 3.1.2 Should

Indicates that a procedure is recommended.

#### 3.1.3 May

Indicates that the procedure is optional.

#### 3.1.4 Will

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

#### 3.1.5 Can

Indicates a possibility or ability.

### 3.2 Technical definitions

#### 3.2.1 Toxic gases

For this document, toxic gases are gases classified as Acute Toxic Category 1, Category 2 and Category 3 according to EC Regulation 1272/2008 on Classification, labelling and packaging (CLP) [1]. See Appendix A.

## 4 Principles

### 4.1 Principle 1 – Training

All personnel handling toxic gases shall be trained and competent. It is important to ensure that all personnel are trained to a level which is commensurate with their involvement with toxic gases. The minimum requirements is that all personnel (including vehicle drivers) handling 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 shall be provided with appropriate safety equipment and training in its use.

The gas supplier should support the customer and on request train customer staff in the safe handling and use of toxic 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 toxic gases in the event of an emergency and liaison with the relevant emergency services.
- Driver training referencing the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) and appropriate national regulations.

For more information, see the following EIGA documents:

Doc. N°	Title of Document	
23	Safety training of employees	[2]
30	Disposal of gases	[3]
39	The Safe Preparation of gas Mixtures	[4]
78	Leak detection fluids - gas cylinder packages	[5]
80	Handling gas container emergencies	[6]
81	Road vehicle emergency and recovery	[7]
129	Pressure receptacles with blocked or inoperable valves	[8]
136	Selection of personal protective equipment	[9]
161	Gas compatibility with Aluminium alloy cylinders	[10]
188	Safe transfer of toxic liquefied gases	[11]
199	Safe handling of electronic specialty gases	[12]
913 *	Transport Security Guidance for EIGA Members	[13]

\*: For EIGA members only

### 4.2 Principle 2 – Supplier responsibilities

Suppliers shall take reasonable steps, typically as part of their social responsibility programme, to ensure that toxic gases are only supplied to competent users. Users shall 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 toxic gases. Whenever possible gas suppliers should support users in the development of their procedures.

For more information, see the following EIGA documents:

Doc. N°	Title of Document	
920 *	Guidance for Qualifying Customers Purchasing Compressed Gases	[14]
919 *	Guidelines for the Preparation of Safety Data Sheets	[15]

\*: For EIGA members only

### 4.3 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 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 Documents:

Doc. N°	Title of Document	
140	Code of Practice - Compressed fluorine and mixtures with inert gases	[16]
162	Code of Practice - Phosphine	[17]
163	Code of Practice - Arsine	[18]
204	Code of Practice – Hydrogen Selenide	[19]

### 4.4 Principle 4 – Storage and use considerations

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

- An absence of excessive wear, rust or damage
- Valve protection and safety 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 user, 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 toxic gases are filled into receptacles, 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 toxic gas receptacles in the open air or where this is not possible, with forced ventilation - refer to Doc 189 for additional guidance [20].

- Filling and use of toxic gas receptacles normally requires additional localised extraction, such as that provided by a fume cubicle, gas cabinet or ventilation hood. refer to Doc 189 for additional guidance [20].
- 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. (see list under principle 3) 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 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.	[20]

#### 4.5 Principle 5 – Valve protection

Toxic gas receptacles 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 or plug to the gas receptacle valve outlet significantly reduces the risk of leakage. According to Packing Instruction P200 of ADR, such a device shall be fitted at all times for gases with an LC<sub>50</sub> below 200 ppm, equivalent to Acute Toxic Category 1 unless the gas receptacle is in use. Any gasket materials used shall be compatible with the gas and suitable for the service pressure.

It is a recognized industry practice 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. shall 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 receptacle valve with a chain. This ensures that the device is not lost whilst the receptacle is in use and is immediately available for refitting when the receptacle is disconnected from the equipment after use.

Toxic gas receptacle valves shall be protected against mechanical damage at all times. When gas receptacles are in use, they shall 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 The fitment of a flow limiting device in the valve outlet may be considered as a means of providing additional safety and may be imposed by national regulations in some countries, however such devices are unsuitable for certain applications e.g. liquefied corrosive gases and/or requiring high flow.

#### 4.6 Principle 6 – Security toxic gases

Access to the toxic gases shall be 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 documents:

Doc. N°	Title of Document	
922 *	Site Security	[21]

\*: For EIGA members only

#### 4.7 Principle 7 – Road transportation

Transport of toxic gases is regulated by ADR in Europe.

Packages shall preferably be loaded in open or ventilated vehicles or open or ventilated containers. If this is not feasible and packages are carried in other closed vehicles or containers, the cargo doors of the vehicles or containers shall be marked with the following in letters not less than 25 mm high:

#### **"WARNING NO VENTILATION, OPEN WITH CAUTION"**

This shall be in a language considered appropriate by the consignor.

If packages are transported in vehicles where the load space is not ventilated, the driver's compartment shall be separated by a gas tight bulkhead. There shall be a procedure for entering the load space (e.g. the use of additional ventilation before the load space is entered).

The security of the receptacles shall be considered and maintained during transport.

Other specific transport precautions:

- Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.
- Ensure that containers are firmly secured.
- Ensure valve is closed and not leaking.
- Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
- Ensure valve protection device (where provided) is correctly fitted.
- Emergency escape mask shall be carried on board for each member of the vehicle crew

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

Doc. N°	Title of Document	
913 *	Transport Security Guidance for EIGA Members	[13]

\*: For EIGA members only

#### 4.8 Principle 8 – Inventory requirements

An inventory of all toxic gases shall be kept in order to satisfy the requirements of the national legislation implementing the Directive Seveso III [22]. Any losses in storage or transport shall be immediately identified and investigated. It is important to closely monitor the storage and movement of 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 toxic gases shall be audited periodically to ensure its correct operation.

For more information, see the following EIGA document:

Doc. N°	Title of Document	
60	Seveso Documents – Guidance on Applicability, Assessment and Legal Documents for Demonstrating Compliance of Industrial Gases Facilities with Seveso Directive (s)	[23]



#### 4.9 Principle 9 - Safety management (Audit, inspection, risk assessment)

Periodic audits shall be performed 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 document:

Doc. N°	Title of Document	
102	Safety audit guidelines	[24]

#### 5 References

- 1 Doc 169, *Classification, and Labelling Guide in accordance with EC Regulation 1272/2008 (CLP Regulation)*, [eiga.eu](http://eiga.eu)
- 2 Doc 23, *Safety Training of Employees*, [eiga.eu](http://eiga.eu)
- 3 Doc 30, *Disposal of Gases*, [eiga.eu](http://eiga.eu)
- 4 Doc 39, *The Safe Preparation of Gas Mixtures*, [eiga.eu](http://eiga.eu)
- 5 Doc 78, *Leak Detection Fluids - Gas Cylinder Packages*, [eiga.eu](http://eiga.eu)
- 6 Doc 80, *Handling Gas Container Emergencies*, [eiga.eu](http://eiga.eu)
- 7 Doc 81, *Road Vehicle Emergency and Recovery*, [eiga.eu](http://eiga.eu)
- 8 Doc 129, *Pressure Receptacles with Blocked or Inoperable Valves*, [eiga.eu](http://eiga.eu)
- 9 Doc 136, *Selection of Personal Protective Equipment*, [eiga.eu](http://eiga.eu)
- 10 Doc 161, *Gas Compatibility with Aluminium Alloy Cylinders*, [eiga.eu](http://eiga.eu)
- 11 Doc 188, *Safe Transfer of Toxic Liquefied Gases*, [eiga.eu](http://eiga.eu)
- 12 Doc 199, *Safe Handling of Electronic Specialty Gases*, [eiga.eu](http://eiga.eu)
- 13 Doc 913, *Transport Security Guidance for EIGA Members*, [eiga.eu](http://eiga.eu)
- 14 Doc 920, *Guidance for Qualifying Customers Purchasing Compressed Gases*, [eiga.eu](http://eiga.eu)
- 15 Doc 919, *Guidelines for the Preparation of Safety Data Sheets*, [eiga.eu](http://eiga.eu)
- 16 Doc 140, *Code of Practice - Compressed Fluorine and Mixtures with Inert Gases*, [eiga.eu](http://eiga.eu)
- 17 Doc 162, *Code of Practice - Phosphine*, [eiga.eu](http://eiga.eu)
- 18 Doc 163, *Code of Practice - Arsine*, [eiga.eu](http://eiga.eu)
- 19 Doc 204, *Code of Practice - Hydrogen Selenide*, [eiga.eu](http://eiga.eu)
- 20 Doc 189, *The Calculation of Harm and No-Harm Distances for the Storage and Use of Toxic Gases in Transportable Containers*, [eiga.eu](http://eiga.eu)
- 21 Doc 922, *Site Security*, [eiga.eu](http://eiga.eu)

- 22 *Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012, on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC (so called "Seveso III").*  
<http://eur-lex.europa.eu>
- 23 *Doc 60, Seveso Documents – Guidance on Applicability, Assessment and Legal Documents for Demonstrating Compliance of Industrial Gases Facilities with Seveso Directive(s),* [eiga.eu](http://eiga.eu)
- 24 *Doc 102, Safety Audit Guidelines,* [eiga.eu](http://eiga.eu)

**Appendix A - Informative list of toxic gases  
according to CLP Classification for acute toxicity**

EIGA SDS	Usual Name	Chemical formula	CAS Registry Number
002	Ammonia	NH <sub>3</sub>	7664-41-7
005	Arsine	AsH <sub>3</sub>	7784-42-1
006	Boron trichloride	BCl <sub>3</sub>	10294-34-5
007	Boron trifluoride	BF <sub>3</sub>	7637-07-2
019	Carbon monoxide	CO	630-08-0
020	Carbonyl fluoride	COF <sub>2</sub>	353-50-4
021	Carbonyl sulphide	COS	463-58-1
022	Chlorine	Cl <sub>2</sub>	7782-50-5
024	Chlorine trifluoride	ClF <sub>3</sub>	7790-91-2
033	Chlorotrifluoroethylene (R1113)	C <sub>2</sub> ClF <sub>3</sub>	79-38-9
040	Diborane	B <sub>2</sub> H <sub>6</sub>	19287-45-7
043	Dichlorosilane	SiH <sub>2</sub> Cl <sub>2</sub>	4109-96-0
056	Ethylene oxide	C <sub>2</sub> H <sub>4</sub> O	75-21-8
057	Fluorine	F <sub>2</sub>	7782-41-4
060	Germane	GeH <sub>4</sub>	7782-65-2
138	Germanium tetrafluoride	GeF <sub>4</sub>	7783-58-6
063	Hexafluoroacetone	C <sub>3</sub> F <sub>6</sub> O	684-16-2
131	Hexafluoro-1,3-Butadiene	C <sub>4</sub> F <sub>6</sub>	685-63-2
068	Hydrogen bromide	HBr	10035-10-6
069	Hydrogen chloride	HCl	7647-01-0
070	Hydrogen fluoride	HF	7664-39-3
071	Hydrogen iodide	HI	10034-85-2
072	Hydrogen selenide	H <sub>2</sub> Se	7783-07-5
073	Hydrogen sulphide	H <sub>2</sub> S	7783-06-4
074	Hydrogen telluride	H <sub>2</sub> Te	7783-09-7
083	Methyl mercaptan	CH <sub>4</sub> S	74-93-1
088	Nitric oxide	NO	10102-43-9
090	Nitrogen dioxide (Dinitrogen tetroxide)	NO <sub>2</sub> (N <sub>2</sub> O <sub>4</sub> )	10102-44-0
099	Phosgene	COCl <sub>2</sub>	75-44-5
100	Phosphine	PH <sub>3</sub>	7803-51-2
102	Phosphorus trifluoride	PF <sub>3</sub>	7783-55-3
106	Selenium hexafluoride	SeF <sub>6</sub>	7783-79-1
143	Silicon tetrachloride	SiCl <sub>4</sub>	10026-04-7
108	Silicon tetrafluoride	SiF <sub>4</sub>	7783-61-1
111	Sulphur tetrafluoride	SF <sub>4</sub>	7783-60-0
113	Sulphur dioxide	SO <sub>2</sub>	7446-09-5
139	Trimethylboron	B(CH <sub>3</sub> ) <sub>3</sub>	593-90-8
123	Tungsten hexafluoride	WF <sub>6</sub>	7783-82-6