INTERNATIONAL STANDARD

ISO 5145

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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
ISO 5145 : 1990 (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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 5145 was prepared by Technical Committee ISO/TC 58, *Gas cylinders.*

Annexes A, B and C form an integral part of this International Standard. Annex D is for information only.

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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 the four fundamental criteria of 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 for in the future in cases where a new gas or gas mixture is developed industrially.

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

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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 of a capacity not greater than 150 L.

It applies to the selection of gas cylinder valve outlet connections which have not yet been standardized on a national level. It particularly applies to countries having neither standards nor regulations and to new gases developed for industrial use.

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

2 General

Gas cylinders for medical use and gas cylinders for industrial use shall be differentiated in order to avoid confusion either by a suitable marking or by a colour code in accordance with ISO 32 and ISO 448.

Before selecting a valve outlet, reference shall be made to ISO 407 and ISO/TR 7470 to ascertain if an outlet is already in use in that geographic area for the gas under consideration. If this is the case, the existing outlet should be used.

3 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were 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 editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 32 : 1977, *Gas cylinders for medical use — Marking for identification of content.*

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 407 : — [1], *Small medical gas cylinders — Yoke-type valve connections.*

ISO 448 : 1981, *Gas cylinders for industrial use — Marking for identification of content.*

ISO 3601-1 : 1988, *Fluid systems — Sealing devices — O-rings — Part 1: Inside diameters, cross-sections, tolerances and size identification code.*

ISO/TR 7470 : 1988, *Valve outlets for gas cylinders — List of provisions which are either standardized or in use.*

1) To be published. (Revision of ISO 407 : 1983 and ISO 407 : 1983/Amd.1 : 1986.)

4 Principle of the determination of valve outlets

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

The FTSC code enables a gas or gas mixture to be assigned to one of the 15 "compatible" gas groups (see clause A.2). Valve outlet connections are allocated to each group (see clause 6).

4.1 Pure 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.

4.2 Gas mixtures

4.2.1 Definition

For the purposes of this International Standard, 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.

4.2.2 Assignment of a gas mixture to a group

NOTE — Account should be taken of national regulations concerning gas mixtures that are approved for manufacture.

The principle of allocation of a four-digit numerical code to gas mixtures is the same as that for pure gases. However, the allocation of a code to a gas mixture, allowing the assignment of this mixture to one of the groups of gases and gas mixtures depends on the chemical and toxicological properties of the components, with the exception of the flammability and oxipotential where these properties in the final mixture determine the group to which the gas mixture belongs.

Gas mixtures shall be grouped according to the following principles:

a) gas mixtures comprising components, all of which are pure gases in the same group, shall be assigned to that group;

b) gas mixtures comprising components which have been assigned, as pure gases, to different groups shall be allocated to a group as follows:

1) group 9 — if the mixture is spontaneously flammable,

2) group 7 — if the mixture comprises group 7 corrosive and flammable components,

3) group 8 — if the mixture comprises group 8 toxic, corrosive and flammable components,

4) group 12 — if the final mixture has an oxipotential greater than that of air,

5) group 4 — for all other mixtures;

c) gas mixtures free from toxic components, subject to decomposition or polymerization, shall be assigned to group 13;

d) flammable gas mixtures free from toxic components shall be assigned to group 6;

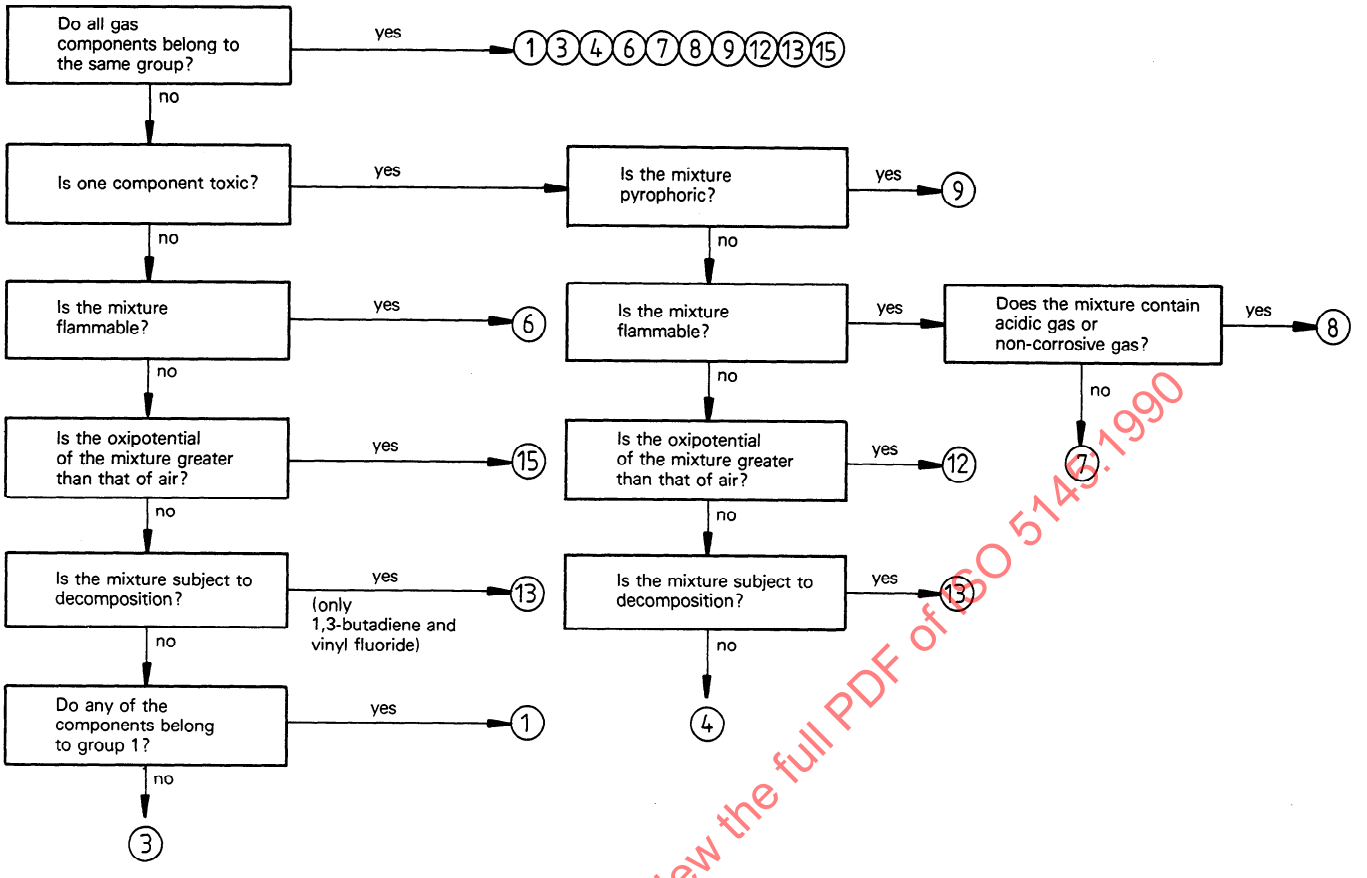
e) gas mixtures having an oxipotential greater than that of air but which are free from toxic components shall be assigned to group 15;

f) non-toxic, non-flammable, gas mixtures having an oxipotential equal to or less than that of air, and comprising components from group 1, shall be assigned to group 1;

g) non-toxic, non-flammable, gas mixtures having an oxipotential equal to or less than that of air, and which are free from group 1 gases, shall be assigned to group 3.

A flow chart to facilitate the allocation of a gas mixture to a gas group is given in figure 1.

1) 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.



The numerals in circles indicate the group to which the gas mixture belongs.

Figure 1 — Flow chart to facilitate the allocation of a gas mixture to a gas group

5 Determination of connection

5.1 Connection

A connection is a mechanical device which 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 2):

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 annex B). The thread is a Whitworth thread with a pitch of 2 mm (see figure 3).

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

5.2 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.

Two methods for ensuring a gas-tight seal are illustrated in annex C. These methods are

a) a metal-to-metal bull-nose joint — the gas-tight seal is maintained by applying a high torque, using a wrench if necessary (see figure C.1), and

b) an elastomer O-ring seal which is fitted to a bull-nose or biconical connection end — the gas-tight seal is maintained using a low torque (see figure C.2).

Other methods of sealing may be adopted.

No details of the construction of the outside surface are given since this will be subject to the method adopted for applying the sealing torque (i.e. with a wrench or by hand).

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

6 Allocation of connections

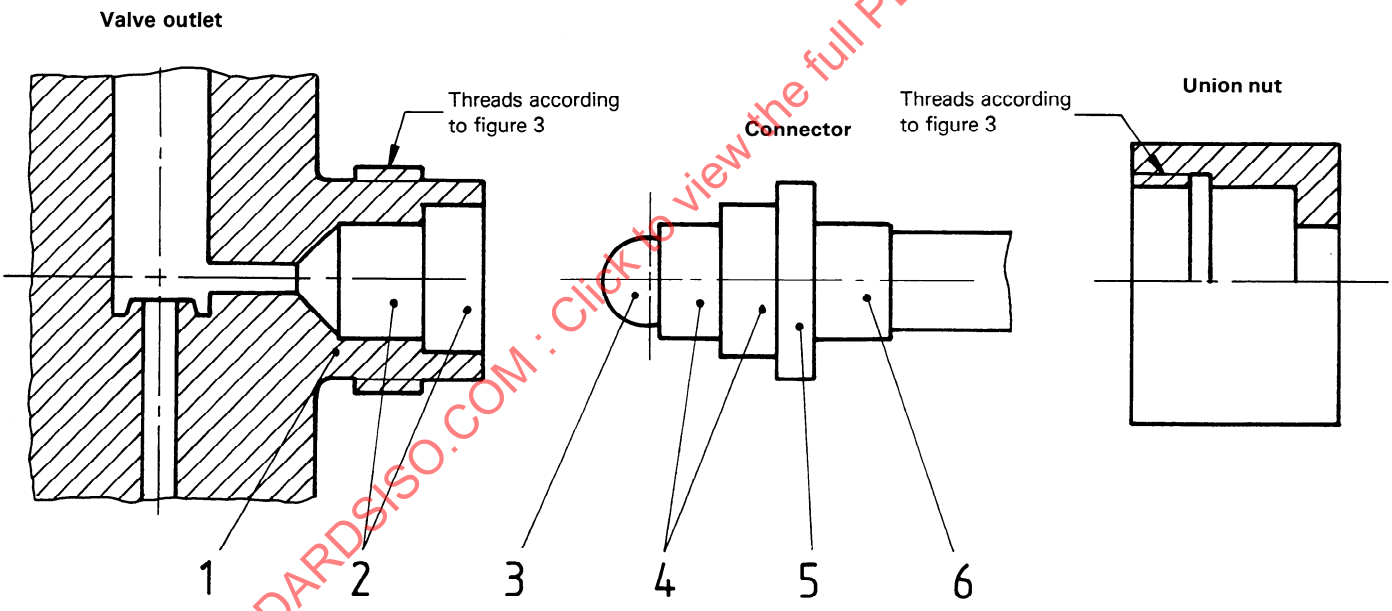
The allocation of 21 connections from the 42 that are available is shown in table 2.

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;

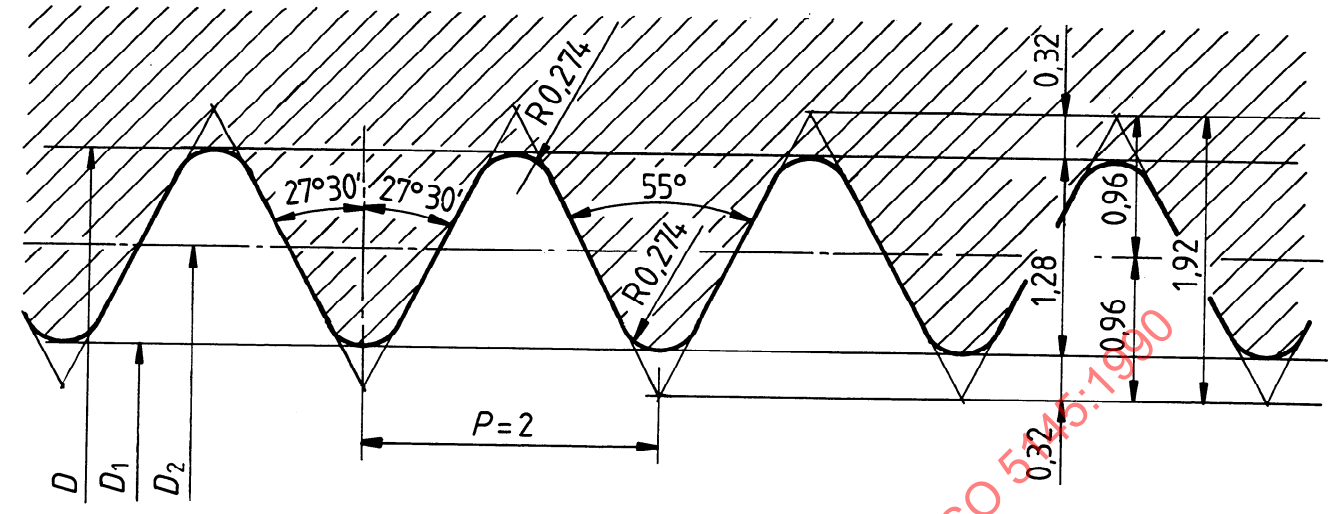
c) the connection(s) which is (are) allocated to the group.



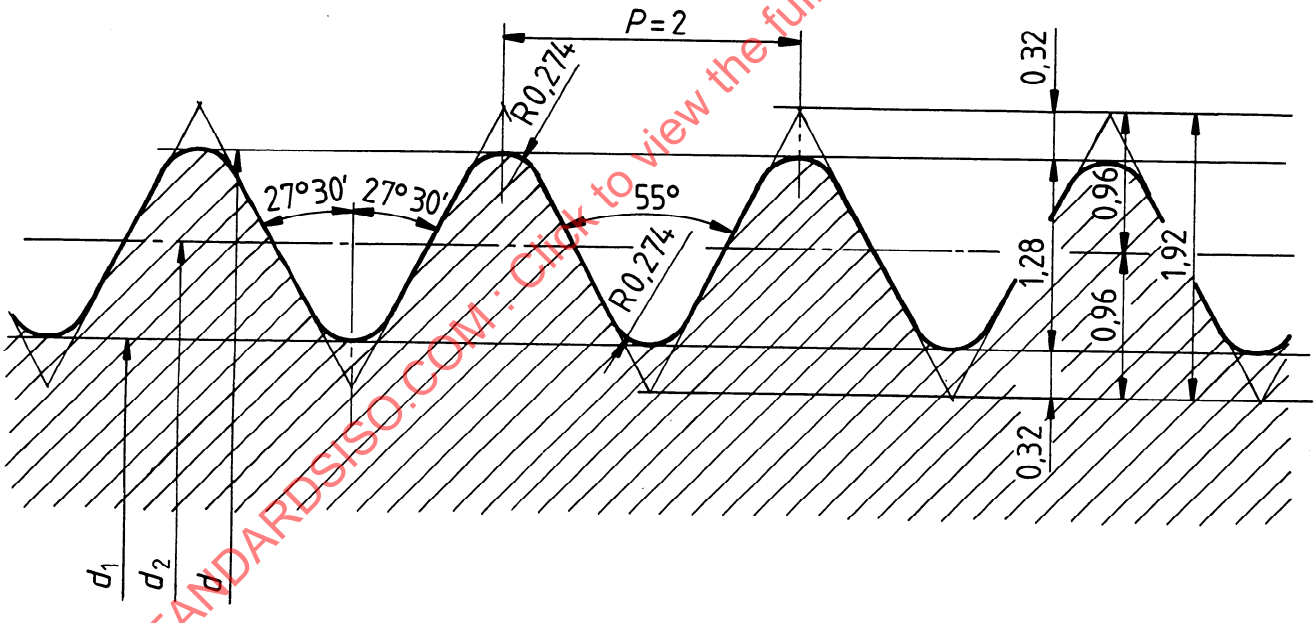
Reference	English	French	German
1	Valve outlet	Raccord de sortie	Seitenstutzen
2	Faucet	Matrice	Matrize
3	Nose	About	Kugelkopf
4	Spigot	Poinçon	Stempel
5	Shoulder	Épaulement	Schulterwehr
6	Shank	Hampe	Stiel

Figure 2 — Connection

Dimensions in millimetres



a) Internal thread



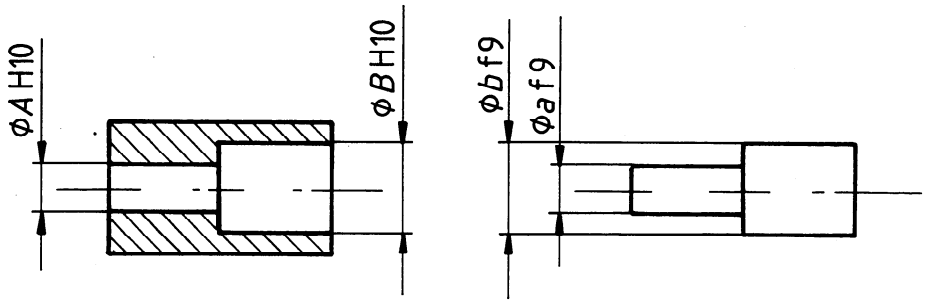
b) External thread

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 3 — Whitworth thread

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

Dimensions in millimetres



Faucet **Spigot**

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 number of combinations							21	21	42

NOTE — For the tolerances, see ISO 286.

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

Nominal diameter of the connection																
24					27					30						
A-B combination	Left-hand thread		Right-hand thread		*A-B* combination	Left-hand thread		Right-hand thread		*A-B* combination	Left-hand thread		Right-hand thread			
	Group (application) [1]	Gas or gas mixture (FTSC code)	Group (application) [1]	Gas or gas mixture (FTSC code)		Group (application) [1]	Gas or gas mixture (FTSC code)	Group (application) [1]	Gas or gas mixture (FTSC code)		Group (application) [1]	Gas or gas mixture (FTSC code)	Group (application) [1]	Gas or gas mixture (FTSC code)		
mm					mm					mm						
11,2-16,8	8 (M)	Cyclopropane (2200)	3 (M)	Helium (0150; 0160)	11,8-20,2			15 (M)	Air-oxygen mixture	12,4-23,6			3 (M)	Helium-oxygen mixture (O_2 < 20 %)		
11,9-16,1			(M)	Special mixtures	12,5-19,5					13,1-22,9			15 (M)	Oxygen-helium mixture (He < 80 %)		
12,6-15,4			15 (M)	78 % N_2-22 % O_2 mixture	13,2-18,8			15 (M)	50 % O_2-50 % N_2O mixture	13,8-22,2			15 (M)	O_2-CO_2 mixture (CO_2 < 7 %)		
13,3-14,7	6 (I)	(2150; 2160)	3 (I)	(0150; 0160)	13,9-18,1	13 (I)	(5100; 5200; 5300; 5301; 5350; 5360)	5 (I, M)	Air (1150; 1160)	14,5-21,5			15 (M)	CO_2-O_2 mixture (CO_2 > 7 %)		
			3 (M)	N_2 only												
14-14	6 (I)	Hydrogen (2150; 2160)	10 (I, M)	Oxygen (4150; 4160)	14,6-17,4	9 (I)	(3300; 3310; 3350)	4 (I)	(0200; 0201; 0203; 0213; 0300; 0303; 0253; 0263)	15,2-20,8						
					15,3-16,7	8 (I)	(2250; 2260)	11 (I, M)	Nitrous oxide (4110)	15,9-20,1	8 (I)	(2200; 2201; 2203; 2300; 2301;)				
					16-16	6 (I)	Commercial butane and propane	2 (I, M)	Carbon dioxide	16,6-19,4	7 (I)	(0202; 2202)				
										17,3-18,7	6 (I)	(2100; 2110) (except H_2 and commercial butane and propane)				
										18-18	14 (I)	Acetylene (5130)	1 (I)	(0100)		

1) I, Industrial; M, Medical.

Table 3 — Allocation of valve outlets

Group *n*	Gas and gas mixture characteristics at 15 °C	Gases and gas mixtures concerned: Pure gases, FTSC code	Gases and gas mixtures concerned: Gas mixture groups which when mixed with group *n* have the final characteristics of group *n*														Allocation of outlet connections: Right-hand (RH) or left-hand (LH) thread	Allocation of outlet connections: Nominal diameter of the connection 24 — Gases and gas mixtures and/or FTSC code	24 — *A-B* combination, mm	27 — Gases and gas mixtures and/or FTSC code	27 — *A-B* combination, mm	30 — Gases and gas mixtures and/or FTSC code	30 — *A-B* combination, mm
			1	2	3	4	5	6	7	8	9	10	11	12	13	14							
1	Non-flammable, non-toxic, gases; less stable thermally than group 3	0100	+	+	+		+ 1)	+ 2)				+ 1)	+ 1)				RH					0100	18-18
2	Carbon dioxide	0110		+													RH			0110	16-16		
3	Non-flammable, non-toxic and thermally stable gases (except carbon dioxide)	0150; 0160		+	+		+ 1)	+ 2)				+ 1)	+ 1)				RH	Medical He	11,2-16,8			He-O_2 (O_2 < 20%)	12,4-23,6
																		0150; 0160	13,3-14,7				
4	Non-flammable, toxic and corrosive or corrosive by hydrolysis gases	0200; 0201; 0203; 0213; 0300; 0303; 0253; 0263	+	+	+	+	+ 1)	+ 2)	+ 2)	+ 2)	+ 1)	+ 1)	+ 1)				RH			0200; 0201; 0213; 0300; 0303; 0253; 0263	14,6-17,4		
5	Air only	1150; 1160					+										RH			1150; 1160	13,9-18,1		
6	Flammable and non-toxic gases	2100; 2110; 2120; 2150; 2160	+	+	+		+ 1)	+				+ 1)	+ 1)		+ 3)	+	LH	H_2	14-14	Commercial butane and propane	16-16	2100; 2110; 2120	17,3-18,7
																		2150; 2160	13,3-14,7				
7	Flammable, toxic and corrosive (basic) gases	0202; 2202	+	+	+		+	+	+		+ 1)	+ 1)	+ 1)				LH					0202; 2202	16,6-19,4
8	Flammable, toxic and corrosive (acidic) or non-corrosive gases	2200; 2201; 2203; 2250; 2260; 2300; 2301	+	+	+		+	+		+	+	+ 1)	+ 1)	+ 1)	+		LH	Medical cyclopropane	11,2-16,8	2250; 2260	15,3-16,7	2200; 2201; 2203; 2300; 2301	15,9-20,1
9	Spontaneously flammable gases	3150; 3160; 3300; 3310	+	+	+			+	+	+	+				+		LH			3150; 3160; 3300; 3310	14,6-17,4		
10	Oxygen only	4150; 4160										+					RH	4150; 4160	14-14				
11	Nitrous oxide only	4110											+				RH			4110	15,3-16,7		
12	Oxidant, toxic and corrosive gases	4203; 4300; 4301; 4303; 4330; 4343; 4351; 4361	+	+	+		+					+	+	+			RH			4203; 4300; 4301; 4303; 4330; 4343; 4351; 4361	12,5-19,5		
13	Flammable gases subject to decomposition or polymerization	5100; 5200; 5300; 5301; 5350; 5360	+	+	+		+	+	+						+		LH			5100; 5200; 5300; 5301; 5350; 5360	13,9-18,1		
14	Acetylene only	5130														+	LH					5130	18-18
15	Oxidant, non-toxic and non-corrosive gas mixtures		+	+	+		+	+				+	+				RH	78 % N_2-22 % O_2	12,6-15,4			O_2-He (He < 80%)	13,1-22,9
																				50 % N_2O-50 % O_2	13,2-18,8	O_2-CO_2(CO_2 < 7%)	13,8-22,2
																				Air-O_2	11,8-20,2	CO_2-O_2(CO_2 > 7%)	14,5-21,5

1) Provided that the final mixture has an oxipotential equal to or less than that of air.

2) Provided that the final mixture is non-flammable.

3) Provided that the final mixture is non-toxic.

Annex A
(normative)

Gas groups

A.1 Numerical gas code (FTSC)

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 flame propagation.

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.

Each category is sub-divided 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.1.1 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.1.2 Toxicity, category II

Subdivision 1: non-toxic (over 500 ppm concentration in air permitted for an 8 h exposure);

Subdivision 2: toxic (50 ppm to 500 ppm concentration in air permitted for an 8 h exposure);

Subdivision 3: very toxic (less than 50 ppm concentration in air permitted for an 8 h exposure).

A.1.3 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 phases withdrawal at 35 bar or less;

Subdivision 5: permanent gas between 35 bar and 300 bar;

Subdivision 6: permanent gas between 35 bar and 200 bar;

Subdivision 7: permanent gas above 200 bar or 300 bar.

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 300 bar reflects the present tendency towards higher pressure applications. The current North American practice requires a limit of 200 bar for which their pressure reducing valves are designed.

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. 200 bar or 300 bar);

Subdivision 7: high pressure range, the lower limit (200 bar or 300 bar) of which depends on the subdivision selected for the medium pressure range.

It is anticipated that the trend towards higher pressures will become international in the future so that the medium pressure range will extend from 35 bar to 300 bar (subdivision 5).

A.1.4 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

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
11	Nitrous oxide
12	Oxidant, toxic and 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

Summaries of the gases and gas mixtures belonging to each group are given in A.2.1 to A.2.15.

A.2.1 Group 1 gases and gas mixtures

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

Gas	FTSC code	Synonym
Bromochlorodifluoromethane	0100	R12B1
Bromochloromethane	0100	
Bromotrifluoromethane	0100	Trifluorobromomethane R13B1
Chlorodifluoromethane	0100	Monochlorodifluoromethane R22
Chloroheptafluoro-cyclobutane [1]	0100	C317
Chloropentafluoroethane	0100	Monochloropentafluoro-ethane R115
1-Chloro-1,2,2,2-tetrafluoro-ethane	0100	R124
1-Chloro-2,2,2-trifluoro-ethane	0100	R133A
Chlorotrifluoromethane	0100	Monochlorotrifluoromethane R13
1,2-Dibromotetrafluoro-ethane [1]	0100	R114B2
1,2-Dichlorodifluoroethylene	0100	R1112a
Dichlorodifluoromethane	0100	R12
Dichlorofluoromethane	0100	R21
1,2-Dichlorohexafluorocyclo-butane [1]	0100	C316
1,1-Dichlorotetrafluoro-ethane	0100	R114A
1,2-Dichlorotetrafluoro-ethane	0100	R114
2,2-Dichloro-1,1,1-trifluoro-ethane [1]	0100	R123
Difluoromethane	0110	Methylene fluoride
Hexafluoroethane	0100	Perfluoroethane R116
Hexafluoropropylene	0100	Hexafluoropropene
Octafluorocyclobutane	0100	Perfluorocyclobutane C318
Octafluoropropane	0100	Perfluoropropane R218
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	
Tetrafluoroethylene	0100	Carbon tetrafluoride R1114
Trichlorofluoromethane [1]	0100	Trichloromonofluoromethane R11
1,1,1-Trichlorotrifluoro-ethane [1]	0100	R113a
1,1,2-Trichlorotrifluoro-ethane [1]	0100	R113
Trifluoromethane	0100	Fluoroform R23

1) Products having a critical temperature greater than 50 °C, or at 50 °C a vapour pressure lower than 3 bar, 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.

Group 1 gas mixtures may be one of the following:

a) intentional mixtures containing gases listed in group 1 only or containing gases listed in group 1 together with all or any of the gases in group 2 and group 3, irrespective of concentration;

b) mixtures (generally as above) containing oxidant gases, from groups 5, 10 and 11, provided that the final mixture has an oxipotential less than or equal to that of air;

c) mixtures containing flammable gases from group 6, provided that the final mixture is non-flammable.

A.2.2 Group 2 gases

Table A.3 — Gases belonging to group 2

Gas	FTSC code	Synonym
Carbon dioxide	0110	Carbonic acid R744 anhydride

A.2.3 Group 3 gases and gas mixtures

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

Gas	FTSC code	Synonym
Argon	0150; 0160	
Helium	0150; 0160	
Krypton	0150; 0160	
Neon	0150; 0160	
Nitrogen	0150; 0160	
Xenon	0150; 0160	
Tetrafluoromethane	0150; 0160	Carbon tetrafluoride R14

Group 3 gas mixtures may be one of the following:

a) intentional mixtures containing gases listed in group 3 only or containing gases listed in group 3 together with all or any of the gases in group 2, irrespective of concentration;

b) mixtures (generally as above) containing oxidant gases, from groups 5, 10 and 11, provided that the final mixture has an oxipotential equal to or less than that of air;

c) mixtures containing flammable and non-toxic gases from group 6 may be allocated to this group provided that the final mixture has been proven to be non-flammable and is non-toxic.

A.2.4 Group 4 gases and gas mixtures

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

Gas	FTSC code	Synonym
Antimony pentafluoride[1)]	0303	
Boron trichloride	0203	Boron chloride
Boron trifluoride	0253; 0263	Boron fluoride
Bromoacetone[1)]	0303	
Carbonylfluoride	0213	
Cyanogen chloride	0303	
Deuterium chloride	0213	
Deuterium fluoride	0203	
Dibromodifluoro-methane[1)]	0200	R12B2
Dichloro-2-chlorovinyl-arsine	0303	Lewisite
Diphosgene[1)]	0303	
Ethyldichloroarsine[1)]	0303	
Hexafluoroacetone	0203	Hexafluoropropan-2; perfluoroacetone
Hydrogen bromide	0203	Hydrobromic acid (anhydrous)
Hydrogen chloride	0213	Hydrochloric acid (anhydrous)
Hydrogen fluoride[1)]	0203	Hydrofluoric acid (anhydrous)
Hydrogen iodide	0203	Hydroiodic acid (anhydrous)
Iodotrifluoromethane	0200	Trifluoromethyl iodide
Methyl bromide	0300	Bromomethane
Methyldichloroarsine	0303	
Mustard gas	0303	
Nitrosyl chloride	0203	
Perfluoro-2-butene	0200	
Phenylcarbylamine chloride	0303	
Phosgene	0303	Carbonyl chloride
Phosphorus pentafluoride	0203	
Phosphorus trifluoride	0203	
Silicon tetrachloride	0203	
Silicon tetrafluoride[1)]	0253; 0263	Tetrafluorosilane R764
Sulfur dioxide	0201	
Sulfur tetrafluoride	0203	
Sulfuryl fluoride	0300	
Tungsten hexafluoride	0303	
Uranium hexafluoride	0303	

1) Products having a critical temperature greater than 50 °C, or at 50 °C a vapour pressure lower than 3 bar, 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.

Group 4 gas mixtures may be one of the following:

a) intentional mixtures containing gases listed in group 4 only or containing gases listed in group 4 together with all or any of the gases in group 1, group 2 and group 3, irrespective of concentration;

b) mixtures (generally as above) containing oxidant gases, from groups 5, 10, 11 and 12, provided that the final mixture has an oxipotential less than or equal to that of air;

c) mixtures containing flammable gases from groups 6, 7, 8, 9 and 13 provided that it has been proven that the final mixture is not flammable and is not liable to decomposition.

A.2.5 Group 5 gases

Table A.6 — Gases belonging to group 5

Gas	FTSC code	Synonym
Air	1150; 1160	

A.2.6 Group 6 gases and gas mixtures

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

Gas	FTSC code	Synonym
Allene	2100	Propadiene
Bromotrifluoroethylene	2100	R113B1
Butane	2100; 2120	
1-Butene	2100	Butylene
2-Butene	2100	Butylene
1-Chloro-1,1-difluoro-ethane	2100	R142B
Chlorofluoromethane	2100	
Deuterium	2150; 2160	
1,1-Difluoroethane	2100	Ethylidene fluoride R152a
1,1-Difluoroethylene	2110	Vinylidene fluoride R1132a
Dimethyl ether	2100	Methyl ether
2,2-Dimethylpropane[1]	2100	Neopentane Tetramethylmethane
Ethane	2110	R170
Ethylacetylene	2100	1-Butyne
Ethylchloride (flammable liquid)	2100	Chloroethane R160
Ethylene	2150; 2160	Ethene
Ethyl ether[1]	2100	R1150
Hydrogen	2150; 2160	
Isobutane	2100	Trimethylmethane R601
Isobutylene	2100	Isobutene; 2-Methylpropene
Methane	2150; 2160	R50
Methylacetylene[1]	2100	Allylene; Propyne
Methyl-3-butene[1]	2100	Isoamylene; Isopropylethylene
Methyl ethyl ether	2100	Ethyl methyl ether
Methyl fluoride	2110	Fluoromethane R41
Natural gas	2150; 2160	
Propane	2100; 2120	R290
Propylene	2100	Propene R1270
1,1,1-Trifluoroethane	2100	R143a

1) Products having a critical temperature greater than 50 °C, or at 50 °C a vapour pressure lower than 3 bar, 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.

Group 6 gas mixtures may be one of the following:

a) intentional mixtures containing gases listed in group 6 and group 14 only or containing gases listed in group 6 and/or group 14 with all or any of the gases in group 1, group 2, group 3 and group 13 (excluding toxic gases from this group), provided that it has been proven that the final mixture is flammable and non-toxic;

b) mixtures (generally as above) containing oxidant gases from groups 5, 10 and 11 provided that the final mixture has an oxipotential equal to or less than that of air.

A.2.7 Group 7 gases and gas mixtures

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

Gas	FTSC code	Synonym
Ammonia	0202	R717
Dimethylamine	2202	
Monoethylamine[1]	2202	Ethylamine R631
Monomethylamine	2202	Methylamine R630
Trimethylamine	2202	

1) Products having a critical temperature greater than 50 °C, or at 50 °C a vapour pressure lower than 3 bar, 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.

Group 7 gas mixtures may be one of the following:

a) intentional mixtures containing gases listed in group 7 only or containing gases listed in group 7 with all or any of the gases in group 1, group 2, group 3 and group 6, provided that the final mixture is flammable;

b) mixtures (generally as above) containing oxidant gases from groups 5, 10, 11 and 12 provided that the final mixture has an oxipotential equal to or less than that of air.

A.2.8 Group 8 gases and gas mixtures

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

Gas	FTSC code	Synonym
Arsine	2300	
Carbon monoxide	2250; 2260	
Carbonyl sulfide	2301	Carbonoxylsulfide
Chloromethane	2200	Methyl chloride R40
Coal gas	Mixture	
Cyanogen	2300	
Cyclopropane	2200	Trimethylene
Deuterium selenide	2301	
Deuterium sulfide	2301	
Dichlorosilane [1)]	2203	
Dimethylsilane	2300	
Fluoroethane	2300	Ethyl fluoride
Germane	2300	
Heptafluorobutyronitrile [1)]	2300	
Hexafluorocyclobutene	2300	
Hyrogen selenide	2301	
Hydrogen sulfide [1)]	2301	
Methyl mercaptan	2201	Methanethiol
Methylsilane	2300	
Nickel carbonyl [1)]	2300	Nickel tetracarbonyle
Pentafluoropropionitrile	2300	
Tetraethyl lead	2300	
Tetramethyl lead	2300	
Trifluoroacetonitrile	2300	
Trifluoroethylene	2200	
Trimethylsilane	2300	

1) Products having a critical temperature greater than 50 °C, or at 50 °C a vapour pressure lower than 3 bar, 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.

Group 8 gas mixtures may be one of the following:

a) intentional mixtures containing gases listed in group 8 only or containing gases listed in group 8 with all or any of the gases in group 1, group 2, group 3, group 4, group 6, group 7, group 9 and group 13, provided that the final mixture is flammable;

b) mixtures (generally as above) containing oxidant gases from groups 5, 10, 11 and 12 provided that the final mixture has an oxipotential equal to or less than that of air.

A.2.9 Group 9 gases and gas mixtures

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

Gas	FTSC code	Synonym
Diethylzinc [1)]	3300	
Pentaborane [1)]	3300	
Phosphine	3310	
Silane	3150; 3160	Silicone tetrahydride
Triethyl aluminium [1)]	3300	
Triethyl borane [1)]	3300	
Trimethylstibine [1)]	3300	

1) Products having a critical temperature greater than 50 °C, or at 50 °C a vapour pressure lower than 3 bar, 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.

Group 9 gas mixtures comprise intentional mixtures containing gases listed in group 9 only or containing gases listed in group 9 with all or any of the gases in group 1, group 2, group 3, group 6, group 7, group 8 and group 13, unless it is proven that the final mixture is not spontaneously flammable nor flammable in which case the mixture would appear in group 4. If the final gas mixture is flammable it would appear in group 8.

A.2.10 Group 10 gases

Table A.11 — Gases belonging to group 10

Gas	FTSC code	Synonym
Oxygen	4150; 4160	

A.2.11 Group 11 gases

Table A.12 — Gases belonging to group 11

Gas	FTSC code	Synonym
Nitrous oxide	4110	

A.2.12 Group 12 gases and gas mixtures

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

Gas	FTSC code	Synonym
Bis-trifluoromethylperoxide	4300	
Bromine pentafluoride [1]	4303	
Bromine trifluoride [1]	4303	
Chlorine	4203	
Chlorine pentafluoride	4303	
Chlorine trifluoride	4303	
Fluorine	4343	
Iodine pentafluoride	4303	
Nitric oxide	4351; 4361	Nitrogen(II) oxide
Nitrogen dioxide [1]	4301	Liquid dioxide Nitrogen(IV) oxide Dinitrogentetraoxide Nitrogen peroxide Nitrogen tetroxide
Nitrogen trioxide	4301	Nitrogen sesquioxide Dinitrogen trioxide Nitrogen(III) oxide
Oxygen difluoride	4343	
Ozone	4330	
Tetrafluorohydrazine	4343	

1) Products having a critical temperature greater than 50 °C, or at 50 °C a vapour pressure lower than 3 bar, 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.

Group 12 gas mixtures comprise all intentional mixtures containing oxidant, toxic and corrosive gases as components with or without other gas(es) and where the final mixture has an oxipotential greater than that of air.

A.2.13 Group 13 gases and gas mixtures

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

Gas	FTSC code	Synonym
1,3-Butadiene (inhibited)	5100	
Chlorotrifluoroethylene	5200	
Diborane	5350; 5360	
Ethylene oxide	5200	Oxirane
Hydrogen cyanide [1]	5301	Hydrocyanic acid (anhydrous)
Propylene oxide	5200	Methyl oxirane
Stibine	5300	Antimonyhydride
Vinyl bromide (inhibited) [1]	5200	
Vinyl chloride (inhibited)	5200	Chloroethylene R1140
Vinyl fluoride (inhibited)	5100	Fluoroethylene R1141
Methyl vinyl ether (inhibited)	5200	Methoxyethylene

1) Products having a critical temperature greater than 50 °C, or at 50 °C a vapour pressure lower than 3 bar, 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.

Group 13 gas mixtures comprise all intentional mixtures containing gases listed in group 13 only or gases listed in group 13 together with all or any of the gases in group 1, group 2, group 3, group 6, group 7 and group 8, unless it is proven that the final mixture is non-flammable or not subject to decomposition in which case if would appear in group 4 (if toxic components are present) or group 6.

A.2.14 Group 14 gases

Table A.15 — Gases belonging to group 14

Gas	FTSC code	Synonym
Acetylene	5130	Ethyne

A.2.15 Group 15 gas mixtures

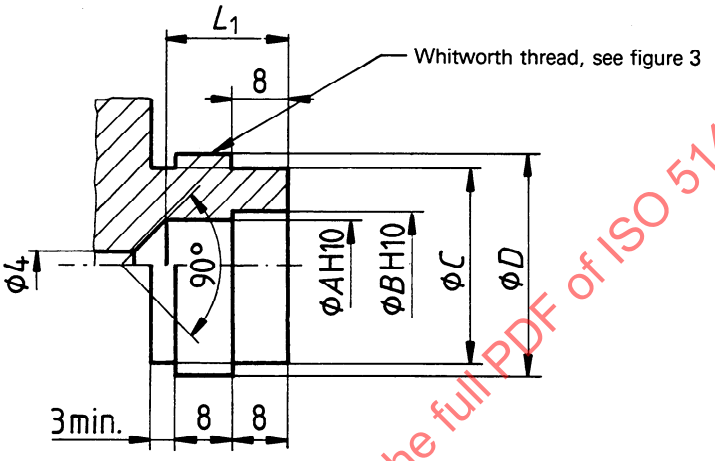
Group 15 gas mixtures comprise all intentional mixtures containing oxygen, air and nitrous oxide as components with or without other non-toxic and non-corrosive gases from groups 1, 2 and 3, and where the final mixture has an oxipotential greater than that of air.

Annex B
(normative)

Connections

B.1 Valve outlets

Dimensions in millimetres



NOTE — For the tolerances, see ISO 286.

Figure B.1 — Valve outlet

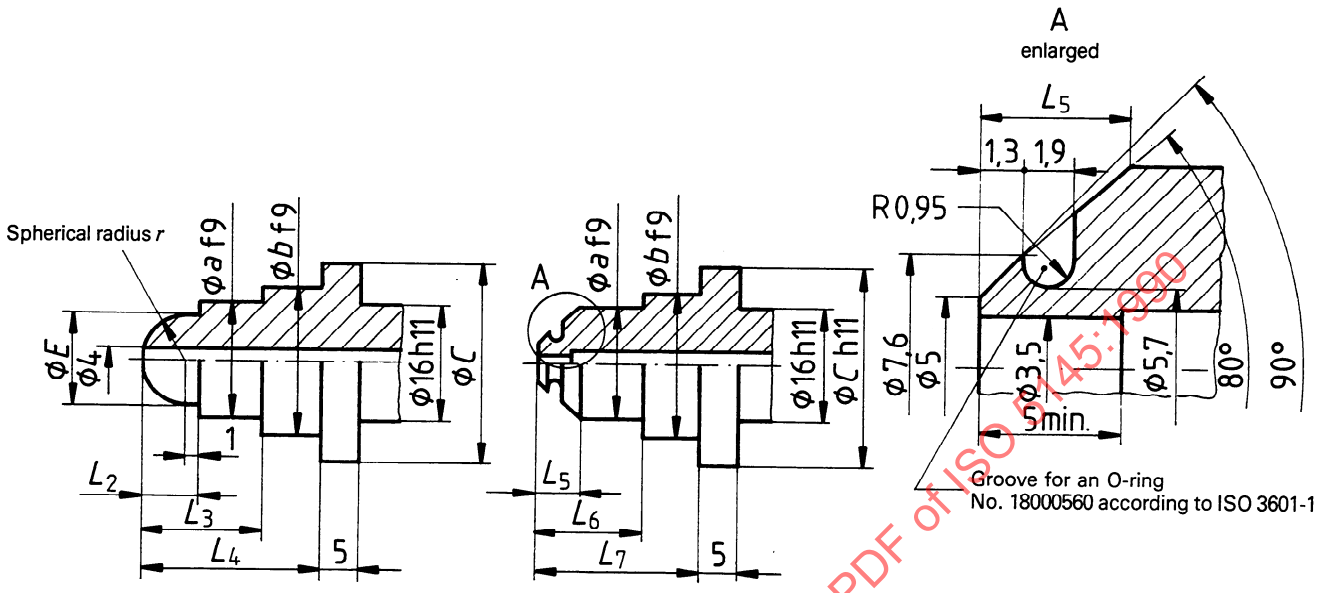
Table B.1 — Dimensions of valve outlets

Dimensions in millimetres

Nominal thread diameter D = nominal diameter of the connection	Constant $A + B$	A	B	C	L_1
24	28	11,2 11,9 12,6 13,3 14	16,8 16,1 15,4 14,7 14	21	17,6 17,3 17 16,6 16,3
27	32	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	24	17,4 17 16,7 16,3 16 15,6 15,3
30	36	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	27	17,8 17,4 17 16,7 16,3 16 15,7 15,3 15

B.2 Connectors

Dimensions in millimetres



a) Bull-nose connector

b) Biconical connector

NOTE — For the tolerances, see ISO 286.

Figure B.2 — Connectors

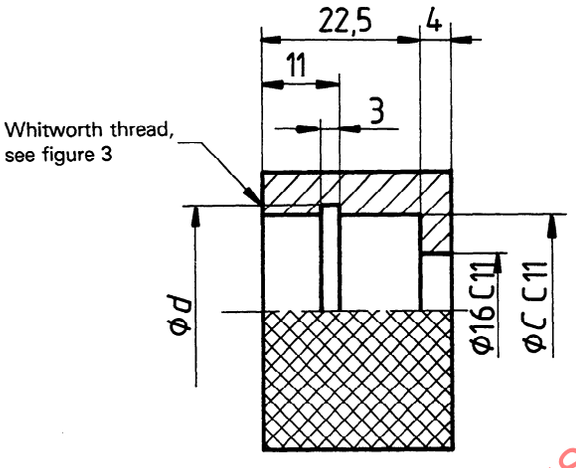
Table B.2 — Dimensions of connectors

Dimensions in millimetres

Nominal diameter of the connection = nominal thread diameter D	Constant $A + B$	A	B	C	r	E	L_2	L_3	L_4	L_5	L_6	L_7
24	28	11,2 11,9 12,6 13,3 14	16,8 16,1 15,4 14,7 14	21	5,5	11	6,5	14,5	22,5	3,44 3,86 4,28 4,7 5,11	14,3	22,3
27	32	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	24						3,8 4,23 4,64 5,05 5,47 5,9 6,3		
30	36	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	27	6	12	7	15	23	4,46 4,88 5,3 5,71 6,13 6,54 6,96 7,38 7,8	15,3	23,3

B.3 Union nut

Dimensions in millimetres



NOTE — For the tolerances, see ISO 286.

Nominal thread diameter d = nominal diameter of the connection	C
24	21
27	24
30	27

Figure B.3 — Union nut

Annex C
(normative)

Double-faucet non-interchangeable connections

C.1 Metal-on-metal gas-tight seal (bull-nose connector)

Dimensions in millimetres

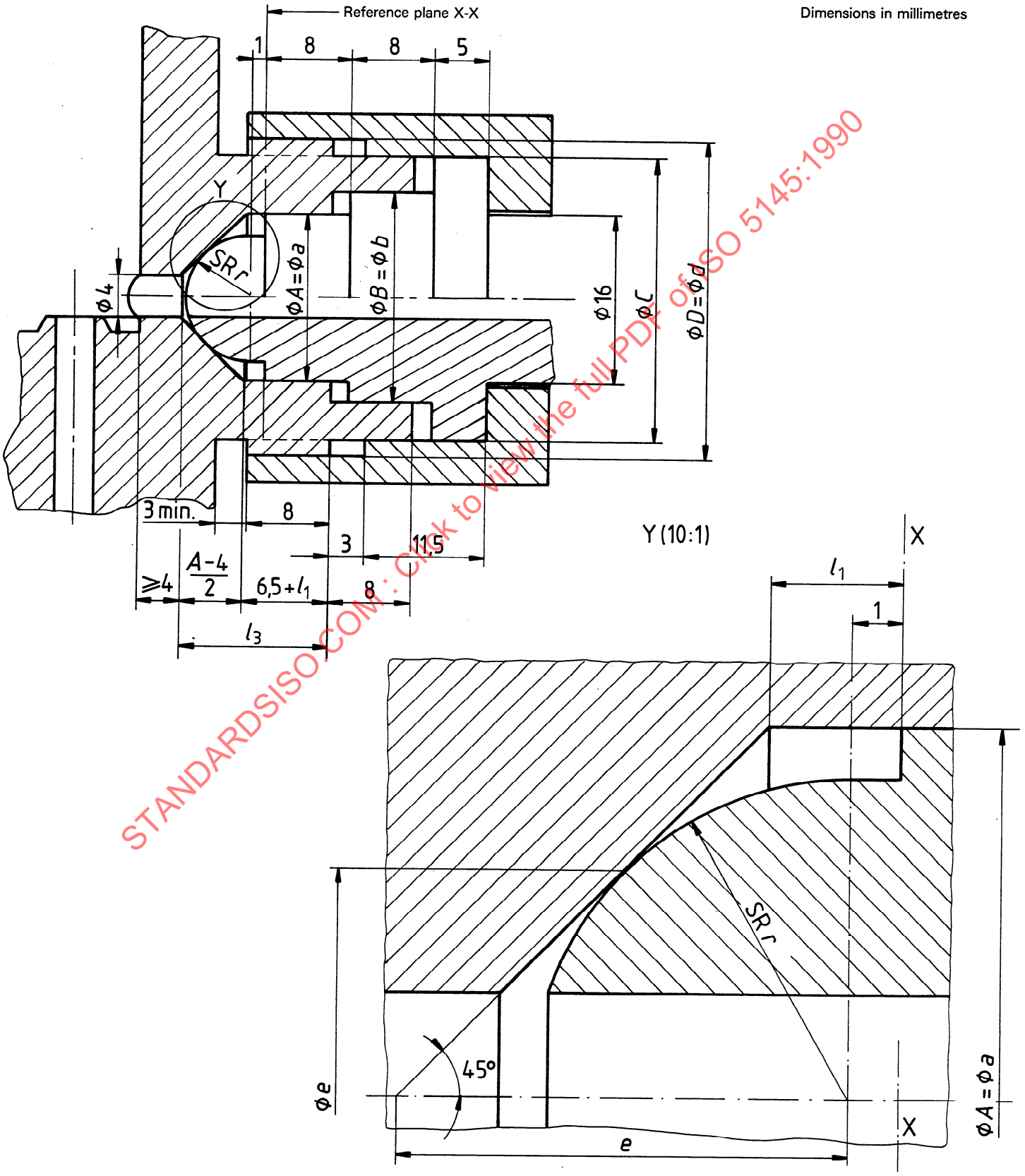


Figure C.1 — Bull-nose connector