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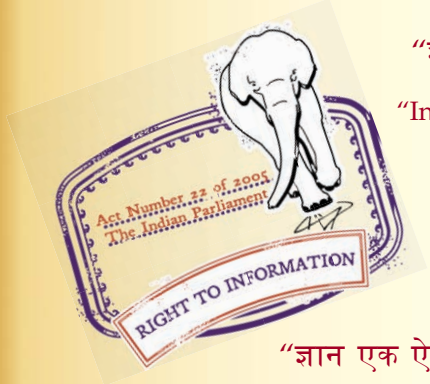

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IS : 8866 - 1978
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Indian Standard

FILLING RATIOS AND CORRESPONDING DEVELOPED PRESSURE FOR HIGH PRESSURE LIQUEFIABLE GASES CONTAINED IN GAS CYLINDERS

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Indian Standard

FILLING RATIOS AND CORRESPONDING DEVELOPED PRESSURE FOR HIGH PRESSURE LIQUEFIABLE GASES CONTAINED IN GAS CYLINDERS

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Indian Standard

FILLING RATIOS AND CORRESPONDING DEVELOPED PRESSURE FOR HIGH PRESSURE LIQUEFIABLE GASES CONTAINED IN GAS CYLINDERS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 27 April 1978, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 Manufacture, possession and use of any gas when contained in cylinders in compressed or liquefied state is regulated under the Gas Cylinder Rules, 1940, of the Government of India as amended from time to time. This standard has been prepared in consultation and agreement with the statutory authorities under those rules.

0.3 This standard has been prepared for the guidance of the designers, users, manufacturers and fillers of gas cylinders for high pressure liquefiable gases to ensure their safe design, handling and use.

0.4 The following specifications relating to gas cylinders for high pressure liquefiable gases had already been published:

IS : 2872-1967 Low carbon steel cylinders for the storage and transportation of liquefiable gases

IS : 7285-1974 Seamless manganese steel cylinders for permanent and high pressure liquefiable gases

IS : 7311-1974 Seamless high carbon steel cylinders for permanent and high pressure liquefiable gases

0.5 The design of the cylinders containing high pressure liquefiable gases is related to the internal vapour pressure developed by the gas in the cylinder at the maximum attainable temperature. In India, this temperature is taken as 65°C.

0.6 In the case of high pressure liquefiable gases, the vapour pressure exerted by the gas in the cylinder increases with the increase in filling ratio, at the same temperature. This is in contrast to the low pressure liquefiable gases where this vapour pressure is constant for a particular gas for all filling ratios and equals the saturated vapour pressure at that temperature. For the high pressure liquefiable gases the 5 percent free space concept, applied in the case of low pressure liquefiable gases, has no application and it is quite practical to specify for each high pressure liquefiable gas, numerous filling ratio values each of which is associated with a given developed pressure at a particular temperature. The only thing that has to be ensured is that the cylinder has been designed taking into account the corresponding developed pressure associated with that particular filling ratio at the maximum attainable temperature of 65°C.

0.7 Additional information about liquid density at 15°C for different gases has also been given in the standard for the benefit of the users and fillers.

0.8 Appropriate precautions should be taken to ascertain the true water capacity of the cylinder and to ensure correctness in the weight of the gas charged in the cylinder so that it is not filled to an excessive pressure.

0.9 This standard is based on data taken from the following standards:

IS : 3710-1966 Filling ratios for liquefiable gases

BS 5355 : 1976 Filling ratios and developed pressures for liquefiable and permanent gases. British Standards Institution.

0.10 The quantities in this standard have been expressed in technical metric units. However, in view of the introduction of International System (SI) units in the country, the relevant SI units and the corresponding conversion factors are given below for guidance:

$$1\ \text{kgf/cm}^2 = 98{\cdot}066\ 5\ \text{kPa (kilopascal)} = 0{\cdot}098\ 066\ 5\ \text{MPa (megapascal)} = 0{\cdot}980\ 665\ \text{bar}.$$

0.11 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard specifies the filling ratios and the associated internal pressure (gauge) developed by different high pressure liquefiable gases contained in cylinders, at the maximum attainable temperature of 65°C.

1.1.1 Filling ratios for low pressure liquefiable gases have been covered in IS : 3710-1978*.

2. TERMINOLOGY

2.1 For the purpose of this standard the following definitions and to those given in IS : 7241-1974† shall apply.

2.1.1 *High Pressure Liquefiable Gas* — A liquefiable gas having a critical temperature above 0°C but not higher than 70°C.

2.1.2 *Filling Ratio* — The ratio of the weight of the liquefiable gas introduced in the cylinder to the weight of the water the cylinder will hold at 15°C.

2.1.3 *Maximum Developed Pressure* — The internal pressure developed by the gas at the maximum attainable temperature of 65°C.

3. FILLING RATIOS AND DEVELOPED PRESSURES

3.1 The filling ratios and the corresponding pressure developed by the different high pressure liquefiable gases at 65°C are given in Table 1.

*Filling ratios for low pressure liquefiable gases contained in cylinders (*first revision*).
†Glossary of terms used in gas cylinders technology.

TABLE 1 FILLING RATIOS AND DEVELOPED PRESSURE

(*Clause* 3.1)

Name of Gas	Chemical Symbol	Filling Ratio	Developed Pressure (Gauge) at 65°C	Liquid Density at 15°C	Critical Temperature
(1)	(2)	(3)	(4)	(5)	(6)
			kgf/cm²	g/ml	
Carbon dioxide (pure)	CO_2	0·667 0·60	191·28 165·96	0·824	+ 31·1°C
Carbon dioxide (1% impurity by volume)	CO_2	0·667* 0·60	196·20 168·07	—	—
Ethane	C_2H_6	0·320	141·35	0·370	+ 32·1°C
Ethylene	C_2H_4	0·270	146·98	—	+ 9·7°C
Hydrogen chloride	HCl	0·42	108·62	0·86	+ 51·3°C
Monobromotrifluoromethane (R-13B$_1$†)	$CBrF_3$	1·51	169·48	1·61	—
Monochlorotrifluoromethane (R-13†)	$CClF_3$	0·91	125·17	0·99	+ 28·9°C
Nitrous oxide (pure)	N_2O	0·667 0·625	172·99 156·12	0·817	+ 36·5°C
Nitrous oxide (1% impurity by volume)	N_2O	0·667 0·625	176·51 158·93	—	—
Sulphur hexafluoride (with up to 1% nitrogen impurity by mass)	SF_6	1·34 1·27	160·34 125·88	1·44	+ 45·5°C‡

*Permissible for gas of not less than 99·0 percent purity [*see* IS : 307-1966 ' Specification for carbon dioxide (*second revision*)'] in cylinders provided with bursting disc which will release the gas if the pressure exceeds 200 kgf/cm². In other cases, a filling ratio of 0·60 shall be used.

†This is the refrigerant number of the gas in accordance with ISO/R 817-1974 ' Organic Refrigerant — Number Designation ' published by the International Organization for Standardization.

‡For pure SF_6 only.

(*Continued from page* 2)

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