# COMPENDIUM ON GAS CYLINDER AND VALVES FOR FIRE EXTINGUISHERS


मानकः पथप्रदर्शकः

**BUREAU OF INDIAN STANDARD**

(Ministry of Consumer, Affair, Food and Public Distribution, Govt of India)

Manak Bhawan, 9, Bahadur Shah Zafar Marg New Delhi – 110 002

# PREFACE

In an era of rapid technological advancement and evolving industrial standards, the role of national standardization bodies has become increasingly crucial. The Bureau of Indian Standards (BIS), established under the BIS Act, 2016, stands at the forefront of this transformation in India. As the National Standards Body, BIS is responsible for the formulation, promotion, and implementation of National Standards, known as Indian Standards. These standards, along with BIS's Conformity Assessment Schemes, form the foundation of a strong technical framework aimed at ensuring quality, safety, and reliability of products. The BIS Standard Mark on products provides consumers with third-party assurance of conformity to specified requirements.

In this context, maintaining stringent quality control and compliance is of utmost importance, particularly in safety-critical equipment. Fire extinguishers and their components, including cylinders and valves, play a vital role in fire protection systems across industrial, commercial, and residential sectors. Mechanical Engineering, with its broad scope, contributes significantly to the design, development, and standardization of such safety equipment.

Formulation of standards for fire extinguisher cylinders, including their design, construction, materials, testing, and performance requirements, as well as associated components such as valves, fittings, and operating mechanisms, is undertaken by the concerned sectional committees of BIS. These standards ensure that fire extinguishers operate reliably under emergency conditions and provide effective fire suppression, thereby safeguarding life and property.

# TABLE OF CONTENTS

| | | | |
|---|---|---|---|
| 6 | Mechanical Foam Cylinder | Specification for Portable Fire Extinguisher, Mechanical Foam Type IS10204: 2001 | 9 |
| 7 | Dry powder | Specification For Dry Powder Fire Extinguisher for Metal Fires IS 11833: 1986 | 9 |
| 8 | Pressure Vessel Materials | Welded Low Carbon Steel Cylinder Exceeding 5 liters water capacity for low pressure liquefiable gases part 1 cylinder for liquefied petroleum gases- specification IS 3196:2013 | 10 |
| | | Welded Low Carbon Steel Cylinder Exceeding 5 liters water capacity for low pressure liquefiable gases part 2 Cylinder for liquefiable non toxic1 gases other than LPG – Specification IS 3196: 2006 | 10 |
| 9 | Testing and Inspection | Selection, Installation and Maintenance of first aid fire extinguishers – Portable and Mobile IS 2190: 2024 | 11 |
| 10 | Valves | Types of safety device for gas cylinder valves IS 5903: 2021 | 12 |
| | | Valve for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders - Specification (fourth revision) IS 3224:2021 | 12 |

# 1. GAS CYLINDER

Fig. 1 Gas Cylinders.

**REFILLABLE SEAMLESS STEEL GAS CYLINDER - SPECIFICATION PART 1 NORMALIZED STEEL CYLINDERS IS 7285**

This standard specifies the requirements for refillable seamless steel gas cylinders made from normalized steel used to store compressed gases. The standard covers design, material composition, manufacturing processes, heat treatment, inspection, and testing of cylinders with specified water capacities. It includes requirements for minimum wall thickness, mechanical properties, and quality control tests such as tensile, hydrostatic, burst, and flattening tests to ensure cylinder strength and safety. The standard also specifies marking, inspection procedures, and acceptance criteria to ensure cylinders are safe for repeated filling, transportation, and long-term service.

**REFILLABLE TRANSPORTABLE SEAMLESS ALUMINUM ALLOY GAS CYLINDER - SPECIFICATIONS 15660: 2017**

This standard specifies the requirements for refillable transportable seamless aluminium alloy gas cylinders used for storing compressed and liquefied gases. The standard covers material specifications, cylinder design, manufacturing processes, heat treatment, inspection, and testing requirements to ensure safety and reliability. It also includes tests such as tensile, hydrostatic pressure, and burst tests, along with marking and certification requirements, to ensure the cylinders are suitable for safe transportation, repeated filling, and long-term service.

**WELDED STAINLESS-STEEL CYLINDERS FOR LPG FROM 0.5 LITERS TO 250 LITERS WATER CAPACITY – SPECIFICATION IS 15637**

specifies the requirements for welded stainless-steel cylinders used for storage and transportation of liquefied petroleum gas (LPG) with water capacities ranging from 0.5 L to

250 L. The standard covers material specifications for stainless steel, cylinder design requirements, manufacturing processes such as forming and welding, and heat treatment where required to ensure strength and corrosion resistance. It also includes dimensional requirements, workmanship standards, inspection procedures, and quality control tests such as hydrostatic pressure test, leak test, burst test, and mechanical tests to verify safety and performance. Additionally, the standard specifies marking, certification, and acceptance criteria to ensure the cylinders are suitable for safe storage, transport, and repeated filling of LPG**.**

**GAS CYLINDER REFILLABLE WELDED ALUMINUM ALLOY CYLINDER DESIGN CONSTRUCTION AND TESTING IS 17613: 2021**

specifies the requirements for the design, construction, manufacturing, inspection, and testing of refillable welded aluminium alloy gas cylinders used for storing and transporting compressed gases. The standard covers material specifications for aluminium alloys, cylinder design criteria including calculation of wall thickness and pressure limits, and manufacturing processes such as forming, welding, and heat treatment. It also outlines inspection and testing procedures, including mechanical tests, hydrostatic pressure tests, burst tests, leak tests, and other quality checks to ensure the structural integrity and safety of the cylinders. Additionally, it includes requirements for marking, certification, and acceptance criteria to ensure the cylinders are suitable for safe repeated filling, transportation, and long-term service.

## 2. CODE OF PRACTICES

**PERIODIC INSPECTION AND REQUALIFICATION - LIQUEFIED PETROLEUM GAS (LPG) CYLINDER FOR AUTOMOTIVE USE IS 16175: 2014**

This standard specifies the requirements for periodic inspection and requalification of LPG cylinders used in automotive applications (Auto LPG cylinders). The standard outlines the procedures for visual inspection, hydrostatic pressure testing, leakage testing, and evaluation of cylinder condition to ensure continued safety during service. It also defines inspection intervals, rejection criteria, repair conditions, and marking requirements after requalification. The purpose of the standard is to ensure that LPG cylinders used in vehicles remain safe, reliable, and suitable for continued use after repeated filling and operation.

**PERIODIC INSPECTION AND TESTING - WELDED CARBON STEEL GAS CYLINDER IS 16185: 2014**

This standard specifies the procedure for periodic inspection and testing of welded carbon steel gas cylinders to ensure they remain safe for continued use. It covers steps such as degassing, valve removal, and internal cleaning, followed by external and internal visual inspection to detect defects like corrosion, dents, cracks, or weld damage. Cylinders are then subjected to hydrostatic pressure testing and leak testing to verify their strength and tightness. The standard defines clear rejection criteria for cylinders with excessive damage or test failure, which must be condemned, while minor defects may be repaired. After successful testing, cylinders are marked with test details and records are maintained.

**PERIODIC INSPECTION AND TESTING OF SEAMLESS STEEL GAS CYLINDERS - (THIRD REVISION) IS 8451: 2018**

includes steps such as safe degassing, valve removal, and internal cleaning, followed by thorough external and internal visual inspection to identify defects like corrosion, cracks, dents, or heat damage. Cylinders are then subjected to hydrostatic pressure testing to verify their strength and check for permanent expansion or leakage, along with valve inspection and leak testing. The standard also defines acceptance and rejection criteria, where cylinders with excessive defects or those failing tests must be permanently condemned, while minor issues may be rectified. After successful testing, cylinders are marked with test information and proper records are maintained for traceability.

## 3. PRODUCT SPECIFICATIONS

Fig. 2 Various fire extinguishers

**PORTABLE FIRE EXTINGUISHER PERFORMANCE AND CONSTRUCTION – SPECIFICATION IS 15683: 2018**

This Indian Standard specifies requirements for portable fire extinguishers, including construction of cylinders, working pressure, discharge performance, and safety provisions.

It covers:

1. Stored pressure extinguishers
2. Cartridge operated extinguishers
3. Mechanical and performance requirements
4. Safety valves and discharge assemblies

The cylinder must be designed as a pressure vessel capable of withstanding specified test pressures without permanent deformation or failure.

## 4. MATERIAL SPECIFICATIONS

### GAS CYLINDER- COMPATIBILITY OF CYLINDER AND VALVE MATERIALS WITH GAS CONTENTS PART 1 METALLIC MATERIALS IS/ISO11114-1: 2020

This standard specifies the requirements for evaluating the compatibility of metallic materials used in gas cylinders and cylinder valves with the gases they contain. The standard provides guidance for determining whether metals used in cylinders and valves are suitable for storing different gases without causing chemical reactions, corrosion, embrittlement, or other forms of material degradation. It includes information on material behaviour in contact with various gases, potential hazards such as hydrogen embrittlement or stress corrosion cracking, and methods for assessing material suitability. The document also outlines recommendations for selecting appropriate metallic materials, safety considerations, and testing or evaluation procedures to ensure that cylinders and valves operate safely throughout their service life. Overall, the standard helps manufacturers, designers, and safety authorities ensure that gas cylinders maintain structural integrity and prevent failures caused by incompatibility between the stored gas and the metallic components.

### GAS CYLINDER- COMPATIBILITY OF CYLINDER AND VALVE MATERIALS WITH GAS CONTENTS PART 2 NON-METALLIC MATERIALS IS/ISO 11114-2: 2020

This standard specifies the requirements for assessing the compatibility of non-metallic materials used in gas cylinders and cylinder valves with the gases stored inside them. The standard mainly focuses on materials such as plastics, elastomers, sealing materials, gaskets, O-rings, and other polymeric components that come in contact with the compressed gases. It provides guidance on evaluating the effects of gases on these materials, including chemical degradation, swelling, permeability, embrittlement, and changes in mechanical properties. The document also outlines test methods and evaluation procedures to determine whether non-metallic materials can safely withstand exposure to different gases under pressure and varying temperature conditions. The purpose of the standard is to ensure that sealing and insulating components maintain their performance and reliability, thereby preventing leakage, contamination, or failure of gas cylinders and valves during service.

### GAS CYLINDERS - COMPATIBILITY OF CYLINDER AND VALVE MATERIALS WITH GAS CONTENTS: PART 3 AUTOGENOUS IGNITION TEST FOR NON - METALLIC MATERIALS IN OXYGEN ATMOSPHERE IS/ISO 11114 – 3: 2010

This standard defines the method for evaluating the compatibility of non-metallic materials used in gas cylinders and valves with oxygen-rich environments by determining their susceptibility to autogenous ignition. The standard describes a controlled test in which the material is exposed to high-pressure oxygen under adiabatic compression conditions to assess whether it ignites spontaneously without an external ignition source. It outlines the test apparatus, procedure, and criteria for evaluating results, helping to identify materials that may

pose a fire or explosion risk in oxygen service. The purpose of this standard is to ensure that only suitable non-metallic materials are used in oxygen applications, thereby enhancing the safety and reliability of gas cylinders and valve systems.

## 5. CARBON DIOXIDE FIRE EXTINGUISHER CYLINDERS

### FIRE EXTINGUISHER, CARBON DIOXIDE TYPE (PORTABLE AND TROLLY MOUNTED) - SPECIFICATION IS 2878: 2004

This standard specifies requirements for carbon dioxide ($CO_2$) type fire extinguishers, both portable and trolley-mounted, used for fire protection in industrial, commercial, and electrical hazard areas. The standard covers the design, construction, materials, and performance requirements of $CO_2$ fire extinguishers to ensure safe and reliable operation. It includes provisions related to cylinder construction, valve assemblies, discharge horns, and operating mechanisms, along with specifications for capacity, weight, and pressure ratings. The standard also outlines testing and inspection procedures such as hydrostatic pressure testing, leakage testing, discharge performance testing, and safety checks to verify the extinguisher's effectiveness and structural integrity. In addition, it specifies marking, labelling, maintenance guidelines, and certification requirements to ensure proper identification and safe use

## 6. MECHANICAL FOAM CYLINDER

### SPECIFICATION FOR PORTABLE FIRE EXTINGUISHER, MECHANICAL FOAM TYPE IS10204: 2001

This standard specifies the requirements for portable mechanical foam type fire extinguishers used for extinguishing Class A and Class B fires, particularly those involving flammable liquids such as oil, petrol, and solvents. The standard covers the design, construction, materials, and capacity requirements of the extinguisher, including the cylinder body, internal components, foam-making mechanism, and discharge assembly. It also provides specifications for the foam solution, propellant gas cartridge (where applicable), operating pressure, and discharge performance to ensure effective firefighting capability. In addition, the standard prescribes testing and inspection procedures such as hydrostatic pressure testing, discharge tests, leakage tests, and mechanical strength checks to verify the reliability and safety of the extinguisher. It further includes requirements for marking, labelling, and maintenance instructions to ensure proper identification, safe operation, and routine servicing. Overall, the standard ensures that mechanical foam fire extinguishers are manufactured and tested according to uniform safety and performance criteria.

## 7. DRY POWDER CYLINDER

### SPECIFICATION FOR DRY POWDER FIRE EXTINGUISHER FOR METAL FIRES IS 11833: 1986

This standard specifies the requirements for dry powder fire extinguishers designed for combating metal fires (Class D fires) involving combustible metals such as magnesium, sodium, or aluminium. The standard covers the construction, materials, capacity, and

performance of extinguishers using specialized dry powders that can safely control metal fires without causing violent reactions. It includes provisions for design and manufacturing, ensuring the extinguisher body can withstand pressure and operate reliably, along with requirements for the extinguishing agent, which must be compatible with burning metals. The standard also outlines performance tests, including discharge efficiency and fire extinguishing capability, as well as requirements for marking, labelling, and instructions for use to ensure proper handling during emergencies. Additionally, it specifies guidelines for inspection, maintenance, and safety, ensuring that the extinguishers remain effective over time**.**

## 8. PRESSURE VESSEL MATERIALS

### WELDED LOW CARBON STEEL CYLINDER EXCEEDING 5 LITERS WATER CAPACITY FOR LOW PRESSURE LIQUEFIABLE GASES PART 1 CYLINDER FOR LIQUEFIED PETROLEUM GASES- SPECIFICATION IS 3196:2013

This standard specifies the requirements for welded low carbon steel cylinders having water capacity exceeding 5 litres that are used for storing low-pressure liquefiable gases such as liquefied petroleum gas (LPG). The standard covers the design, manufacturing processes, materials, and construction requirements of these cylinders to ensure safe storage and transportation of LPG. It includes provisions related to chemical composition and mechanical properties of steel, welding procedures, dimensional requirements, and heat treatment to ensure adequate strength and durability. The standard also specifies inspection and testing procedures such as hydrostatic pressure testing, tensile testing, burst testing, and leak testing to verify the cylinder's structural integrity and safety. In addition, it provides requirements for marking, stamping, quality control, and certification to ensure proper identification and traceability. Overall, the standard ensures that LPG cylinders are manufactured according to uniform safety and performance requirements to minimize risks during handling, filling, storage, and transportation.

### WELDED LOW CARBON STEEL CYLINDER EXCEEDING 5 LITERS WATER CAPACITY FOR LOW PRESSURE LIQUEFIABLE GASES PART 2 CYLINDER FOR LIQUEFIABLE NON-TOXIC GASES OTHER THAN LPG – SPECIFICATION IS 3196: 2006

This standard specifies the requirements for welded low carbon steel cylinders having water capacity greater than 5 litres used for storing and transporting low-pressure liquefiable non-toxic gases other than liquefied petroleum gas (LPG). The standard covers important aspects such as design criteria, material specifications, manufacturing methods, welding procedures, and dimensional requirements to ensure the structural strength and safety of the cylinders. It also includes provisions related to heat treatment, inspection, and quality control during production to maintain uniform manufacturing standards. In addition, the standard prescribes various testing procedures such as hydrostatic pressure testing, tensile testing, leak testing, and other mechanical tests to verify the cylinder's reliability under service conditions. It further specifies requirements for marking, stamping, certification, and identification of cylinders to ensure traceability and compliance with safety regulations. Overall, the standard ensures that

cylinders used for storing liquefiable non-toxic gases are manufactured and tested to maintain safe performance during filling, storage and handling.

## 9. TESTING AND INSPECTION

### SELECTION, INSTALLATION AND MAINTENANCE OF FIRST AID FIRE EXTINGUISHERS – PORTABLE AND MOBILE IS 2190: 2024

The standard provides comprehensive guidelines for the selection, installation, operation, inspection, and maintenance of portable and mobile first-aid fire extinguishers used in various types of occupancies. The standard helps in choosing the correct type and capacity of extinguisher based on the class of fire (A, B, C, D, and electrical), level of hazard, and specific risks present in the area. It specifies requirements for proper installation, including location, mounting height, accessibility, visibility, and distribution so that extinguishers are readily available during emergencies. The standard also details procedures for regular inspection, testing, and maintenance, including periodic checks, refilling, and hydrostatic testing to ensure reliability and readiness. It outlines responsibilities for trained personnel, record keeping, and safety precautions during handling and servicing.

## 10. VALVES

Fig. 3 types of valves

Valves for fire extinguisher cylinders are critical components that control the discharge, sealing, and safe operation of the extinguisher. They are designed to withstand high internal pressure and ensure quick, reliable release of the extinguishing agent when activated. These valves typically include features such as operating levers, safety pins, pressure indicators, and sealing arrangements to prevent leakage and accidental discharge. Depending on the type of extinguisher, the valve may be designed for stored pressure or cartridge-operated systems. Proper materials, precise construction, and strict testing standards are followed to ensure durability, corrosion resistance, and consistent performance in emergency situations, making the valve an essential part of overall fire safety equipment.

Types of valves in fire extinguishers:

1. Squeeze-grip valve: The most common type for hand-held portable extinguishers, designed for quick activation by squeezing a lever.

2. Tilt valve: Typically found on large trolley-mounted or wheeled extinguishers, which operate when the extinguisher is tilted or tipped.

3. Ball valve: A quarter-turn valve that utilizes a spherical ball with a hole in the centre to control the flow of the agent.

4. Pressure relief valve: Safety mechanism designed to vent excess pressure in a controlled manner.

**FOLLOWING ARE THE STANDARD RELATED TO THE VALVES OF FIRE EXTINGUISHERS:**

**TYPES OF SAFETY DEVICE FOR GAS CYLINDER VALVES IS 5903: 2021**

This standard specifies the types of safety devices used in gas cylinder valves to protect against overpressure and accidental hazards. It includes devices such as rupture discs, fusible plugs, and pressure relief valves, which are designed to release gas safely under abnormal conditions like excessive temperature or pressure. The standard outlines their design, materials, performance requirements, and testing to ensure reliable operation and enhanced safety of gas cylinders during storage and, handling.

**VALVE FOR COMPRESSED GAS CYLINDERS EXCLUDING LIQUEFIED PETROLEUM GAS (LPG) CYLINDERS - SPECIFICATION (FOURTH REVISION) IS 3224:2021**

This standard covers the requirements for design, materials, manufacture and testing of new valve fittings for use with refillable aluminium and steel cylinders for compressed gases (permanent and high and low pressure liquefiable and dissolved gases) other than liquefied petroleum gas (LPG) up to 1 000 litre water capacity. The standard also covers valve fittings for use in firefighting and for compressed natural gas cylinders for automotive use.