
Gas cylinders — Gases and gas mixtures — Determination of corrosiveness for the selection of cylinder valve outlet

Bouteilles à gaz — Gaz et mélanges de gaz — Détermination de la corrosivité pour le choix des raccords de sortie de robinets

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 2, *Cylinder fittings*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 23, *Transportable gas cylinders*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 13338:2017), which has been technically revised. The main changes are as follows:

- the corrosiveness of gases and gases mixtures has been clarified;
- the definition of FTSC codes for corrosiveness gases and gas mixtures has been clarified in [Clause 4](#);
- minor editorial changes have been made in [Table 1](#).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 5145 specifies the dimensions of different valve outlets for different compatible gas groups. These compatible gas groups are determined according to practical criteria defined in ISO 14456.

These criteria are based on certain physical, chemical, toxic and corrosive properties of the gases. In particular, the gas corrosiveness is considered in this document.

The aim of this document is to assign a classification category for each gas that takes into account the tissue corrosiveness of the gas for skin, eyes and the respiratory tract as well as the potential for a corrosiveness related acid/base chemical reaction.

For gas mixtures containing corrosive components, a calculation method based on the additivity method of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS)^[3] is proposed.

However, for gas mixtures containing corrosive gas components, some valve outlets standards require the use of the corrosive category regardless of the corrosive gas concentration.

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Gas cylinders — Gases and gas mixtures — Determination of corrosiveness for the selection of cylinder valve outlet

1 Scope

This document specifies the following, in order to determine the corrosiveness of gases and gas mixtures so that a suitable outlet connection can be assigned to each of them:

- for pure gases and some liquids, a complete list indicating their corrosiveness;
- for gas mixtures, a calculation method, in the absence of experimental data, relating to the corrosiveness of each of their components.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

tissue corrosiveness

<gases or gas mixtures> ability of a gas to damage or destroy living tissues (eyes, skin and mucous membranes)

Note 1 to entry: It corresponds to GHS hazard class “Skin corrosion/irritation” Cat. 1, 1A, 1B or 1C, or to GHS hazard class “Serious eye damage/eye irritation”, Cat. 1.

3.2

irritant

property of a gas which can cause a temporary reaction to the skin, eyes and mucous membranes

Note 1 to entry: It corresponds to GHS hazard class “Skin corrosion/irritation”, Cat. 2, or to GHS hazard class “Serious eye damage/eye irritation”, Cat. 2.

4 Classification

Gas cylinder connections should take into account all aspects of corrosiveness as reflected in the subdivisions of the C code of the FTSC code (which includes tissue corrosiveness and acid/base chemical reactivity). The subdivisions of the FTSC code are given below and repeated in the footer of [Table 1](#):

- 0: non-corrosive;
- 1: non-halogen acid forming;
- 2: basic;
- 3: halogen acid forming.

In addition, gases and gas mixtures are classified into the following tissue corrosiveness categories:

- C: corrosive (irreversible damage);
- i: irritant (reversible damage);
- nc: non-corrosive, non-irritant;

which are indicated for information in the column “Tissue corrosiveness category” of [Table 1](#).

5 Categories of corrosiveness for pure gases

The corrosiveness of single gases is indicated in [Table 1](#). Column 4 lists the subdivision of the G code of the FTSC code. Column 5 lists the tissue corrosiveness category.

Table 1 — Corrosiveness categories of pure gases

Gas/liquid name	Chemical formula	Synonym	FTSC C code	Tissue corrosiveness category ^c
Ammonia ^a	NH ₃	R717	2	C
Antimony pentafluoride ^a	SbF ₅		3	C
Arsine	AsH ₃		0	nc
Bis-trifluoromethylperoxide	(CF ₃) ₂ O ₂		0	nc
Boron trichloride	BCl ₃	Boron chloride	3	C
Boron trifluoride	BF ₃	Boron fluoride	3	C
Bromine pentafluoride ^a	BrF ₅		3	C
Bromine trifluoride ^a	BrF ₃		3	C
Bromoacetone ^a	CH ₃ COCH ₂ Br		3	C
1,3-Butadiene, stabilized	CH ₂ = CH-CH = CH ₂		0	nc
Carbon monoxide	CO		0	nc
Carbonyl fluoride	CF ₂ O		3	C
Carbonyl sulfide	COS	Carbonoxylsulfide	1	C
Chlorine	Cl ₂		3	C
Chlorine pentafluoride	ClF ₅		3	C
Chlorine trifluoride	ClF ₃		3	C
Chloromethane	CH ₃ Cl	Methyl chloride R40	0	nc
Chlorotrifluoroethylene, stabilized	C ₂ ClF ₃		0	nc
Cyanogen	(CN) ₂		0	i
Cyanogen chloride	ClCN		3	C
Cyclopropane	C ₃ H ₆	Trimethylene	0	nc

Key FTSC (see ISO 14456)

- 0 = non-corrosive
- 1 = non-halogen acid forming
- 2 = basic
- 3 = halogen acid forming

^a Some products, being liquid at normal ambient conditions, are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.

^b This category is conservative and is used to indicate that this a weak acid.

^c This column is for guidance only. For more information, see Reference [3].

Table 1 (continued)

Gas/liquid name	Chemical formula	Synonym	FTSC C code	Tissue corrosiveness category ^c
Deuterium chloride	DCl		3	C
Deuterium fluoride	DF		3	C
Deuterium selenide	D ₂ Se		1 ^b	i
Deuterium sulfide	D ₂ S		1 ^b	i
Diborane	B ₂ H ₆		0	nc
Dibromodifluoromethane ^a	CBr ₂ F ₂	R12B2	0	nc
Dichlorosilane	SiH ₂ Cl ₂		3	C
Diethylzinc ^a	(C ₂ H ₅) ₂ Zn		0	nc
Dimethylamine	(CH ₃) ₂ NH		2	C
Dimethylsilane	(CH ₃) ₂ SiH ₂		0	nc
Diphosgene ^a	C ₂ O ₂ Cl ₄		3	C
Ethylchloroarsine ^a	C ₂ H ₅ AsCl ₂		3	C
Ethylene oxide	C ₂ H ₄ O	Oxirane	0	i
Fluorine	F ₂		3	C
Germane	GeH ₄		0	nc
Heptafluorobutyronitrile ^a	C ₄ F ₇ N		0	nc
Hexafluoroacetone	C ₃ F ₆ O	Perfluoroacetone	3	C
Hexafluorocyclobutene	C ₄ F ₆		0	nc
Hydrogen bromide	HBr	Hydrobromic acid (anhydrous)	3	C
Hydrogen chloride	HCl	Hydrochloric acid (anhydrous)	3	C
Hydrogen cyanide	HCN	Hydrocyanic acid (anhydrous)	1 ^b	i
Hydrogen fluoride ^a	HF	Hydrofluoric acid (anhydrous)	3	C
Hydrogen iodide	HI	Hydroiodic acid (anhydrous)	3	C
Hydrogen selenide	H ₂ Se		1 ^b	i
Hydrogen sulfide	H ₂ S		1 ^b	i
Iodine pentafluoride ^a	IF ₅		3	C
Iodotrifluoromethane	CF ₃ I	Trifluoromethyl iodide	0	nc
Methyl bromide	CH ₃ Br	Bromomethane	0	i
Methyl mercaptan	CH ₃ SH	Methanethiol	1 ^b	i
Methyl vinyl ether (inhibited)	C ₃ H ₆ O	Methoxyethylene	0	nc
Key FTSC (see ISO 14456)				
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^b This category is conservative and is used to indicate that this is a weak acid.				
^c This column is for guidance only. For more information, see Reference [3].				

Table 1 (continued)

Gas/liquid name	Chemical formula	Synonym	FTSC C code	Tissue corrosiveness category ^c
Methyldichloroarsine ^a	CH ₃ AsCl ₂		3	C
Methylsilane	CH ₃ SiH ₃		0	nc
Monoethylamine ^a	C ₂ H ₅ NH ₂	Ethylamine R631	2	C
Monomethylamine	CH ₃ NH ₂	Methylamine R630	2	C
Nickel carbonyl ^a	Ni(CO) ₄	Nickel tetracarbonyl	0	nc
Nitric oxide	NO	Nitrogen oxide	1	C
Nitrogen dioxide	NO ₂	Nitrogen(IV) oxide	1	C
Nitrogen trifluoride	NF ₃		0	i
Nitrosyl chloride	NOCl		3	C
Oxygen difluoride	F ₂ O		3	C
Ozone (note: "not filled into cylinders")	O ₃		0	i
Pentaborane ^a	B ₅ H ₁₀		0	nc
Pentafluoropropionitrile	C ₃ F ₅ N		0	nc
Perfluoro-2-butene	C ₄ F ₈		0	nc
Phenylcarbylamine chloride ^a	C ₆ H ₅ NCCL ₂		3	C
Phosgene	COCl ₂	Carbonyl chloride	3	C
Phosphine	PH ₃		0	nc
Phosphorus pentafluoride	PF ₅		3	C
Phosphorus trifluoride	PF ₃		3	C
Propylene oxide	C ₃ H ₆ O	Methyl oxirane	0	i
Silane	SiH ₄	Silicon tetrahydride	0	nc
Silicon tetrachloride ^a	SiCl ₄		3	c
Silicon tetrafluoride	SiF ₄	Tetrafluorosilane R764	3	C
Stibine	SbH ₃	Antimony hydride	0	nc
Sulfur dioxide	SO ₂		1	C
Sulfur tetrafluoride	SF ₄		3	C
Sulfuryl fluoride	SO ₂ F ₂		0	nc
Tetraethyllead ^a	(C ₂ H ₅) ₄ Pb		0	nc
Tetrafluorohydrazine	N ₂ F ₄		3	C
Tetramethyllead	(CH ₃) ₄ Pb		0	nc
Triethylaluminum ^a	(C ₂ H ₅) ₃ Al		0	nc
Triethylborane	(C ₂ H ₅) ₃ B		0	nc
Trifluoroacetonitrile ^a	C ₂ F ₃ N		0	C

Key FTSC (see ISO 14456)

- 0 = non-corrosive
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^b This category is conservative and is used to indicate that this a weak acid.

^c This column is for guidance only. For more information, see Reference [3].

Table 1 (continued)

Gas/liquid name	Chemical formula	Synonym	FTSC C code	Tissue corrosiveness category ^c
Trifluoroethylene	C ₂ HF ₃		0	nc
Trimethylamine	(CH ₃) ₃ N		2	C
Trimethylsilane	(CH ₃) ₃ SiH		0	nc
Trimethylstibine ^a	(CH ₃) ₃ Sb		0	nc
Tungsten hexafluoride	WF ₆		3	C
Uranium hexafluoride	UF ₆		3	C
Vinyl bromide (inhibited)	C ₂ H ₃ Br		0	nc
Vinyl chloride (inhibited)	C ₂ H ₃ Cl	Chloroethylene R1140	0	nc
Vinyl fluoride (inhibited)	C ₂ H ₃ F	Fluoroethylene R1141	0	nc
Key FTSC (see ISO 14456)				
0 = non-corrosive				
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3 = halogen acid forming				
^a Some products, being liquid at normal ambient conditions, are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.				
^b This category is conservative and is used to indicate that this is a weak acid.				
^c This column is for guidance only. For more information, see Reference [3].				

6 Corrosiveness of gas mixtures — Calculation method

Gas mixtures containing C or i components are classified according to a calculation method similar to the calculation described in the GHS for the hazard class serious eye damage/eye irritation. For the purpose of this document, the threshold concentration limits of [Table 2](#) shall apply.

Table 2 — Generic concentration limits of C and i that trigger classification of the mixture as C or i

Sum of ingredients classified as	C	i
C	≥3 %	≥1 % but <3 %
i		≥10 %
(10 × C) + i		≥10 %

EXAMPLE 1

Mixture containing



in which HF and F₂ are both corrosive C components.

The sum of the components (2,5 % + 2,6 % = 5,1 %) is higher than the threshold (3 %) for classifying the mixture as C.

This gas mixture is thus corrosive and thus the corresponding C code is 3.

EXAMPLE 2