INTERNATIONAL STANDARD

ISO 5145

Second edition
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Cylinder valve outlets for gases and gas mixtures — Selection and dimensioning

Raccords de sortie de robinets de bouteilles à gaz et mélanges de gaz — Choix et dimensionnement

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 5145 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 2, *Cylinder fittings*.

This second edition cancels and replaces the first edition (ISO 5145:1990), to which connections for 300 bar and medical applications have been added.

Introduction

At the beginning of the 1960s the members of ISO/TC 58/SC 2 were charged with the task of drafting an International Standard on gas cylinder valve outlets.

It soon became obvious that millions of different types of valve outlets are in use, and the various countries concerned were not ready to give up their own systems. It was therefore only possible to draw up a list of the existing provisions, either standardized or in use, which was published as Technical Report ISO/TR 7470. The number and variety of such provisions give an idea of the complexity and scope of the task entrusted to ISO/TC 58/SC 2.

Towards the end of the 1970s ISO/TC 58/SC 2 realized that the task in hand could only be achieved by adopting a long-term solution; this was to create an ideal system of valve outlets which would not be interchangeable with the existing systems. This system would be based on four fundamental criteria, namely safety, simplicity, compactness and tightness.

Two key actions were then undertaken in parallel:

— a classification and grouping of gases and gas mixtures;

— a practical definition of an original, non-interchangeable, connection system.

ISO 5145 represents a synthesis of these two actions. It is a practical guide for the selection of cylinder valve outlets for gases and gas mixtures. In view of the fact that no country seemed ready to give up their national standards and to adopt an International Standard specifying the dimensions of gas cylinder valve outlets, it was agreed that this International Standard need not be complied with where a national standard predates it.

ISO 5145 presents a logical system for determining valve outlets for gas cylinders for all gases or gas mixtures. It is of special interest for those countries which have no national standards or regulations. Its provisions can be called upon in the future in cases where a new gas or gas mixture is developed industrially.

The main purpose in standardizing valve outlets is to prevent the interconnection of non-compatible gases. The user is cautioned to ensure that a particular outlet connection, when used, is compatible with any other connections or gases that might be connected to that outlet. Because of the multiplicity of connections in use and the existence of many national standards, this concern cannot be overstated.

ISO 5145 thus represents a basis for international agreement in the more or less remote future.

Cylinder valve outlets for gases and gas mixtures — Selection and dimensioning

1 Scope

This International Standard establishes practical criteria for determining valve outlet connections for gas cylinders.

It applies to the selection of gas cylinder valve outlet connections and specifies the dimensions for a number of them.

This International Standard does not apply to connections used for cryogenic gas withdrawal or gases for breathing equipment which are the subject of other International Standards.

WARNING — The gas cylinder valve outlet connection is not the only safeguard against accidental misuse; gas cylinder labelling and colour code shall be checked before use.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 286-1:1988, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits*

ISO 286-2:1988, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

ISO 10156:1996, *Gases and gas mixtures — Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets*

ISO 10286:1996, *Gas cylinders — Terminology*

ISO 10298:1995, *Determination of toxicity of a gas or gas mixture*

ISO 13338:1995, *Determination of tissue corrosiveness of a gas or gas mixture*

3 Principle of the determination of valve outlets

3.1 Basic principle

This International Standard establishes a method of allocating to any gas or mixture of gases contained in cylinders, four-digit code numbers (FTSC). This code number categorizes the gas or gas mixture in terms of its physical/chemical properties and/or inflammability, toxicity, state of the gas and corrosiveness (see A.1).

The FTSC code enables a gas or gas mixture to be assigned to one of the 15 “compatible” gas groups (see A.2). Valve outlet connections are allocated to each group (see Clause 5).

NOTE Attention is drawn to the fact that the only purpose of the numerical code is to group compatible gases together in order that the particular valve outlet assigned to each group may be selected. The code is only applicable for the valve outlet selection used in this International Standard and is not intended as an identification code.

3.2 Single gases

Pure gases are assigned to one of the first fourteen-gas groups group, 15 being reserved for specific gas mixtures. It is recognized that a “pure gas” may contain some impurities, but it is intended that this should not affect the valve outlet selection.

Five groups are assigned to individual named gases from which mixtures and other gases are excluded. These five groups are as follows:

a) group 2 – carbon dioxide;

b) group 5 – air;

c) group 10 – oxygen;

d) group 11 – nitrous oxide;

e) group 14 – acetylene.

3.3 Gas mixtures

3.3.1 Definition

For the purposes of this document, a gas mixture is defined as an intentional combination of two or more gases which may be either in the gaseous phase or liquefied under pressure when in a gas cylinder.

NOTE This International Standard does not attempt to identify gas mixtures which may be safely and satisfactorily prepared; this is the responsibility of the gas manufacturer. It does not describe any methods or techniques for preparing gas mixtures.

3.3.2 Assignment of a gas mixture to a group

The principle of allocation of a four-digit numerical code (FTSC) to gas mixtures is the same as that for single gases. The allocation of the FTSC code to a gas mixture, which allows the assignment of this mixture to one of the group of gases and gas mixtures (see Table A.1), depends on the inflammability, oxidizing ability, toxicity and corrosiveness of the final mixture. For the determination of flammability and oxidizing ability, use ISO 10156, for toxicity use ISO 10298 and for corrosiveness use ISO 13338.

Mixtures containing spontaneously flammable gases (i.e. pyrophoric gases such as silane in Table A.10) shall be considered as spontaneously flammable gas mixtures if the content of the pyrophoric gas(es) is more than 1,4 %.

4 Determination of connection

4.1 Connection

A connection is a mechanical device that conveys gas via a gas cylinder valve to a filling or use system without leakage to the atmosphere. It shall be robust and able to withstand repeated connection and disconnection. It shall be designed such that it can only be used for the group of gases to which it is allocated.

A connection comprises a minimum of three parts (see Figure 1):

a) a valve outlet — the part of the cylinder valve through which gas is discharged;

b) a connector — the part of the filling or use system through which the gas is conveyed;

c) a union nut — the means by which the connector is secured to the valve outlet and by which the seal is ensured.

The design of the double-recess type of connection is derived from the “step index principle”.

The step index system comprises a double recess (faucet) into the valve outlet, into which a spigot of two differing diameters is designed to fit (see the figure in Table 1). The lengths of the recesses and spigots are the same for each connection but the diameters vary depending on the group of gases for which the recess or spigot is designed. The form, dimensions and tolerances are illustrated in Table 1 which provides for 42 non-interchangeable connections.

Three nominal diameters 24 mm, 27 mm and 30 mm have been adopted for the connections (see Annexes B and C). The thread is a Whitworth thread with a pitch of 2 mm (see Figure 2).

NOTE Internal “double-recess step index connections” are not used because of their excessive size.

4.2 Leak tightness

Leak tightness is achieved by the sealing end of the connector bearing on the conical part of the valve outlet connection, this seal being maintained by the union nut (see Annex B).

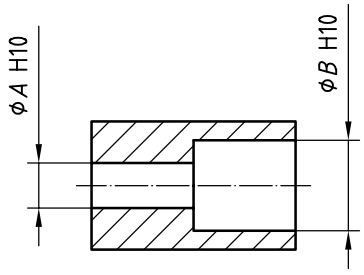
Other methods of sealing may be adopted.

No details of the external dimensions of the union nut are given since this will be subject to the method adopted for applying the sealing force (i.e. with a spanner or by hand).

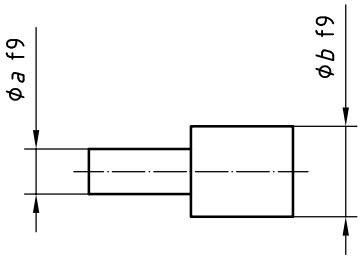
This International Standard does not specify the choice of materials; however, it is necessary to use materials for the O-ring, valve and valve connector that are compatible with the gas content of the cylinder and the service for which they are intended.

Table 1 — Non-interchangeable combinations $A + B$

Dimensions in millimetres



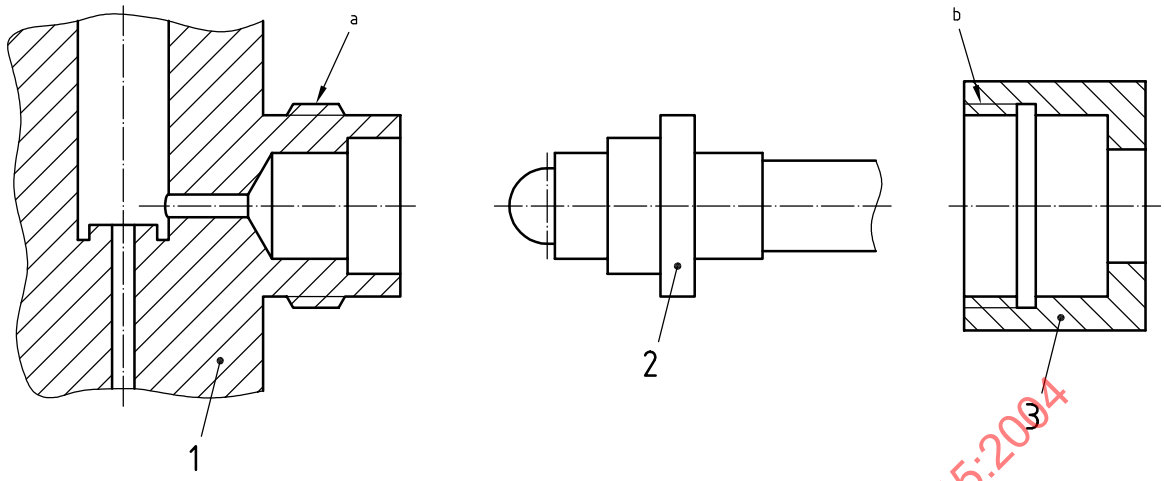
Female



Male

Nominal diameter of the connection = nominal thread diameter D, d	Constant $A + B$						Available combinations		
	28		32		36				
	A	B	A	B	A	B	Right-hand thread	Left-hand thread	Total of right- and left-hand threads
24	11,2 11,9 12,6 13,3 14	16,8 16,1 15,4 14,7 14	—	—	—	—	5	5	10
27	—	—	11,8 12,5 13,2 13,9 14,6 15,3 16	20,2 19,5 18,8 18,1 17,4 16,7 16	—	—	7	7	14
30	—	—	—	—	12,4 13,1 13,8 14,5 15,2 15,9 16,6 17,3 18	23,6 22,9 22,2 21,5 20,8 20,1 19,4 18,7 18	9	9	18
						Total numbers of combinations	21	21	42

NOTE For the tolerances, see ISO 286-1 and ISO 286-2.



Key

1 valve
2 connector
3 union nut

a Thread according to Figure 2b).
b Thread according to Figure 2a).

Figure 1 — Female and male connections

5 Allocation of connections

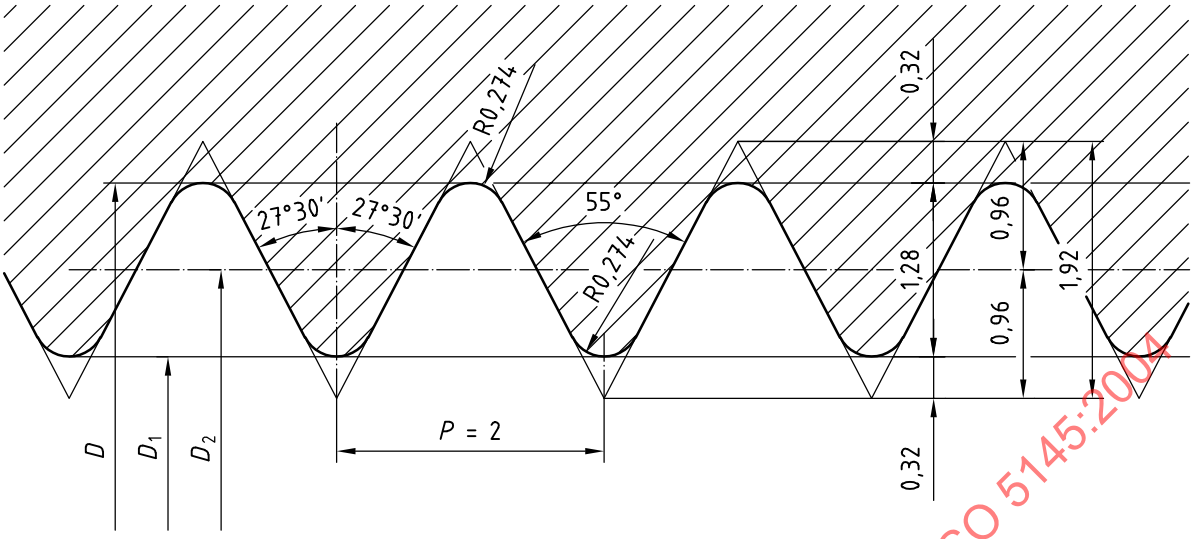
The allocation of 33 connections from the 42 that are available is shown in Table 2. Table 3 shows that each group of gases has been established in accordance with:

a) the FTSC code;

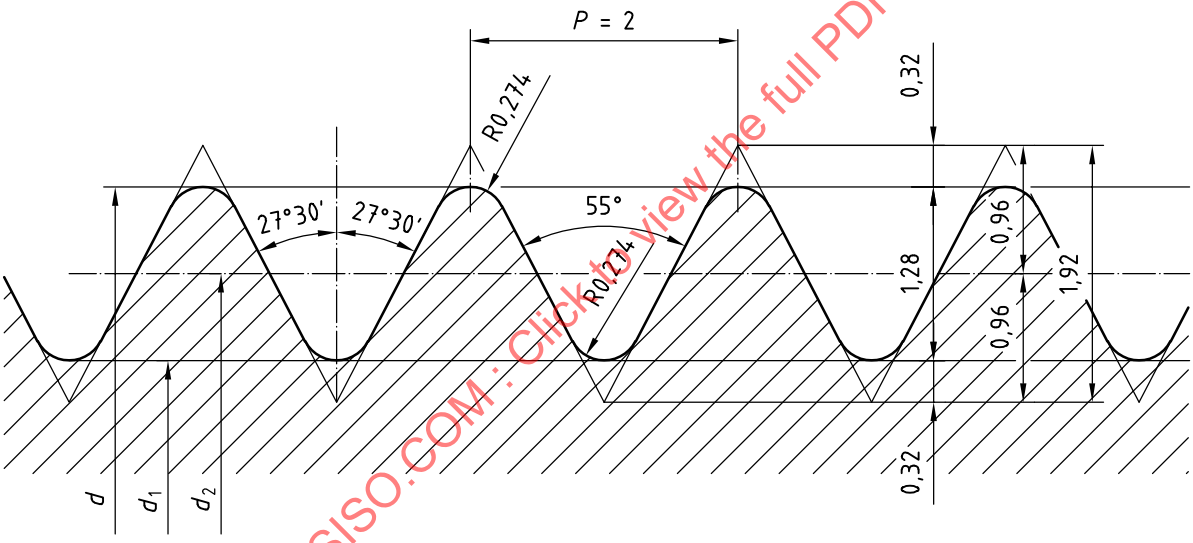
b) the gases for other groups which may be component parts of the mixture of which the final properties are similar to those of that group;

c) the connection(s) which is (are) allocated to the group.

Dimensions in millimetres



a) **Internal thread**



b) **External thread**

Nominal diameter = major diameter	D, d	**24**	**27**	**30**
Pitch diameter	D_2, d_2	22,72	25,72	28,72
Minor diameter	D_1, d_1	21,44	24,44	27,44

Figure 2 — Basic dimensions of Whitworth threads with pitch P equal to 2 mm

Table 2 — Allocation of valve outlets for gases and gas mixtures by connection type

Nominal diameter of the connection														
24					27					30				
A-B combination mm	Left-hand thread		Right-hand thread		*A-B* combination mm	Left-hand thread		Right-hand thread		*A-B* combination mm	Left-hand thread		Right-hand thread	
	Group (utilisation)	Gas or gas mixture (FTSC code)	Group (utilisation)	Gas or gas mixture (FTSC code)		Group (utilisation)	Gas or gas mixture (FTSC code)	Group (utilisation)	Gas or gas mixture (FTSC code)		Group (utilisation)	Gas or gas mixture (FTSC code)	Group (utilisation)	Gas or gas mixture (FTSC code)
11,2-16,8	8 (M)[a]	Medical cyclopropane (2200) ***6***	3 (M)	Helium and xenon (0110) ***1***	11,8-20,2		***18***	3 (M)	Nitrogen ***11***	12,4-23,6		***34***	3 (M)	Helium-oxygen mixture ($O_2 < 20\%$) ***25***
11,9-16,1		***7***	10 (I)	Oxygen (4150) ***2***	12,5-19,5		***19***	15 (M)	Air + He + CO (CO < 1%) Mixture (4203; 4300; 4301; 4303; 4330; 4343; 4351) ***12***[b]	13,1-22,9		***35***	15 (M)	$O_2 + N_2$ ($O_2 > 22\%$) or O_2 + He ***26***
12,6-15,4		***8***	15 (M)	Medical air and synthetic medicinal air ***3***	13,2-18,8		***20***	15 (M)	50 % O_2 - 50 % N_2O mixture ***13***	13,8-22,2		***36***	15 (M)	O_2 - CO_2 mixture ($CO_2 \leqslant 7\%$) ***27***
13,3-14,7	6 (I) [a]	(2150) ***9***	3 (I) (M)	(0150) Inert gas and gas mixtures (0150) ***4***	13,9-18,1	13 (I)	(5100; 5200; 5300; 5301; 5350) ***21***	5 (I)	Air (1050) ***14***	14,5-21,5		***37***	15 (M)	O_2 - CO_2 mixture ($CO_2 > 7\%$) ***28***
14-14	6 (I)	Hydrogen (2150) ***10***	10 (M)	Oxygen (4050) ***5***	14,6-17,4	9 (I)	(3300; 3310; 3150) ***22***	4 (I)	(0200; 0201; 0203; 0213; 0300; 0303; 0253) ***15***	15,2-20,8	6 (I)	(2170) ***38***	3 (M)	N_2 + NO mixture (100 < NO < 1 000 ppm) ***29***

Table 2 — *(continued)*

Nominal diameter of the connection														
24					27					30				
A-B combination mm	Left-hand thread		Right-hand thread		*A-B* combination mm	Left-hand thread		Right-hand thread		*A-B* combination mm	Left-hand thread		Right-hand thread	
	Group (utilisation)	Gas or gas mixture (FTSC code)	Group (utilisation)	Gas or gas mixture (FTSC code)		Group (utilisation)	Gas or gas mixture (FTSC code)	Group (utilisation)	Gas or gas mixture (FTSC code)		Group (utilisation)	Gas or gas mixture (FTSC code)	Group (utilisation)	Gas or gas mixture (FTSC code)
					15,3-16,7	8 (I)	(2250) *23*	11 (M)	Nitrous oxide (4110) *16*	15,9-20,1	8 (I)	(2200; 2201; 2203; 2300; 2301) *39*	3 (I)	(0170) *30*
					16-16	6 (I)	Commercial butane and propane (2100) *24*	2 (M)	Carbon dioxide (0110) *17*	16,6-19,4	7 (I)	(0202; 2202) *40*	5 (I)	Air (1070) *31*
										17,3-18,7	6 (I)	(2100; 2110) (except H_2 and butane and propane) *41*	10 (I)	(4070) *32*
										18-18	14 (I)	Acetylene (5130) *42*	3 (M) 1 (I)	SF_6, C_2F_6, C_3F_8 (0100) *33*

a I for industrial applications; M for medical applications.

b Caution: this valve outlet is used for two different applications (oxidizing, toxic and/or corrosive gases and medicinal breathable application). However, these applications are so different that this is found acceptable (toxic gas is unlikely to be distributed in a hospital).

Table 3 — Allocation of valve outlets by gas group

Group No.	Gas and gas mixture characteristic at 15°C	Allocation of outlet connections							
		Single gases, FTSC code, code FTSC	Right-hand (RH) or left-hand (LH) thread	Nominal diameter of the connection					
				24		27		30	
				Gases and gas mixtures and/or FTSC code	*A-B*, combination mm	Gases and gas mixtures and/or FTSC code	*A-B*, combination mm	Gases and gas mixtures and/or FTSC code	*A-B*, combination mm
1	Non-flammable, non-toxic gases; less stable thermally than group 3	0100	RH					0100	18-18 ***33***
2	Carbon dioxide	0110	RH			0110	16-16 (M) ***17***		
3	Non-flammable, non-toxic and thermally stable gases (except carbon dioxide)	0150 0170	RH	Medical helium xenon	11,2-16,8 ***1***	Nitrogen (M) (I)	11,8-20,2 ***11***	$He-O_2$ (O_2<20%)	12,4-23,6 ***25***
				Inert gas and gas mixtures	13,3-14,7 ***4***			0170	15,9-20,1
								N_2 + NO mixture (100 < NO < 1 000 ppm)	15,2-20,8 ***29***
								SF_6, C_2F_6, C_3F_8	18-18 ***33***
4	Non-flammable, toxic and corrosive by hydrolysis gases	0200; 0201; 0203; 0213; 0300; 0303; 0253; 0263	RH			0200; 0201; 0213; 0300; 0303; 0253; 0263	14,6-17,4 ***15***		
5	Air only [a]	1150 1170	RH			1050 Air (I)	13,9-18,1 ***14***	1170 Air (I)	16,6-19,4 ***31***
6	Flammable and non-toxic gases	2100; 2110; 2120; 2150; 2170	LH	H_2 ⩽ 250 bar	14-14 ***10***	Commercial butane and propane	16-16 ***24***	2170	15,2-20,8 ***38***
				2150	13,3-14,7 ***9***			2100; 2110 except H_2 and commercial butane and propane	17,3-18,7 ***41***
7	Flammable and corrosive (basic gases)	0102; 2102	LH					0102; 2102	16,6-19,4
8	Flammable, toxic and corrosive (acidic) or non-corrosive gases	2200	LH	Medical cyclopropane	11,2-16,8 ***6***	2250	15,3-16,7 ***23***	2200; 2201; 2203; 2300; 2301	15,9-20,1 ***39***

Table 3 — *(continued)*

Group No.	Gas and gas mixture characteristic at 15°C	Allocation of outlet connections							
		Single gases, FTSC code, code FTSC	Right-hand (RH) or left-hand (LH) thread	Nominal diameter of the connection 24		27		30	
				Gases and gas mixtures and/or FTSC code	*A-B*, combination mm	Gases and gas mixtures and/or FTSC code	*A-B*, combination mm	Gases and gas mixtures and/or FTSC code	*A-B*, combination mm
9	Spontaneously flammable	3150; 3300; 3310	LH			3150; 3300; 3310	14,6-17,4		
							22		
10	Oxygen and high pressure oxidant	4050 4070	RH	4050 (M)	14-14 oxygen (M) ***5***			4070 including high pressure oxidant	17,3-18,7 ***32***
				4050 (I)	11,9-16,1 ***2***				
11	Nitrous oxide	4110	RH			4110 (M)	15,3-16,7 ***16***		
12	Oxidant, toxic and corrosive gases	4203; 4300; 4301; 4303; 4330; 4343; 4351; 4361	RH			4203; 4300; 4301; 4303; 4330; 4343; 4351	12,5-19,5 ***12***[b]		
13	Flammable gases subject to decomposition or polymerization	5100; 5200; 5300; 5301; 5350	LH			5100; 5200; 5300; 5301; 5350	13,9-18,1 ***21***		
14	Acetylene only	5130	LH					5130 (Acétylène)	18-18 ***42***
15	Oxidant, non-toxic and non-corrosive gas mixture		RH	Medicinal air and synthetic medicinal air (M)	12,6-15,4 ***3***	50 % N_2O- 50 % O_2 mixture (M)	13,2-18,8 ***13***	$O_2 + N_2$ ou O_2 – He mixtures	13,1-22,9 ***26***
								O_2-CO_2 ($CO_2 \leqslant 7$ %) (M)	13,8-22,2 ***27***
						air+He+CO (CO < 1 %) mixture (M)	12,5-19,5 ***12***[b]	CO_2-O_2 ($CO_2 > 7$ %) (M)	14,5-21,5 ***28***

[a] For medical application, see group 15.

[b] Caution: this valve outlet is used for two different applications (oxidizing, toxic and/or corrosive gases and medicinal breathable applications). However, these applications are so different that this is found acceptable (toxic gas is unlikely to be distributed in a hospital).

6 Marking

The outlets and the connections shall be marked with the number of the corresponding outlet as indicated in Table 4.

Table 4 — Marking

DN	*A*	*B*	Mark number	
			Left hand thread	Right hand thread
24	11,2	16,8	6	1
	11,9	16,1	7	2
	12,6	15,4	8	3
	13,3	14,7	9	4
	14	14	10	5
27	11,8	20,2	18	11
	12,5	19,5	19	12
	13,2	18,8	20	13
	13,9	18,1	21	14
	14,6	17,4	22	15
	15,3	16,7	23	16
	16	16	24	17
30	12,4	23,6	34	25
	13,1	22,9	35	26
	13,8	22,2	36	27
	14,5	21,5	37	28
	15,2	20,8	38	29
	15,9	20,1	39	30
	16,6	19,4	40	31
	17,3	18,7	41	32
	18	18	42	33

Annex A
(normative)

Gas groups

A.1 Numerical gas code (FTSC)

A.1.1 General

The code number assigned to each gas is based on the following four physico-chemical criteria.

Category I: fire potential, defining the gas behaviour with respect to combustion.

Category II: toxicity.

Category III: gas state, defining the physical state of the fluid in the cylinder at 15 °C within a given pressure range.

Category IV: corrosiveness (with respect to living tissue).

Each category is subdivided into different characteristics, each identified by a different digit. In this way, a gas in a given state is characterized by a series of four digits (one digit per category) as illustrated below.

A.1.2 Fire potential, category I

Subdivision 0: inert (any gas not classified under subdivisions 1 to 5 below);

Subdivision 1: supports combustion (oxidizing gas having an oxipotential equal to or less than that of air);

Subdivision 2: flammable (gas having flammable limits in air);

Subdivision 3: spontaneously flammable;

Subdivision 4: highly oxidizing (oxidizing gas having an oxipotential greater than that of air);

Subdivision 5: flammable and subject to decomposition or polymerization.

A.1.3 Toxicity, category II

Subdivision 0: life supporting at atmospheric pressure;

Subdivision 1: non-toxic LC50 $>$ 0,005 % by volume; (For LC50, see the definition in ISO 10298.)

Subdivision 2: toxic; 0,000 2 % by volume $<$ LC50 $\leqslant$ 0,005 % by volume;

Subdivision 3: very toxic LC50 $\leqslant$ 0,000 2 % by volume.

A.1.4 State of the gas (in the cylinder at 15 °C, category III)

Subdivision 0: liquefied gas at 35 bar or less;

Subdivision 1: liquefied gas at over 35 bar;

Subdivision 2: liquid withdrawal – liquefied gas (optional);

Subdivision 3: dissolved gas;

Subdivision 4: gas phase withdrawal at 35 bar or less;

Subdivision 5: compressed gas between 35 bar and 250 bar (Europe);

Subdivision 6: compressed gas between 35 bar and 182 bar (North America);

Subdivision 7: compressed gas above 182 bar (North America) or 250 bar (Europe).

Either subdivision 5 or subdivision 6 shall be used, never both. The selection of either subdivision will determine the meaning of subdivision 7.

Subdivisions 5 and 6 have been adopted as a result of a compromise between the European and the North American proposals. The European preference for a limit of 250 bar reflects the current tendency towards higher-pressure applications. The current North American practice requires a limit of 182 bar for which their pressure reducing valves are designed. This is the working pressure at the referenced temperature of 15 °C.

Therefore three pressure classes have been retained:

Subdivision 4: 35 bar or less — gas only (including cryogenic gas withdrawal);

Subdivision 5 or 6: medium pressure range, each user being imperatively required to select one subdivision exclusively to determine the upper limit of the medium pressure range (i.e. 182 bar or 250 bar);

Subdivision 7: high pressure range, the lower limit (182 bar or 250 bar) of which depends on the subdivision selected for the medium pressure range.

A number of pressure ranges have been established to safeguard the selection of the proper cylinder valve outlet connection. These ranges have been chosen to protect downstream regulators and other ancillary equipment from over-pressurized conditions.

Subdivisions 8 and 9 have been allocated for liquid withdrawal cylinders of cryogenic gases in the USA.

All pressures are working pressures in accordance with ISO 10286.

A.1.5 Corrosiveness, category IV

Subdivision 0: non-corrosive;

Subdivision 1: non-halogen acid forming;

Subdivision 2: basic;

Subdivision 3: halogen acid forming.

A.2 Grouping of gases

A.2.1 General

The characteristics of each gas group are summarized in Table A.1.

Table A.1 — Gas group characteristics

Group	Characteristics
1	Non-flammable, non-toxic gases and qualifying gas mixtures, less stable thermally than group 3
2	Carbon dioxide
3	Non-flammable, non-toxic and thermally stable gases (except carbon dioxide) and qualifying gas mixtures
4	Non-flammable, toxic and corrosive (or corrosive by hydrolysis) gases and qualifying gas mixtures
5	Air
6	Flammable and non-toxic gases and qualifying gas mixtures
7	Flammable, toxic and corrosive (basic) gases and qualifying gas mixtures
8	Flammable, toxic and corrosive (acidic) or non-corrosive gases and qualifying gas mixtures
9	Spontaneously flammable gases and qualifying gas mixtures
10	Oxygen and high pressure oxidant
11	Nitrous oxide
12	Oxidant, toxic and/or corrosive gases and qualifying gas mixtures
13	Flammable gases and qualifying gas mixtures subject to decomposition or polymerization
14	Acetylene
15	Oxidant, non-toxic and non-corrosive gas mixtures (normally medical)

Summaries of the gases and gas mixtures belonging to each group are given in A.2.2 to A.2.16.

NOTE For compressed gases given in the following tables (Tables A.2 to A.15), the third digit used in this document is a 5. Most of these gases may be filled in a gas cylinder at a different pressure and consequently the digits 6 or 7 are then to be used. For liquefied gases, the third digit used in this standard is 0 or 1 (in accordance with the pressure). Most of these gases may be used with liquid withdrawal cylinders and consequently the corresponding Figure 2 is then to be used (whatever is the pressure).

A.2.2 Group 1 gases and gas mixtures

See Table A.2.

Table A.2 — Gases and gas mixtures belonging to group 1

Gas	FTSC code	Synonym
Bromochlorodifluoromethane	0100	R12B1
Bromochloromethane	0100	Halon 1011
Bromotrifluoromethane	0100	Trifluorobromomethane R13B1
Chlorodifluoromethane	0100	Monochlorodifluoromethane R22
Chloroheptafluorocyclobutane [a]	0100	C317
Chloropentafluoroethane	0100	Monochloropentafluoroethane R115
1 - Chloro-1,2,2,2-tetrafluoroethane	0100	R124
1 - Chloro-2,2,2-trifluoroethane	0100	R 133a
Chlorotrifluoromethane	0100	Monochlorotrifluoromethane R13
1,2-Dibromotetrafluoroethane [a]	0100	R114B2
1,2-Dichlorodifluoroethylene	0100	R1112a
Dichlorodifluoromethane	0100	R12
Dichlorofluoromethane	0100	R21
1,2-Dichlorohexafluorocyclobutane [a]	0100	C316
1,1-Dichlorotetrafluoroethane	0100	R114a
1,2-Dichlorotetrafluoroethane	0100	R 114
2,2-Dichloro-1,1,1-trifluoro ethane [a]	0100	R 123
Hexafluoroethane	0100	Perfluoroethane R116
Hexafluoropropylene	0100	Hexafluoropropene R 1216
Octafluorocyclobutane	0100	Perfluorocyclobutane RC 318
Octafluoropropane	0100	Perfluoropropane R 218
Pentachlorofluoroethane	0100	
Pentafluoroethane	0100	R125
Pentafluoroethyliodide	0100	
Perfluorobutane	0100	
Sulfur hexafluoride	0100	
1,1,1,2-Tetrachlorodifluoro ethane	0100	R112a
1,1,2,2-Tetrachlorodifluoro ethane	0100	R112
1,1,2,2-Tetrafluoro-1-chloro ethane	0100	
Trichlorofluoromethane [a]	0100	Trichloromonofluoromethane R11
1,1,1-Trichlorotrifluoroethane [a]	0100	R113a
1,1-Trichlorotrifluoroethane [a]	0100	R113
Trifluoromethane	0100	Fluoroform R23

[a] Some products, being liquid at normal ambient conditions, are included since they may be supplied in non-pressurized containers. They are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.

For gas mixtures, see 3.3.2.

A.2.3 Group 2 gases

See Table A.3.

Table A.3 — Gases belonging to group 2

Gas	FTSC code	Synonym
Carbon dioxide	0110	Carbonic acid R744 anhydride

A.2.4 Group 3 gases and gas mixtures

See Table A.4.

Table A.4 — Gases and gas mixtures belonging to group 3

Gas	FTSC code	Synonym
Argon	0150	
Helium	0150	
Krypton	0150	
Neon	0150	
Nitrogen	0150	
Xenon	0110	
Tetrafluoromethane	0150	Carbon tetrafluoride R14

For gas mixtures, see 3.3.2.

A.2.5 Group 4 gases and gas mixtures

See Table A.5.

Table A.5 — Gases and gas mixtures belonging to group 4

Gas	FTSC code	Synonym
Antimony pentafluoride [a]	0303	
Boron trichloride	0203	Boron chloride
Boron trifluoride	0253	Boron fluoride
Bromoacetone [a]	0203	
Carbonyl-fluoride	0213	
Cyanogen chloride	0303	
Deuterium chloride	0213	
Deuterium fluoride	0203	
Dibromodifluoromethane [a]	0100	R12B2
Dichloro-2-chlorovinyl arsine	0303	Lewisite
Diphosgene [a]	0303	
Ethyldichloroarsine [a]	0303	
Hexafluoroacetone	0203	Hexafluoropropane-2perfluoroacetone
Hydrogen bromide	0203	Hydrobromic acid (anhydrous)
Hydrogen chloride	0213	Hydrochloric acid (anhydrous)
Hydrogen fluoride [a]	0203	Hydrofluoric acid (anhydrous)
Hydrogen iodide	0203	Hydroiodic acid (anhydrous)
Iodotrifluoromethane	0200-**0100** [b]	Trifluoromethyl iodide
Methyl bromide	0200	Bromomethane
Methyldichloroarsine	0303	
Mustard gas	0303	
Nitrosyl chloride	0303	
Perfluoro-2-butene	0200-**0100** [b]	
Phenylcarbylamine chloride	0303	
Phosgene	0303	Carbonyl chloride
Phosphorus pentafluoride	0203	
Phosphorus trifluoride	0203	
Silicon tetrachloride	0203	
Silicon tetrafluoride [a]	0253	Tetrafluorosilane R764
Sulfur dioxide	0201	
Sulfur tetrafluoride	0300	
Sulfuryl fluoride	0200	
Tungsten hexafluoride	0303	
Uranium hexafluoride	0303	

[a] Some products, being liquid at normal ambient conditions, are included since they may be supplied in non-pressurized containers. They are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.

[b] To be consistent with ISO 10298, the former FTSC code is completed by the new one in boldface corresponding to the new toxicity level.

For gas mixtures, see 3.3.2

A.2.6 Group 5 gases

See Table A.6.

Table A.6 — Gases belonging to group 5

Gas	FTSC code	Synonym
Air	1050	

A.2.7 Group 6 gases and gas mixtures

See Table A.7.

Table A.7 — Gases and gas mixtures belonging to group 6

Gas	FTSC code	Synonym
Allene	2100	Propadiene
Bromotrifluoroethylene	2100	R 113B1
Butane	2100	
1 - Butene	2100	Butylene
2 - Butene	2100	Butylene
1-Chloro-1,1-difluoroethane	2100	R142b
Chlorofluoromethane	2100	
Deuterium	2150	
1,1-Difluoroethane	2100	Ethylidene fluoride R 152a
Difluoromethane	0110	Methylene fluoride R 32
1,1-Difluoroethylene	2110	Vinylidene fluoride R1132a
Dimethylether	2100	Methyl ether
2,2-Dimethylpropane [a]	2100	Tetramethylmethane
Ethane	2110	R170
Ethylacetylene	2100	1-Butyne
Ethylchloride [a]	2100	Chloroethane R160
Ethylene	2150	Ethene
Ethyl ether (inflammable liquid) [a]	2100	R1150
Hydrogen	2150	
Isobutane	2100	Trimethylmethane R601
Isobutylene	2100	2-Methylpropene
Methane	2150	R50
Methylacetylene [a]	2100	Allylene; Propyne
3-Methyl-1-butene [a]	2100	Isoamylene:Isopropylethylene
Methyl ethyl ether	2100	Ethyl methyl ether
Methyl fluoride	2110	Fluoromethane R41
Natural gas	2150	
Propane	2100	R290
Propylene	2100	Propene R1270
1,1,1-Trifluoroethane	2100	R143a

[a] Some products, being liquid at normal ambient conditions, are included since they may be supplied in non-pressurized containers. They are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.

For gas mixtures, see 3.3.2

A.2.8 Group 7 gases and gas mixtures

See Table A.8.

Table A.8 — Gases and gas mixtures belonging to group 7

Gas	FTSC code	Synonym
Ammonia	2102	R717
Dimethylamine	2102	
Monoethylamine [a]	2102	Ethylamine R631
Monomethylamine	2102	Methylamine R630
Trimethylamine	2102	

[a] Some products, being liquid at normal ambient conditions, are included since they may be supplied in non-pressurized containers. They are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.

For gas mixtures, see 3.3.2

A.2.9 Group 8 gases and gas mixtures

See Table A.9.

Table A.9 — Gases and gas mixtures belonging to group 8

Gas	FTSC code	Synonym
Arsine	2300	
Carbon monoxide	2250	
Carbonyl sulfide	2201	Carbonoxylsulfide
Chloromethane	2200-**2100** [b]	Methyl chloride R40
Coal gas	Mixture	
Cyanogen	2200	
Cyclopropane	2200-**2100** [b]	Trimethylene
Deuterium selenide	2301	
Deuterium sulfide	2201	
Dichlorosilane [a]	2203	
Dimethylsilane	2300-**2100** [b]	
Fluoroethane	2300-**2100** [b]	Ethyl fluoride
Germane	2300	
Heptafluorobutyronitrile [a]	2300	
Hexafluorocyclobutene	2100	
Hyrogen selenide	2301	
Hydrogen sulfide [a]	2201	
Methyl mercaptan	2201	Methanethiol
Methylsilane	2300-**2100** [b]	
Nickel carbonyl [a]	2300	Nickel tetracarbonyle
Pentafluoropropionitrile	2300	
Tetraethyl lead	2300	
Tetramethyl lead	2200	
Trifluoroacetonitrile	2200	
Trifluoroethylene	2200	
Trimethylsilane	2300-**2100** [b]	

[a] Some products, being liquid at normal ambient conditions, are included since they may be supplied in non-pressurized containers. They are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.

[b] To be consistent with ISO 10298, the former FTSC code is completed by the new one in boldface corresponding to the new toxicity level.

For gas mixtures, see 3.3.2

A.2.10 Group 9 gases and gas mixtures

See Table A.10.

Table A.10 — Gases and gas mixtures belonging to group 9

Gas	FTSC code	Synonym
Diethylzinc [a]	3300	
Pentaborane [a]	3300	
Phosphine	3310	
Silane	3150	Silicone tetrahydride
Triethyl aluminium [a]	3300	
Triethyl borane,	3200	
Trimethylstibine [a]	3300	

[a] Some products, being liquid at normal ambient conditions, are included since they may be supplied in non-pressurized containers. They are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.

For gas mixtures, see 3.3.2.

A.2.11 Group 10 gases

See Table A.11.

Table A.11 — Gases belonging to group 10

Gas	FTSC code	Synonym
Oxygen	4150	

A.2.12 Group 11 gases

See Table A.12.

Table A.12 — Gases belonging to group t1

Gas	FTSC code	Synonym
Nitrous oxide	4110	

A.2.13 Group 12 gases and gas mixtures

See Table A.13.

Table A.13 — Gases and gas mixtures belonging to group 12

Gas	FTSC Code	Synonym
Bis-trifluoromethylperoxide	4300	
Bromine pentafluoride [a]	4303	
Bromine trifluoride [a]	4303	
Chlorine	4203	
Chlorine pentafluoride	4303	
Chlorine trifluoride	4203	
Fluorine	4343	
Iodine pentafluoride	4303	
Nitric oxide	4351	Nitrogen(II) oxide
Nitrogen dioxide [a]	4301	Liquid dioxide Nitrogren (IV) oxide Dinitrogenetetraoxide Nitrogen peroxide
Nitrogen trifluoride	4153	Nitrogen tetraoxide
Nitrogen trioxide	4301	Nitrogen sesquioxide Dinitrogen trioxide Nitrogen (III) oxide
Oxygen difluoride	4343	
Ozone	4330	
Tetrafluorohydrazine	4343	

[a] Some products, being liquid at normal ambient conditions, are included since they may be supplied in non-pressurized containers. They are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.

For gas mixtures, see 3.3.2.

A.2.14 Group 13 gases and gas mixtures

See Table A.14.

Table A.14 — Gases and gas mixtures belonging to group 13

Gas	FTSC code	Synonym
1,3-Butadiene, stabilized	5100	
Chlorotrifluoroethylene, stabilized	5200	R1113
Diborane	5350	
Ethylene oxide	5200	Oxirane
Hydrogen cyanide, stabilized [a]	5301	Hydrocyanic acid (anhydrous)
Propylene oxide	5100	Methyl oxirane
Stibine	5300	Antimony hydride
Tetrafluoroethylene, stabilized	5100	
Vinyl bromide, stabilized [a]	5100	
Vinyl chloride, stabilized	5100	Chloroethylene R1140
Vinyl fluoride, stabilized	5100	Fluoroathyhne R1141
Methyl vinyl ether, stabilized	5100	Methoxyethylene

[a] Some products, being liquid at normal ambient conditions, are included since they may be supplied in non-pressurized containers. They are included in this grouping because valve outlets are necessary when these products are supplied together with a propellant in a pressure container.

For gas mixtures, see 3.3.2

A.2.15 Group 14 gases

See Table A.15.

Table A.15 — Gases belonging to group 14

Gas	FTSC code	Synonym
Acetylene	5130	Ethyne

A.2.16 Group 15 gas mixtures (normally medical)

For gas mixtures, see 3.3.2 for general applications.