

Specification for

Filling ratios and developed pressures for liquefiable and permanent gases

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British Chemical Engineering Contractors' Association	Institution of Chemical Engineers*
British Gas Corporation	Institution of Gas Engineers
British Insurance (Atomic Energy) Committee	Institution of Mechanical Engineers
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Electricity Supply Industry in England and Wales	Water-tube Boilermakers' Association
	Welding Institute

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard.

Aluminium Federation	Department of Industry (National Engineering Laboratory)
Association of Drum Manufacturers	Institution of Fire Engineers
British Compressed Gases Association	Institute of Refrigeration
British Railways Board	Liquefied Petroleum Gas Industry Technical Association (UK)
British Steel Corporation	Ministry of Defence
Camping Trade Association of Great Britain	Society of Motor Manufacturers and Traders Ltd.
Chief and Assistant Chief Fire Officers' Association	
Department of the Environment	

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Foreword

This British Standard is one of a series based upon the recommendations in the report (published in 1969) of the Home Office Gas Cylinders and Containers Committee for materials, design, construction, testing, filling and maintenance of containers intended for the conveyance by road of permanent and liquefiable gases under pressure.

It has been prepared under the auspices of the Pressure Vessel Standards Committee at the request of the Home Office in order to satisfy the technical requirements of new legislation currently under consideration for such conveyance.

This particular standard deals with filling ratios and developed pressures for liquefiable and permanent gases filled into containers.

This British Standard replaces BS 1736 published in 1951 and presents a wider scope in that filling ratios are specified for a greater number of liquefiable gases and it also specifies the developed pressures for permanent gases. BS 1736 is now withdrawn.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 40, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies the filling ratios and developed pressures to be used when filling, selecting or designing containers of 1 litre water capacity and above for conveyance of liquefiable or permanent gases by road within the United Kingdom.

NOTE As guidance only, for overseas markets, corresponding filling ratio and developed pressure data for climatic areas other than the United Kingdom are given in Appendix C.

2 References

The titles of the British Standards referred to in this standard are listed on the inside back cover.

3 Definitions

For the purposes of this British Standard the following definitions apply.

3.1

critical temperature

the temperature above which the substance cannot exist in a liquid state

3.2

liquefiable gas

a gas which is liquefiable by pressure at $-10\text{ }^{\circ}\text{C}$ but which is completely vapourized at $17.5\text{ }^{\circ}\text{C}$ when at not more than $1\,013\text{ mbar}^{1)}$

3.3

high-pressure liquefiable gas

a gas which has a critical temperature from $-10\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$ inclusive

3.4

low-pressure liquefiable gas

a gas which has a critical temperature above $70\text{ }^{\circ}\text{C}$ those toxic substances which are liquid at $1\,013\text{ mbar}^{1)}$ pressure at $0\text{ }^{\circ}\text{C}$ but which boil at or below $30\text{ }^{\circ}\text{C}$ at that pressure shall be treated as low-pressure liquefiable gases

3.5

permanent gas

a gas which has a critical temperature below $-10\text{ }^{\circ}\text{C}$

3.6

filling ratio

the ratio of the mass of gas introduced into a container to the mass of water (water capacity) at $15\text{ }^{\circ}\text{C}$ that fills the container fitted as for use, i.e. complete with valve, dip tube, float etc, as necessary

NOTE The water capacity stamped on the container may refer to the minimum designed water capacity of the container without fittings, in which case the net water capacity must be ascertained.

Although water capacity is defined as a mass it may be expressed as a volume.

where filling ratios are calculated in accordance with the requirements of Appendix A they shall be maximum values and hence the filling mass charged into a container must take account of the accuracy of the filling procedure

3.7

developed pressure

the pressure developed by the contents of the container at the pressure reference temperature as given in Table 2

3.8

reference temperature for filling ratio

the temperature at which the liquid density is to be evaluated for calculating the filling ratio

3.9

reference temperature for developed pressure

the temperature at which the developed pressure is to be determined

3.10

maximum permissible pressure

the maximum permissible pressure in service is the pressure developed by the contents at the pressure reference temperature taking into account the filling ratio for high pressure liquefiable gases and the intended charging pressure at $15\text{ }^{\circ}\text{C}$ for permanent gases

4 General

4.1 Table 1 classifies those gases conveyed in commercial quantities for which data are given in this standard. It also indicates any associated hazard.

4.2 The reference temperatures for filling ratio and for developed pressure referred to in this standard vary with the size of container. The relationship between reference temperature and container volume is given in Table 2.

4.3 Where filling ratios and developed pressures are not specified for gases or gas mixtures, the procedure to be followed is included as Appendix B to this standard.

¹⁾ $1\,013\text{ mbar} = 760\text{ mmHg}$.

Table 1 — Classification of gases

Permanent gases (t_c less than $-10\text{ }^{\circ}\text{C}$)	Liquefiable gases	
	High pressure ($t_c - 10\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$)	Low pressure (t_c greater than $70\text{ }^{\circ}\text{C}$)
Air Argon ^a Boron trifluoride ^{ba} Carbon monoxide ^{ba} Coal gas ^{ca} Fluorine Helium ^b Hydrogen ^b Methane (natural gas and town gas, excluding coal gas) Neon Nitrogen Oxygen	Carbon dioxide ^b Ethane ^b Ethylene ^{ca} Hydrogen chloride Bromotrifluoromethane (R.13B1) Chlorotrifluoromethane (R.13) Nitrous oxide Sulphur hexafluoride	^a Ammonia ^{ca} Boron trichloride ^b Butadiene Octafluorocyclobutane (R.C318) ^b Iso butane ^c n-butane ^{ca} Carbonyl chloride ^{ca} Chlorine ^{ca} Chlorine trifluoride ^a Cyanogen chloride ^b 1-chloro-1, 1-difluoroethane (R.142b) Chloropentafluoroethane (R.115) ^b 1, 1-difluoroethane (R.152a) 2-chloro-1, 1, 1-trifluoroethane (R.133a) 1, 2-dichlorotetrafluoroethane (R.114) ^b Dimethylether ^b Ethylamine ^b Ethyl chloride ^{ba} Ethylene oxide ^{ba} Hydrogen cyanide ^{ca} Hydrogen fluoride ^{ca} Hydrogen sulphide Bromochlorodifluoromethane (R.12B1) Chlorodifluoromethane (R.22) Dichlorofluoromethane (R.21) Dichlorodifluoromethane (R.12) ^b Monomethylamine ^b Dimethylamine ^b Trimethylamine ^a Methyl bromide ^{ba} Methyl chloride ^{ca} Nitrogen tetroxide ^{ca} Nitrosyl chloride ^b Propane ^b Cyclopropane ^b Propylene ^{ca} Sulphur dioxide ^b Vinyl chloride Gas mixtures: Azeotrope R500 (73.8 % R12 and 26.2 % R152a) Azeotrope R502 (48.8 % R22 and 51.2 % R115) ^a Ethylene oxide 12 % and R12, 88 %

^a These gases are poisonous and are the once referred to in this standard are toxic. Other gases not so marked may have poisonous properties in less degree or be suffocating in heavy concentrations.

^b For the purpose of transport these gases are considered to be flammable.

^c These gases are considered corrosive for the purpose of periodic testing, (see BS 5430).

t_c is the critical temperature.

Reference to refrigerants by number designation (e.g. R.12) is in accordance with international agreements (see BS 4580).

Table 2 — Reference temperature in °C for filling ratio and for developed pressure for conveyance in the United Kingdom (climatic area shade temperature $\leq 35^\circ\text{C}$ ($\leq 95^\circ\text{F}$))

Type of contents	Reference temperatures for filling ratio °C				Reference temperatures for developed pressure °C			
	Container volume V				Container volume V			
	V up to and including 130 litres	V greater than 130 litres up to and including 1 m ³	V greater than 1 m ³ up to and including 5 m ³	V greater than 5 m ³	V up to and including 130 litres	V greater than 130 litres up to and including 1 m ³ (see note)	V greater than 1 m ³ up to and including 5 m ³ (see note)	V greater than 5 m ³ (see note)
Low pressure liquefiable gases	45	42.5	42.5	38 ^b	55	50	47.5	42.5
High pressure liquefiable gases					52.5 ^a	52.5 ^a	50	45
Permanent gases					60			

NOTE For the purpose of the above table when the ratio of the overall length of the container to the diameter exceeds 4.5, the volume of the container shall be taken as that volume contained in a length 4.5 times the external diameter.

^a When safety devices are fitted to carbon dioxide containers this reference temperature may be reduced to 50 °C.

^b For containers exceeding 5 m³ in volume, the reference temperature for filling ratio may be reduced from 38 °C to 33 °C for the winter period, November to April, provided that containers so filled are discharged before the following 1 May.

4.4 The developed pressure figures quoted in the various tables are assumed to be for pure gases. If impurities are present the effect on the developed pressure must be taken into account, for example, by treating the impure substance as a mixture for the purposes of Appendix A.

4.5 The physical data for the majority of the gases in this standard are taken from the Report of the Home Office Gas Cylinders and Containers Committee, published in 1969. Pressure values have been converted from lbf/in² to bar²⁾ using a factor of 0.068 947 6 and rounded to the same number of significant figures as in the above report.

5 Filling ratios and developed pressures for liquefiable gases for containers made to BS 5045, BS 5045-1, BS 5045-2 and BS 5045-3 and HOAL 3 and 4³⁾

5.1 High pressure liquefiable gases

5.1.1 The chosen filling ratio shall be such that

- 1) The pressure developed by the contents at the reference temperatures does not exceed the maximum permissible pressure.

- 2) The pressure developed at 5 °C above the reference temperature does not exceed the maximum permissible pressure by more than 20 %.

5.1.2 Filling ratios and the associated developed pressures at the reference temperatures applying in the United Kingdom for different sizes of containers are given in Table 3. If it is desired to use containers designed for developed pressures other than those given in Table 3, then the procedure in Appendix B shall be followed.

Formulae for calculating filling ratios are given in Appendix A. In calculating the filling ratio from the physical data, allowance shall be made for the negative degree of uncertainty in the accuracy of the density data.

5.1.3 For impure gases and mixtures of high pressure liquefiable gases with other gases, the permissible filling ratio shall be determined experimentally so as to comply with the requirements of **5.1.1**.

5.1.4 For guidance only for overseas markets, corresponding filling ratio and developed pressure data for climatic areas other than the United Kingdom are given in Appendix C, Table 19.

²⁾ 1 bar = 10⁵ N/m² = 100 kPa.

³⁾ Home Office specifications for aluminium alloy containers for the conveyance of compressed gases.

Table 3 — High pressure liquefiable gases

Gas	Critical temperature	Liquid density at 15 °C	Filling ratio	Developed pressures bar (gauge)		
				45 °C	50 °C	52.5 °C
Carbon dioxide	31.1	0.824	0.75 ^a 0.667 ^a	152.3 120.8	173.5 136.8	184.1 144.8
Ethane	32.1	0.370	0.36	135.8	150.3	157.2
Ethylene	9.7	—	0.325	145.5	157.9	164.1
Hydrogen chloride	51.3	0.86	0.78	127.9	153.2	165.9
Nitrous oxide	36.5	0.817	0.75	142.7	163.4	173.7
Refrigerant 13	28.9	0.99	1.09	160.8	177.5	186.3
Refrigerant 13B1	67.0	1.61	1.60	147.1	170.2	182.0
Sulphur hexafluoride with up to 1 % nitrogen impurity (m/m)	45.5 (pure SF ₆)	1.44	1.46	148.1	166.9	175.8

^a A 0.667 filling ratio shall be used for fire extinguishing applications, a 0.75 filling ratio shall be used for all other applications.

5.2 Low pressure liquefiable gases

5.2.1 General. The chosen filling ratio shall be such that in no circumstances shall the liquid portion of the gas occupy more than 97 % of the volume of the container at the filling ratio reference temperature, nor shall the container be liquid full at a temperature 5 °C greater than the filling ratio reference temperature.

Formulae for calculating filling ratios are given in Appendix A. In calculating the filling ratio from the physical data, allowance shall be made for the negative degree of uncertainty in the accuracy of the density data.

5.2.2 Filling ratios. The filling ratios to be used for the commercially pure gases listed in Table 1 are given in Table 6. Columns giving the vapour pressure developed at the pressure reference temperature associated with the filling ratio reference temperature have also been included.

Vapour pressure data for commercial butane and commercial propane as defined in BS 4250 are given in Table 7.

5.2.3 Mixtures of low pressure liquefiable gases.

Except as allowed under 5.2.4 the density of a mixture of low pressure liquefiable gases shall be determined experimentally at the appropriate filling ratio reference temperature, from which, after allowance for the tolerance on the proportions of the mixture, the filling ratio shall be determined in accordance with 5.2.1. Alternatively the density of the mixture may be calculated using the formula given in Appendix A.

5.2.4 Mixtures of liquefiable petroleum gases. For mixtures of liquefiable petroleum gases Table 8 to Table 15 should be used for obtaining filling ratios appropriate to the reference temperature. The density of the mixture shall be determined experimentally at a convenient temperature and for any given reference temperature the maximum permissible filling ratio is the value at the intersection of the row beginning with the value determined for the density and the column headed by the temperature at which it was determined.

See 5.1.1 and Table 2 for the association of reference temperature with size of container.

5.2.5 Mixtures of liquefiable petroleum gases consisting wholly of saturated hydrocarbons. Table 8, Table 10, Table 12 and Table 14 give the maximum permissible filling ratios for mixtures of liquefiable petroleum gases consisting wholly of saturated hydrocarbons.

5.2.6 Mixtures of liquefiable petroleum gases consisting wholly of unsaturated hydrocarbons or containing more than 2 mol % of C₂ hydrocarbons. Table 9, Table 11, Table 13 and Table 15 give the maximum permissible filling ratios for mixtures of liquefiable petroleum gases consisting wholly of unsaturated hydrocarbons, or containing more than 2 mol % of C₂ hydrocarbons.

5.2.7 Mixtures of liquefiable petroleum gases containing both saturated and unsaturated hydrocarbons. For mixtures consisting only partly of unsaturated hydrocarbons the maximum permissible filling ratio shall be determined

- by reading from Table 9, Table 11 Table 13 or Table 15 as appropriate, or
- by linear interpolation between the value in Table 8, Table 10, Table 12 or Table 14 as appropriate to the reference temperature for filling ratio, density determined and temperature of density determination, and the corresponding value in Table 9, Table 11, Table 13 or Table 15.

For example if “ x ” is the proportion by mass of unsaturated hydrocarbons in the mixture, $(FR)_a$ and $(FR)_b$ are the filling ratios given by Table 8, Table 10, Table 12 or Table 14 and Table 9, Table 11, Table 13 or Table 15 respectively for the given density, temperature of density determination and reference temperature, and $(FR)_m$ is the filling ratio appropriate to the mixture

$$(FR)_m = (FR)_a - x [(FR)_a - (FR)_b]$$

6 Containers made to specifications other than BS 5045-1, BS 5045-2 and BS 5045-3 or HOAL 3 and 4⁴⁾

6.1 General. Other containers may be used for the conveyance of compressed or liquefiable gases provided that they are made

- to one of the published specifications listed below;
- to any other specification which has been approved by HM Inspector of Explosives and used in accordance with the conditions of the above mentioned approval.

6.2 Permanent gases. Containers made to BS 399, BS 400 and BS 1045 and, provided that they have been inspected by an approved inspecting authority, BS 1287 and BS 1288, for a design pressure of 124 bar⁵⁾ may be filled to a charging pressure at 15 °C of 137 bar.

Containers made to HO “S”, HO “T”⁶⁾, HOAL 1 and HOAL 2⁴⁾ may be filled to a charging pressure appropriate to the design pressure.

6.3 High pressure liquefiable gases

6.3.1 Containers made to the specifications given in BS 399, BS 400, BS 401, BS 1045, BS 1287, BS 1288 with a design pressure of 124 bar, and to specifications HO “S”, HO “T” and HOAL 1 and HOAL 2 with a minimum design pressure of 137 bar may be used with the filling ratios listed in Table 4.

Table 4 — High pressure liquefiable gases

Gas	Critical temperature	Liquid density at 15 °C	Filling ratio
	°C	g/cm ³	
Carbon dioxide	31.1	0.824	0.75 ^a 0.667 ^a
Ethane	32.1	0.370	0.36
Ethylene	9.7	—	0.325
Hydrogen chloride	51.3	0.86	0.78
Nitrous oxide	36.5	0.817	0.75
Refrigerant 13	28.9	0.99	1.09
Refrigerant 13 B1	67.0	1.61	1.60
Sulphur hexafluoride with up to 1 % nitrogen impurity (m/m)	45.5	1.44	1.46

^a A 0.667 filling ratio shall be used for fire extinguishing applications; a 0.75 filling ratio shall be used for all other applications.

6.3.2 For hydrogen chloride and refrigerant 13 B1, containers made to other specifications approved by HM Inspector of Explosives may be used with the filling ratios listed in Table 5.

6.3.3 Cylinders made to BS 399, BS 400 and BS 1045 are normally ordered to a nominal water capacity; before use with a high pressure liquefiable gas the minimum water capacity must be measured.

Table 5 — Hydrogen chloride and refrigerant 13 B1

Gas	Critical temperature	Filling ratio	Minimum design pressure	
			V up to and including 130 litres	V greater than 130 litres
Hydrogen chloride	°C			
	51.3	0.65	75.0 bar	69.0 bar
Refrigerant 13 B1	67.0	1.31	26.0 bar	25.0 bar

⁴⁾ Home Office specifications for aluminium alloy containers for the conveyance of compressed gases.

⁵⁾ 1 bar = 10⁵ N/m² = 100 kPa.

⁶⁾ Home Office specifications for seamless alloy steel cylinders for the conveyance of compressed gases.

6.4 Low pressure liquefiable gases. Low pressure liquefiable gases may be carried in any container made to the following specifications.

BS 401, BS 1500, BS 1515, HO paper S13, DSIR Paper S12C and any other specification approved by HM Inspector of Explosives provided that the design pressure of the container according to the specification or code to which it was made is not less than the vapour pressure in the container at the filling ratio reference temperature given in Table 2.

The filling ratio shall be that appropriate to the filling ratio reference temperature in Table 2 as shown in Table 6, and Table 8 to Table 15.

Table 6 — Low pressure liquefiable gases, filling ratios and physical properties

NOTE These data are complete for the reference temperatures given in Table 2, applicable to low pressure liquefiable gases in various size ranges of container for conveyance in the United Kingdom. Liquid density data for 43 °C, 47.5 °C and 50 °C are quoted to ensure compliance with the over-rider on filling ratio given in 5.2.1. Except where stated, these data relate to the pure gases. For certain gases the probable impurities are such that it would be necessary to reduce the filling ratio, and cases of doubt should be referred to HM Inspector of Explosives.

Temp. °C	Substance	Ammonia	Boron trichloride	Butadiene 1-3	n-butane ^c	Iso butane ^c	Carbonyl chloride	Chlorine	Chlorine tri-fluoride	Cyanogen chloride ^a	Dimethyl ether	Ethylamine
	Critical temperature °C	132.4	178.8	152	152	135	182	144	153	174 ^b	126.9	183
	Normal boiling point °C	- 33.4	12.7	- 4.5	- 0.5	- 11.7	7.6	- 34.1	12.0	13.0	- 24.9	16.6
	Liquid density confidence limit %	± 0.00	± 0.30	± 0.20	± 0.50	± 0.50	± 0.20	± 0.40	± 0.20	± 0.50	± 1.00	± 0.30
15	Liquid density g/cm ³	0.617	1.344	0.626	0.584	0.566	1.385	1.424	1.840	1.179	0.676	0.688
	Vapour pressure bar gauge	6.27	0.103	2.07	0.77	1.54	0.31	4.76	0.13	0.10	3.37	—
	Vapour pressure bar absolute	—	—	—	—	—	—	—	—	—	—	0.958
33	Liquid density g/cm ³	0.590	1.300	0.605	0.563	0.543	1.341	1.371	1.784	1.139	0.647	0.667
	Filling ratio	0.572	1.223	0.585	0.543	0.524	1.298	1.324	1.727	1.099	0.621	0.645
38	Liquid density g/cm ³	0.582	1.293	0.598	0.556	0.537	1.328	1.355	1.768	1.128	0.638	0.661
	Filling ratio	0.564	1.216	0.578	0.536	0.518	1.285	1.309	1.711	1.088	0.612	0.639
42.5	Liquid density g/cm ³	0.575	1.283	0.592	0.551	0.531	1.317	1.341	1.754	1.116	0.630	0.655
	Vapour pressure bar gauge	15.63	1.67	3.65	3.05	4.60	2.26	11.02	2.39	1.88	8.45	1.46
	Filling ratio	0.558	1.206	0.573	0.533	0.512	1.275	1.295	1.698	1.077	0.605	0.633
43	Liquid density g/cm ³	0.574	1.282	0.591	0.550	0.530	1.316	1.339	1.752	1.115	0.629	0.654
45	Liquid density g/cm ³	0.571	1.278	0.588	0.548	0.527	1.310	1.333	1.745	1.110	0.626	0.652
	Filling ratio	0.553	1.202	0.569	0.528	0.508	1.268	1.287	1.689	1.071	0.601	0.630
47.5	Liquid density g/cm ³	0.567	1.273	0.585	0.545	0.524	1.304	1.324	1.739	1.104	0.621	0.649
	Vapour pressure bar gauge	18.02	2.08	4.32	3.65	5.36	2.79	12.54	3.04	2.37	9.71	1.90
50	Liquid density g/cm ³	0.563	1.268	0.582	0.542	0.520	1.297	1.316	1.729	1.098	0.617	0.646
	Vapour pressure bar gauge	19.31	2.31	4.67	3.95	5.78	3.08	13.35	3.41	2.64	10.38	2.14
55	Vapour pressure bar gauge	22.08	2.81	5.45	4.62	6.64	3.70	15.04	4.23	3.23	11.83	2.68

Densities and filling ratios assume 1.5 % maximum HCN by mass.

Calculated.

See Table 7 for vapour pressure data for commercial butane and commercial propane.

Table 6 — Low pressure liquefiable gases, filling ratios and physical properties

Temp. °C	Substance	Ethyl chloride	Ethylene oxide	Hydrogen cyanide	Hydrogen fluoride	Hydrogen sulphide	Methyl- amine	Dimethyl- amine	Trimethyl- amine	Methyl- bromide	Methyl- chloride
	Critical temperature °C	187.2	195.8	183.5	188	100.4	156.9	164.6	160.2	191	143.1
	Normal boiling point °C	12.3	10.8	25.7	19.5	-60.4	-6.3	6.9	2.9	3.5	-24.1
	Liquid density g/cm ³	± 0.50	± 0.50	± 2.50	± 0.50	± 1.00	± 1.00	≤ 45 °C ± 1.0 > 45 °C ± 2.0	≤ 45 °C ± 1.0 > 45 °C ± 2.0	± 1.00	± 0.20
	Vapour pressure bar gauge	0.900	0.876	0.694	0.978	0.800	0.666	0.661	0.639	1.690	0.927
	Vapour pressure bar absolute	0.16	0.20	—	—	14.53	1.43	0.36	0.57	0.58	3.28
15		—	—	0.67	0.86	—	—	—	—	—	—
33	Liquid density g/cm ³	0.873	0.852	0.668	0.942	0.751	0.643	0.640	0.617	1.641	0.894
	Filling ratio	0.842	0.822	0.631	0.909	0.721	0.617	0.614	0.592	1.575	0.865
38	Liquid density g/cm ³	0.865	0.845	0.660	0.932	0.737	0.635	0.633	0.610	1.627	0.884
	Filling ratio	0.834	0.815	0.624	0.899	0.707	0.609	0.607	0.586	1.562	0.855
42.5	Liquid density g/cm ³	0.858	0.839	0.653	0.923	0.724	0.629	0.626	0.604	1.615	0.875
	Vapour pressure bar gauge	1.85	2.06	0.84	1.17	28.99	5.14	2.52	2.74	2.64	8.13
	Filling ratio	0.828	0.810	0.617	0.891	0.695	0.604	0.601	0.580	1.550	0.847
43	Liquid density g/cm ³	0.857	0.838	0.652	0.922	0.723	0.623	0.625	0.604	1.614	0.874
45	Liquid density g/cm ³	0.854	0.836	0.650	0.918	0.717	0.625	0.622	0.601	1.609	0.869
	Filling ratio	0.824	0.806	0.614	0.886	0.688	0.600	0.597	0.577	1.545	0.841
47.5	Liquid density g/cm ³	0.850	0.833	0.646	0.913	0.710	0.622	0.618	0.597	1.600	0.864
	Vapour pressure bar gauge	2.30	2.56	1.18	1.54	32.37	6.14	3.16	3.30	3.18	9.38
50	Liquid density g/cm ³	0.845	0.829	0.642	0.908	0.703	0.618	0.614	0.594	1.594	0.859
	Vapour pressure bar gauge	2.54	2.84	1.37	1.74	34.18	6.69	3.53	3.56	3.47	10.02
55	Vapour pressure bar gauge	3.10	3.44	1.78	2.19	38.02	7.89	4.24	4.17	4.10	11.41

Table 6 — Low pressure liquefiable gases, filling ratios and physical properties

Temp. °C	Substance	Nitrogen tetroxide	Nitrosyl chloride	Propane	Cyclo-propane	Propylene	Sulphur dioxide	Vinyl chloride	Refrigerant 12	Refrigerant 21	Refrigerant 22
	Critical temperature °C	158.0	173	96.8	124.4	91.8	157.5	156.5	112.0	178.5	96.0
	Normal boiling point °C	21.0	– 5.9	– 42.1	– 32.9	– 47.8	– 10.0	– 13.8	– 29.8	8.9	– 40.8
	Liquid density confidence limit %	± 0.50	See Note 1	± 0.50	± 0.50	± 0.30	± 0.20	± 0.50	± 0.15	± 0.10	± 0.10
15	Liquid density g/cm ³	1.458	1.312	0.509	0.615	0.524	1.395	0.920	1.346	1.390	1.231
	Vapour pressure bar gauge	—	1.34	6.33	4.90	7.91	1.80	1.87	3.90	0.26	6.94
	Vapour pressure bar absolute	0.72	—	—	—	—	—	—	—	—	—
33	Liquid density g/cm ³	1.414	1.266	0.482	0.589	0.491	1.347	0.884	1.280	1.346	1.163
	Filling ratio	1.364	1.215	0.465	0.568	0.474	1.303	0.853	1.239	1.304	1.126
38	Liquid density g/cm ³	1.401	1.253	0.474	0.582	0.482	1.333	0.874	1.261	1.334	1.142
	Filling ratio	1.352	1.203	0.457	0.561	0.466	1.290	0.843	1.221	1.292	1.106
42.5	Liquid density g/cm ³	1.388	1.241	0.466	0.575	0.474	1.319	0.866	1.243	1.322	1.122
	Vapour pressure bar gauge	1.56	5.01	13.51	11.03	16.19	6.04	5.47	9.20	2.17	15.44
	Filling ratio	1.340	1.179	0.449	0.555	0.458	1.277	0.835	1.203	1.281	1.087
43	Liquid density g/cm ³	1.387	1.240	0.465	0.574	0.473	1.318	0.865	1.321	1.321	1.119
45	Liquid density g/cm ³	1.382	1.234	0.461	0.572	0.469	1.311	0.861	1.232	1.316	1.110
	Filling ratio	1.333	1.173	0.444	0.552	0.453	1.269	0.830	1.193	1.275	1.075
47.5	Liquid density g/cm ³	1.376	1.227	0.456	0.567	0.463	1.304	0.856	1.221	1.310	1.097
50	Liquid density g/cm ³	1.369	1.221	0.451	0.563	0.459	1.296	0.851	1.211	1.303	1.085
55	Vapour pressure bar gauge	3.22	7.76	18.00	14.96	21.53	8.89	7.92	12.65	3.55	20.93
NOTE $t \leq 39\text{ }^{\circ}\text{C}$, $\pm 1.1\%$ 39 °C, $< 51\text{ }^{\circ}\text{C}$, $\pm 2.0\%$.											