INTERNATIONAL STANDARD

ISO 13338

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Determination of tissue corrosiveness of a gas or gas mixture

Détermination de la corrosivité des gaz ou mélanges de gaz sur les tissu

Reference numbe
ISO 13338:1995(E

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 13338 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 2, *Cylinder fittings*.

Annex A of this International Standard is for information only.

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Introduction

The purpose of ISO 5145 is to establish practical criteria for the determination of outlet connections of gas cylinders of water capacity 150 litres or less. These criteria are based on certain physicochemical properties of the gases, in particular their corrosiveness.

One of the difficulties in the application of ISO 5145 resides in the absence of criteria for classifying the corrosiveness level of a gas or a gas mixture. In fact,

— in the case of pure gases, there are few data in the literature, but above all,

— in the case of gas mixtures, these data are very often nonexistent.

Investigation has shown that there is no correlation between the toxicity values defined by LC_{50} (see ISO 10298) and corrosiveness.

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Determination of tissue corrosiveness of a gas or gas mixture

1 Scope

This International Standard gives

— for pure gases: 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,

in order to determine the corrosiveness of gases and gas mixtures on tissue so that a suitable outlet connection can be assigned to each of them.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 5145:1990, *Cylinder valve outlets for gases and gas mixtures — Selection and dimensioning.*

3 Definitions and symbols

3.1 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1.1 tissue corrosiveness of gases or gas mixtures: Ability of a gas to damage or destroy living tissues (eyes, skin and mucous membranes).

3.1.2 irritant gas: Gas which may cause a temporary reaction to the skin, eyes and mucous membranes.

NOTE 1 An irritant gas is regarded for the purposes of ISO 5145 as noncorrosive.

3.2 Symbols

L	limit
V	volume
C	indicates a corrosive component
C+	indicates a very corrosive component
i	indicates an irritant component
nc	indicates an noncorrosive component

4 Classification

Two levels of corrosiveness are defined (C+: very corrosive, C: corrosive), to provide greater accuracy in the calculation method for the corrosiveness of mixtures.

In accordance with the above, gases are classified into the following categories:

C+: very corrosive
C: corrosive
} corrosive in the sense of ISO 5145

i: irritant
nc: noncorrosive, non-irritant
} noncorrosive in the sense of ISO 5145

For a complete definition for purposes of the gas cylinder connection, the subdivisions of the FTSC code defined at the bottom of table 1 shall also be taken into account:

0: noncorrosive, non-irritant (nc)

1: forms nonhalogen acids (C+, C or i)

2: basic (C+, C or i)

3: forms halogen acids (C+, C or i)

5 Categories of corrosiveness for pure gases

The corrosiveness category of each gas (C+, C, i or nc) corresponding to the classification defined in clause 4 is shown in table 1.

Table 1 — Corrosiveness categories of pure gases

Group No.	Gas name	Chemical formula	Synonym	FTSC Code	Corrosiveness category
7	Ammonia	NH_3	R717	0202	C
4	Antimony pentafluoride	SbF_5		0303	C+
8	Arsine	AsH_3		2300	nc
12	Bis-(trifluoromethyl)peroxide	$(CF_3)_2O_2$		4300	nc
4	Boron trichloride	BCl_3	Boron chloride	0203	C
4	Boron trifluoride	BF_3	Boron fluoride	0253	C+
12	Bromine pentafluoride	BrF_5		4303	C+
12	Bromine trifluoride	BrF_3		4303	C+
4	Bromoacetone	CH_3COCH_2Br		0303	C
13	Buta-1,3-diene (inhibited)	$CH_2 = CH-CH = CH_2$		5100	nc
8	Carbon monoxide	CO		2250	nc
8	Carbonyl sulfide	COS	Carbonoxylsulfide	2301	nc
4	Carbonyl fluoride	CF_2O		0213	C+
12	Chlorine	Cl_2		4203	C+
12	Chlorine pentafluoride	ClF_5		4303	C+
12	Chlorine trifluoride	ClF_3		4303	C+
8	Chloromethane	CH_3Cl	Methyl chloride R40	2200	nc
13	Chlorotrifluoroethylene	C_2ClF_3		5200	nc
8	Cyanogen	$(CN)_2$		2300	i
4	Cyanogen chloride	ClCN		0303	C
8	Cyclopropane	C_3H_6	Trimethylene	2200	nc
4	Deuterium chloride	DCl		0213	C
4	Deuterium fluoride	DF		0203	C+
8	Deuterium selenide	D_2Se		2301	i
8	Deuterium sulfide	D_2S		2301	i
13	Diborane	B_2H_6		5350	nc
4	Dibromodifluoromethane	CBr_2F_2	R12B2	0200	nc
4	Dichloro(2-chlorovinyl)arsine	$C_2H_2AsCl_3$	Lewisite	0303	C+
8	Dichlorosilane	SiH_2Cl_2		2203	C
9	Diethylzinc	$(C_2H_5)_2Zn$		3300	nc
7	Dimethylamine	$(CH_3)_2NH$		2202	C
8	Dimethylsilane	$(CH_3)_2SiH_2$		2300	nc
4	Diphosgene	$C_2O_2Cl_4$		0303	C
4	Ethyldichloroarsine	$C_2H_5AsCl_2$		0303	C
13	Ethylene oxide	C_2H_4O	Oxirane	5200	i
12	Fluorine	F_2		4343	C+
8	Fluoroethane	C_2H_5F	Ethyl fluoride	2300	nc
8	Germane	GeH_4		2300	nc

Group No.	Gas name	Chemical formula	Synonym	FTSC Code	Corrosiveness category
8	Heptafluorobutyronitrile	C_3F_7N		2300	nc
4	Hexafluoroacetone	C_3F_6O	Perfluoroacetone	0203	C
8	Hexafluorocyclobutene	C_4F_6		2300	nc
4	Hydrogen bromide	HBr	Hydrobromic acid (anhydrous)	0203	C
4	Hydrogen chloride	HCl	Hydrochloric acid (anhydrous)	0213	C
13	Hydrogen cyanide	HCN	Hydrocyanic acid (anhydrous)	5301	i
4	Hydrogen fluoride	HF	Hydrofluoric acid (anhydrous)	0203	C+
4	Hydrogen iodide	HI	Hydroiodic acid (anhydrous)	0203	C
8	Hydrogen selenide	H_2Se		2301	i
8	Hydrogen sulfide	H_2S		2301	i
12	Iodine pentafluoride	IF_5		4303	C+
4	Iodotrifluoromethane	CF_3I	Trifluoromethyl iodide	0200	nc
4	Methyl bromide	CH_3Br	Bromomethane	0300	i
8	Methyl mercaptan	CH_3SH	Methanethiol	2201	i
13	Methyl vinyl ether (inhibited)	C_3H_6O	Methoxyethylene	5200	nc
4	Methyldichloroarsine	CH_3AsCl_2		0303	C+
8	Methylsilane	CH_3SiH_3		2300	nc
7	Monoethylamine	$C_2H_5NH_2$	Ethylamine R631	2202	C
7	Monomethylamine	CH_3NH_2	Methylamine R630	2202	C
4	Mustard gas	$C_4H_8Cl_2S$		0303	C+
8	Nickel carbonyl	$Ni(CO)_4$	Nickel tetracarbonyl	2300	nc
12	Nitric oxide	NO	Nitrogen oxide	4351	C
12	Nitrogen dioxide	NO_2	Nitrogen(IV) oxide	4301	C
12	Nitrogen trifluoride	NF_3		4153	i
12	Nitrogen trioxide	N_2O_3	Nitrogen sesquioxide	4301	C
4	Nitrosyl chloride	NOCl		0203	C+
12	Oxygen difluoride	F_2O		4343	C+
12	Ozone	O_3		4330	i
9	Pentaborane	B_5H_{10}		3300	nc
8	Pentafluoropropionitrile	C_3F_5N		2300	nc
4	Perfluorobut-2-ene	C_4F_8		0200	nc
4	Phenylcarbylamine chloride	$C_6H_5NCCl_2$		0303	C
4	Phosgene	$COCl_2$	Carbonyl chloride	0303	C
9	Phosphine	PH_3		3310	nc
4	Phosphorus pentafluoride	PF_5		0203	C+
4	Phosphorus trifluoride	PF_3		0203	C+
13	Propylene oxide	C_3H_5O	Methyl oxirane	5200	i

Group No.	Gas name	Chemical formula	Synonym	FTSC Code	Corrosiveness category
9	Silane	SiH_4	Silicon tetrahydride	3150	nc
4	Silicon tetrafluoride	SiF_4	Tetrafluorosilane R764	0253	C+
4	Silicon tetrachloride	$SiCl_4$		0203	C
13	Stibine	SbH_3	Antimony hydride	5300	nc
4	Sulfur dioxide	SO_2		0201	C
4	Sulfur tetrafluoride	SF_4		0203	C+
4	Sulfuryl fluoride	SO_2F_2		0300	nc
8	Tetraethyllead	$(C_2H_5)_4Pb$		2300	nc
12	Tetrafluorohydrazine	N_2F_4		4343	C+
8	Tetramethyllead	$(CH_3)_4Pb$		2300	nc
9	Triethylaluminium	$(C_2H_5)_3Al$		3300	nc
9	Triethylborane	$(C_2H_5)_3B$		3300	nc
8	Trifluoroacetonitrile	C_2F_3N		2300	i
8	Trifluoroethylene	C_2HF_3		2200	nc
7	Trimethylamine	$(CH_3)_3N$		2202	C
8	Trimethylsilane	$(CH_3)_3SiH$		2300	nc
9	Trimethylstibine	$(CH_3)_3Sb$		3300	nc
4	Tungsten hexafluoride	WF_6		0303	C
4	Uranium hexafluoride	UF_6		0303	C
13	Vinyl bromide (inhibited)	C_2H_3Br		5200	nc
13	Vinyl chloride (inhibited)	C_2H_3Cl	Chloroethylene R1140	5200	nc
13	Vinyl fluoride (inhibited)	C_2H_3F	Fluoroethylene R1141	5100	nc

NOTES

1 Description of each group:

Group 4: nonflammable, toxic and corrosive or corrosive by hydrolysis;

Group 7: basic, flammable and corrosive;

Group 8: flammable, toxic and corrosive (acid) or noncorrosive;

Group 9: spontaneously flammable;

Group 12: oxidizing, toxic and corrosive;

Group 13: flammable, subject to decomposition.

2 Key FTSC (ISO 5145)

0 = noncorrosive

1 = forms nonhalogenated acids

2 = basic

3 = forms halogenated acids

6 Corrosiveness of gas mixtures — Calculation method

For each of the corrosiveness categories of a component, the lower concentration limits (as a volume percentage) corresponding to each of these corrosiveness categories for the mixture obtained are defined as shown in table 2 below.

Table 2 — Lower concentration limits for each category of corrosiveness of a component

Limits in volume percentage

Corrosiveness category of the component		Very corrosive (C+)	Corrosive (C)	Irritant (i)
Lower concentration limits	L_{C+}	1	—	—
	L_C	0,2	5	—
	L_i	0,02	0,5	5

6.1 Gas mixtures containing one very corrosive, corrosive or irritant component

The diagram in table 3, which illustrates table 2, can be used in the following way:

The point corresponding to the percentage concentration of the component is placed on this diagram in the column corresponding to its corrosiveness category. The area in which it is located determines the corrosiveness of the mixture.

EXAMPLE

Mixture containing: 6 % NH_3 + 94 % N_2

For the example chosen, ammonia is classified in clause 5, table 1, in category C (corrosive). By looking at table 2 or the diagram in table 3, it can be seen that for corrosive components the lower concentration limit for the "corrosive" category is $L_C = 5$ % and the lower concentration limit for the "irritant" category is $L_i = 0,5$ %.

The mixture in the example contains 6 % NH_3, which is a concentration greater than 5 %, so the mixture is categorized as corrosive.

6.2 Gas mixtures containing several very corrosive, corrosive or irritant components

The mixture shall be checked first to see if it is very corrosive (in accordance with 6.2.1). If it is not, then secondly if it is corrosive (in accordance with 6.2.2) and, if it is not, finally if it is irritant (in accordance with 6.2.3).

6.2.1 Very corrosive gas mixture

A mixture of very corrosive gases will be classified as a "very corrosive gas mixture" if

$$\sum \left(\frac{V_{C+}}{L_{C+}} \right) \geqslant 1$$

where

V_{C+} is the percentage, by volume, of each very corrosive component;

L_{C+} is the percentage limit, by volume, for very corrosive gas mixtures (this limit is equal to 1 % for each very corrosive component, see table 2).

Any corrosive or irritant gases that may be present in the mixture do not enter into the calculation.

EXAMPLE

Mixture containing

0,5 % HF + 0,6 % F_2 + 98,9 % N_2

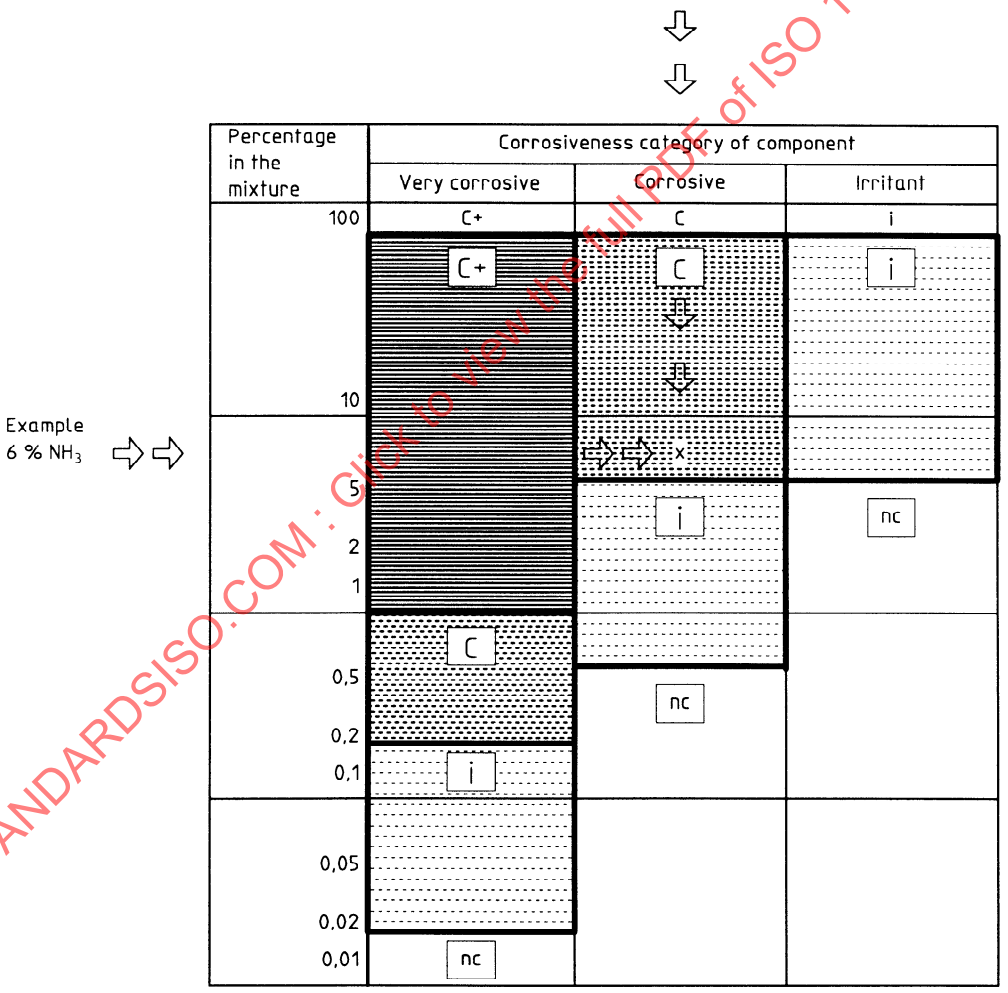
in which

HF is very corrosive (C+), F_2 is very corrosive (C+)

$$\sum\left(\frac{V_{C+}}{L_{C+}}\right) = \frac{0,5}{1} + \frac{0,6}{1} = 1,1 > 1$$

This gas mixture is thus very corrosive.

Table 3 — Diagram for a single very corrosive, corrosive or irritant component



6.2.2 Corrosive gas mixtures

A mixture of very corrosive and/or corrosive gases will be classified as "corrosive" if

$$\sum \left(\frac{V_C}{L_C} \right) \geqslant 1$$

where

V_C is the percentage, by volume, of each very corrosive or corrosive component;

L_C is the limit percentage, by volume, for corrosive gas mixtures (this limit is equal to 0,2 % for each very corrosive gas component and to 5 % for each corrosive gas component, see table 2).

Any irritant gases present in the mixture do not enter into the calculation.

EXAMPLE

Mixture containing:

0,1 % HF + 0,1 % Cl_2 + 2 % $COCl_2$ + 3 % HCN + 94,8 % N_2

in which

HF is very corrosive (C+), Cl_2 is very corrosive (C+), $COCl_2$ is corrosive (C)

$$\sum \left(\frac{V_C}{L_C} \right) = \frac{0,1}{0,2} + \frac{0,1}{0,2} + \frac{2}{5} = 1 + \frac{2}{5} = \frac{7}{5} > 1$$

This gas mixture is thus corrosive.

6.2.3 Irritant gas mixtures

A mixture of very corrosive gases and/or corrosive gases and/or irritant gases will be classified as "irritant" if

$$\sum \left(\frac{V_i}{L_i} \right) \geqslant 1$$

where

V_i is the percentage, by volume, of each very corrosive, corrosive or irritant component;

L_i is the limit percentage, by volume, for irritant gas mixtures (this limit is equal to 0,02 % for each very corrosive component, 0,5 % for each corrosive component and 5 % for each irritant component, see table 2).