भारतीय मानक

Indian Standard

IS 18719 : 2024

क्रायोजेनिक वेसल्स — 1 000 लीटर तक के परिवहनीय वैक्यूम इंसुलेटेड वाहिकाएं — प्रचालन अपेक्षाएँ

Cryogenic Vessels — Transportable Vacuum Insulated Vessels of Not More Than 1 000 Litres — Operational Requirements

ICS 23. 020.40

भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDARDS

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May 2024 **Price Group 7**

Gas Cylinders Sectional Committee, MED 16

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard is to keep pace with the latest technological developments and international practices. Also, the standard has been brought into the latest style and format of Indian Standards, and references of Indian Standards, wherever applicable have been updated.

While formulating this standard assistance has mainly been taken from ISO 21029-1 : 2018 'Cryogenic vessels — Transportable vacuum insulated vessels of not more than 1 000 litres volume — Part 1: Design, fabrication, inspection and tests'. Assistance has also been derived from ISO 21029-2 : 2015 'Cryogenic vessels — Transportable vacuum insulated vessels of not more than 1 000 litres volume — Part 2: Operational requirements'.

The relevant SI units and corresponding conversion factors are given below for guidance:

$$1 \text{ kgf/cm}^2 = 98.066\ 5 \text{ kPa (kilopascal)} = 10 \text{ m of Water Column (WC)}$$

$$= 0.098\ 066\ 5 \text{ MPa (megapascal)}$$

$$= 0.980\ 665 \text{ bar}$$

$$1 \text{ Pa} = 1 \text{ N/m}^2$$

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

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 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CRYOGENIC VESSELS — TRANSPORTABLE VACUUM INSULATED VESSELS OF NOT MORE THAN 1 000 LITRES — OPERATIONAL REQUIREMENTS

1 SCOPE

1.1 This Indian Standard specifies operational requirements for transportable vacuum insulated cryogenic vessels of not more than 1 000 litres volume designed to operate above atmospheric pressure. It also includes putting into service, filling, withdrawal, transport within the location, storage, maintenance, periodic inspection, and emergency procedures in the respect to these vessels.

1.2 This standard does not cover:

a) Small cryogenic vessels specifically designed for personal medical use; and
b) Transportation of cryogenic vessels by public road, rail, sea, and air, for which additional requirements may apply.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards:

IS No./Other Standards	*Title*
IS 7241 : 1981	Glossary of terms used in gas cylinder technology (*first revision*)
ISO 21010 : 2017	Cryogenic vessels — Gas/ materials compatibility
ISO 21029-1 : 2018	Cryogenic vessels — Transportable vacuum insulated vessels of not more than 1 000 litres volume — Part 1: Design, fabrication, inspection and tests
IS/IEC 60079 (Part 1) to (Part 11)	Explosive atmosphere
ISO 23208 : 2017	Cryogenic vessels — Cleanliness for cryogenic service

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 7241 and the following shall apply.

3.1 Putting into Service — Operation by which a vessel is prepared to be used, applying to either a new vessel being used for the first time or an existing vessel being returned to service.

3.2 Filling — Operation by which a transportable vessel undergoes a prefill check, filling with a cryogenic fluid and an after fill check.

3.3 Withdrawal — Operation by which the product is withdrawn from a vessel connected to the supply system.

3.4 Outdoor Location — Location outside of any building or structure and not enclosed by more than two walls.

3.5 Underground Location — Area or room whose ground or floor is on all sides, significantly lower than the adjacent ground surfaces.

3.6 Vessel — Transportable cryogenic vessel.

3.7 Competent Person — Trained and qualified person for the purpose mentioned in this document.

3.8 Enterprise — Any person or company that has a legal duty of care.

3.9 Filler — Any enterprise that loads cryogenic fluids into a cryogenic vessel.

3.10 Owner — Enterprise that legally owns the cryogenic vessel.

3.11 Operator — Any enterprise for filling, storage, transport, and withdrawal of cryogenic product.

4 PRELIMINARIES BEFORE PUTTING INTO SERVICE

4.1 General

Before putting into service, verify:

a) Vessel is suitable for the intended service; and
b) Marking, labelling and handover documents are correct and complete.

4.2 Marking and Labelling

4.2.1 *Marking*

The transportable cryogenic vessel shall bear the following markings in clearly legible and durable characters:

4.2.1.1 *On the inner vessel*

a) Name and address or other means of identification of the manufacturer of the inner vessel;
b) Serial number of the inner vessel; and
c) Mark confirming successful final acceptance tests of the inner vessel.

4.2.1.2 *On the outer jacket*

The information marked on the inner vessel shall be repeated on the data plate mounted or permanently attached to the outer jacket:

a) Name and address or other means of identification of the manufacturer of the transportable cryogenic vessel;
b) Serial number of the transportable cryogenic vessel;
c) Maximum permissible working pressure (p_s in bar) of the transportable cryogenic vessel;
d) Test pressure of the transportable cryogenic vessel;
e) Volume of the inner vessel (in litres);
f) Tare mass (in kilograms) of the transportable cryogenic vessel;
g) Date of the final acceptance tests (month, year);
h) Final acceptance test mark;
j) Date of the next periodic inspection (year);
k) The date of the last periodic inspection (month, year);
m) Last periodic inspection mark;
n) Reference to the operating instructions; and
p) (Optional) Instructions for transporting the transportable cryogenic vessel (such as lifting, lashing).

4.2.1.3 *Prior to filling*

a) A flow sheet with operating instructions;
b) An unshortened identification of the fluid which is transported in accordance with the transport and substance regulations and its net mass in accordance with the documentation;
c) Danger labels in accordance with transport regulations;
d) Risk and safety phrases associated with the gas content; and
e) Name and address of the fluid producer or supplier.

The marking as described under **4.2.1.1(a)** to **4.2.1.2(n)** should be permanently affixed, for example, stamped, either on a reinforced part of the transportable cryogenic vessel, or on a ring, or on permanently affixed attachment(s).

The technique used for marking and attaching should not adversely affect the integrity of the transportable cryogenic vessel.

Marks described under **4.2.1.3(a)** to **4.2.1.3(e)** can either be stamped or indicated on a durable information disc or label attached to the transportable cryogenic vessel or indicated in an adherent and clearly visible manner such as painting or by an equivalent process.

Additional markings can be given, provided that they do not obscure or create confusion with specified markings called for in this standard.

4.2.2 *Labelling*

For labelling the following shall be affixed:

a) Flow diagram denoting operation;
b) Identification of cryogenic fluid service;
c) Hazard labels as applicable regulations;

d) Safety instructions; and
e) Identification and contact details of service provider.

4.3 Handover Documents

In addition to the manufacturer's documentation, where necessary the cryogenic vessel shall be accompanied by vessel specific documents and instructions for all items:

a) Operations;
b) Auxiliary equipment; and
c) Inspection records.

These documents shall be retained by the owner of the vessel. Operator shall have appropriate instructions available.

5 PERSONNEL TRAINING

Personnel trained for the specific tasks shall be allowed to put into service, fill, handle, operate or maintain the cryogenic vessel.

Training program shall include:

a) Normal procedures;
b) Product and hazard identification;
c) Safe operating limits;
d) Emergency procedures;
e) Physical and chemical properties of cryogenic product and their effects on human body; and
f) Personnel protective equipment (for example, safety boots/goggles/gloves).

Refresher training shall be imparted as necessary. Training records shall be documented and maintained.

6 SAFETY REQUIREMENTS

6.1 General

6.1.1 Data plate, marking, and labelling shall be legible and fitted to the correct product.

6.1.2 Appropriate warning signs, regarding product hazards and personnel protective equipment requirements, shall be displayed.

6.1.3 Parts/joints/connections under pressure should be depressurized before disconnection.

6.1.4 Leaking valves or connections shall be isolated and depressurized before rectification. If this is not possible, leaking valves under pressure shall be tightened by trained personnel using suitable tools and manufacture recommended procedures.

6.1.5 Direct flame or intense heat shall never be used to raise the pressure or de-ice frozen components.

6.1.6 All surfaces which may come into contact with the product shall be cleaned for the intended service:

a) For cleanliness requirements, (*see* ISO 23208); and
b) Valve outlets shall be kept clean, dry, and free from contaminants.

6.1.7 Vessels and their accessories shall not be modified without proper authorization. It is recommended, that the couplings and/or hoses be attached to vessels in a manner that prevents unauthorized removal.

6.2 Safety Considerations

In all operations as well as training the following safety considerations shall be addressed suitably.

6.2.1 *Volume Expansion*

Small amounts of cryogenic fluids produce large volumes of vaporized gas.

6.2.2 *Asphyxiation*

Cryogenic gas (usually heavier than air) is prone for accumulation in lower areas resulting in oxygen deficient area and may cause asphyxiation.

6.2.3 *Oxygen Enriched Atmosphere*

Spillage/leakage of oxygen can result in an oxygen enriched atmosphere, which increases the risk of fire.

6.2.4 *Ventilation*

Importance of ventilation in storage and operation of cryogenic liquids.

6.2.5 *Cold Embrittlement*

Cryogenic liquids are extremely cold and cause cold embrittlement when in contact with certain materials (for example, metals or plastics)

6.2.6 *Cold Burn*

Cryogenic liquids are extremely cold and when in direct contact with cryogenic fluids produce cold burns. Cold burns can also be produced from contact with uninsulated equipment.

7 PUTTING INTO SERVICE

7.1 This operation shall follow a written procedure and results shall be recorded and retained by operating company. Vessel and accessories shall be visually checked for damage. It shall be verified that:

a) Vessel and accessories are designed for its intended cryogenic service;

b) Relief devices with a correct set pressure are installed on the vessel [set pressure of primary safety valve shall not be higher than maximum allowable working pressure (MAWP)];

c) All valves are working as intended;

d) Labels are legible and of the intended product service;

e) Required and recommended tests have been carried out; and

f) Vessel and accessories are clean and compatible for the intended service, (*see* ISO 23208 and ISO 21010).

Cryogenic vessels shall be purged with an appropriate gas until the dryness and purity requirement are satisfied.

7.2 Vessel shall be cooled in accordance with the manufacturer's recommendations. Steps shall be taken to avoid any uncontrolled pressure rise due to rapid liquid evaporation. Cooling gas chosen shall take into account the risk of solidification.

7.3 Measuring and controlling devices (for example, level gauge, pressure regulator, etc) shall be checked for correct operation and setting.

8 LOCATION

The requirements listed in this clause are valid for storage as well as other activities, such as filling, withdrawal, etc.

a) Vessels shall be located in a suitable area such as in the open air or in a sufficiently ventilated (natural or forced ventilation as required) enclosed area, away from sources of heat (for example, welding source, open fire, etc). Hot work shall be subjected to appropriate safety measures with prior approval from designated personnel. The area shall be kept clear and suitable access shall be provided;

b) Vessels shall not be located underground;

c) Floor of designated storage area shall be level and strong enough to take the mass of the full vessels and their components shall be protected against mechanical damage;

d) In case of emergency, adequate means of escape shall be provided. Emergency exits shall be kept clear at all times. All doors/gates should preferably be outward opening and wide enough to provide easy access and exit routes for personnel;

e) Vessels with risk of toppling over shall be firmly secured in the upright position;

f) Operating area shall be clearly marked with appropriate warning signs;

g) If vessels are stored indoors for extended periods (for example, overnight or weekends) appropriate ventilation shall be ensured. Alternatively pressure relief valve outlets shall be piped to a safe place;

h) Vent pipe-work shall be designed to ensure proper pressure relief from vessel. It shall also be designed to prevent accumulation of rainwater and blockage by airborne material; and

j) Access to storage area shall be controlled.

9 TRANSPORT WITHIN THE LOCATION

This clause refers to transport of filled vessels within specific location and excludes transportation by public roads, rail, waterways, sea, and air for which additional requirements may apply.

9.1 Before transport, cryogenic vessels shall be examined for signs of damage or leaks and valves shall be checked to ensure that they are operational and in the correct position.

9.2 Cryogenic vessels should not be subjected to impacts or falls, these may damage the outer jacket or suspension system of cryogenic vessels resulting in loss of insulating properties.

If vehicles are used for transportation (either powered or unpowered), cryogenic vessels should be secured against toppling over.

Cryogenic vessels shall be handled only by those means for which they are designed and equipped.

9.3 Transportation of cryogenic vessels should ensure adequate ventilation, considering the potential hazards of oxygen deficiency or enrichment.

If transporting through enclosed spaces (such as between floors via lift) cryogenic vessels shall not be accompanied by any personnel, unless adequate safety precautions have been taken.

Vehicles used for transport, shall have well ventilated cargo areas and where possible separate cargo and passenger compartments. In case of common cargo and passenger compartment with limited ventilation an atmosphere monitoring system along oxygen deficiency alarm system shall accompany the personnel travelling with the vessel.

Vessels should be transported in their correct position and shall be securely fixed by appropriate means.

10 FILLING

Following operations shall be carried out in accordance with a written procedure.

10.1 Prefill Checks

Prior to filling, examine the condition of the vessel as indicated in Table 1. Vessel shall not be filled if any of these criteria are not met, prior to filling all non-compliance shall be corrected.

10.2 Preparations

10.2.1 Depending on type of cryogenic vessel, it may be filled by volume or by mass, taking into account product density. Necessary measuring equipment shall be in good working order and within the calibration period, where required.

10.2.2 If there is no residual pressure in the vessel prior to filling, it shall be purged to remove possible contaminants. For carbon dioxide vessels, only gaseous carbon dioxide shall be used for purging.

10.2.3 If the vessel is warm, it shall be cooled in accordance with the manufacturer's recommendations. Carbon dioxide vessels shall be pressurized to at least 5 kg/cm^2 with gaseous carbon dioxide before introducing liquid CO_2.

10.2.4 Purity of the residual product in the vessel shall be analyzed and recorded where required by specification. Where the residual purity is outside specification, the vessel shall be purged until it meets specification.

10.2.5 The fill hose shall be securely connected, purged, and cooled before filling.

10.2.6 Where necessary, the pressure shall be reduced by venting to facilitate filling. For carbon dioxide the pressure shall not drop below 5 kg/cm^2.

Table 1 Prefill Checks

(*Clause* 10.1)

Sl No.		Acceptance Criteria for Filling
(1)	(2)	(3)
i)	Data plate	Present, legible, and in accordance with **4.2**
ii)	Inspection date	Within required period
iii)	Product identification labels	Legible and fitted to the correct product
iv)	Vessel and accessories	No obvious signs of damage, corrosion, dirt, oil or grease, no unusual ice formations.
v)	Valves	Operable
vi)	Pressure relief devices	In place, free from ice or other obstructions
vii)	Filling connection	Correct connection fitted for product identified by the product identification label and cap-fitted as required
viii)	Pressure gauge	Positive pressure in vessel
ix)	Connections	Free from dirt, oil or grease and free from water or excessive ice

10.3 After Fill Check

10.3.1 Vessel mass or level of contents and pressure shall be checked and if necessary, vessel shall be vented to reach the level required by specification.

10.3.2 Where required by specification, the vessel contents shall be analyzed and recorded.

10.3.3 Check and ensure all valves are closed, no unusual cold spots have developed and there are no leaks.

11 PRODUCT WITHDRAWAL

11.1 Operator shall check and confirm:

a) Product and pressure in vessel are compatible with the downstream supply system;
b) Correct hose connection is fitted;
c) Vessel is positioned in accordance with manufacturer's recommendations;
d) Suitable mechanism to prevent back flow from downstream supply system in to cryogenic vessel; and
e) All sections of pipework where cryogenic fluid can be trapped is protected by a relief valve or other suitable relief device.

11.2 For de-icing frozen valves, flames or hammering shall never be used.

12 CHANGE OF SERVICE

This operation shall follow a written procedure and stepwise results shall be recorded and maintained by the company who made or ordered the change of service of cryogenic vessel.

12.1 The procedure shall include the following:

a) Confirm the cryogenic vessel is designed for its intended cryogenic service. For oxidizing fluids additional requirements in **12.2** shall be considered;
b) Depressurization, emptying of the vessel shall be performed in accordance with **13**;
c) Cryogenic vessel shall be cleaned by using a suitable cleaning procedure;
d) All the applicable couplings shall be replaced as per new cryogenic fluid service;
e) The vessel marking and labelling shall be removed and replaced with new product labelling; and
f) Relabeling over existing labelling is prohibited.

12.2 If the vessel is intended for oxidizing fluids, the following additional requirements shall be considered.

a) The vessel and all piping and accessories shall be purged with inert gas until the outlet temperature is at least close to ambient temperature. The purge gas inlet temperature shall never exceed the maximum operating temperature of 50 ^{o}C;
b) It shall be verified by suitable methods that the vessel and all piping and accessories are not contaminated by hydrocarbons; and
c) Before the vessel is filled with an oxidizing fluid, a competent person shall verify that the procedure has been carried out correctly.

13 TAKING OUT OF SERVICE

This operation shall follow a written procedure and stepwise results shall be recorded and maintained.

13.1 The procedure shall include the following:

a) Emptying of the vessel;
b) Depressurizing to a positive pressure of no greater than 2 kg/cm^2;
c) Monitoring pressure and mass, if necessary; verifying that no line is obstructed; and
d) Taking into account the properties of the product involved (for example, solidification of CO_2).

13.2 For cryogenic vessel intended to be taken into service again, following additional points shall be considered.

a) Purge the cryogenic vessel along with all piping and its accessories with inert gas;
b) If applicable, additional steps recommended in **12** for oxidizing fluids shall be applied as the vessel is taken out of service;
c) If cryogenic vessel is to be transported or stored, protective caps shall be fitted on all open connections; and

d) For storage, nominal positive pressure of dry inert gas shall be maintained in cryogenic vessel and shall be labelled accordingly.

13.3 If vessel is to be scrapped, in addition to above mentioned steps it shall be purged with inert gas and labelled accordingly. Product identification labels shall be removed and nameplates rendered unusable.

14 MAINTENANCE AND REPAIR

Maintenance is required to ensure that equipment remains in a safe condition. The responsibility for the maintenance and repair shall be established between the contracting parties (for example, owner, filler). Maintenance generally comprises:

a) Inspection of condition of vessel, piping and accessories;
b) Verification of operability of valves;
c) Minor repairs (for example, changing of seals); and
d) Cleaning external surfaces and redoing labelling.

Maintenance operations shall only be carried out by trained personnel. Original spare parts should preferably be used. Alternatively, suitable spare part approved by a competent person.

15 PERIODIC INSPECTION

15.1 Inspection shall be performed at intervals not exceeding 10 years or as per applicable statutory regulations.

15.1.1 Equipment and pressure-relief device check:

a) Re-closable pressure-relief devices shall be lift-tested either in situ or off the vessel; and
b) Non re-closable pressure-relief devices, where fitted, shall be replaced.

15.1.2 All other equipment shall be checked for satisfactory functioning:

a) Visual external examination;
b) Check for signs of damage; and
c) Check content and legibility of data plate (*see* **4.2**) and other markings.

15.1.3 *Leak Test*

a) Leak test using an inert gas or working medium at permissible working pressure shall be carried out;
b) The vessel integrity may be checked by a leak test (*see* **15.1.2**); and
c) Measurement of vacuum if required (vacuum measurement shall only be performed when the thermal performance is deficient).

15.2 In addition to **15.1**, inspection shall be performed at intervals not exceeding 5 years or as per applicable statutory regulations.

15.2.1 The re-closable pressure-relief devices shall be lift-tested.

15.2.2 Non re-closable pressure-relief devices shall be visually inspected.

Satisfactory examination shall be confirmed in accordance with ISO 21029-1 or equivalent standards.

16 ADDITIONAL REQUIREMENTS FOR FLAMMABLE GASES

16.1 General Safety Requirements (*See* **6**)

16.1.1 *General*

a) Open vessel/dewar shall not be used for flammable gases;
b) Precautions shall be taken when approaching a leak as the product may ignite and produce a flame. Products such as hydrogen require specific care as the flame is invisible;
c) PPE and clothing shall be selected considering protection against static charges and flames. Electrically conductive footwear shall be worn;
d) Fill/withdrawal connections shall be capped when not in use; and
e) Spillage of flammable fluids can result in the risk of fire or explosion.

16.1.2 *Electrical Equipment*

a) Electrical equipment shall be in accordance with requirements of hazardous area classification as per IS/IEC 60079 (Part 1) to (Part 11); and
b) In the classified area, personnel shall not be permitted to carry sources of flame, or non-approved electrical equipment. Consideration shall be given to all electric equipment, for example, mobile, phones and radio transmitters.

16.1.3 *Earthing System*

a) All parts of the installation shall be bonded to ensure electrical continuity;
b) Installations shall be earthed, resistance ≤ 10 Ω;
c) Major items of equipment (for example, the vessel) shall be bonded directly to the earth point and shall not rely upon the piping as a means to earth; and
d) For trans-filling processes, equalization of the electrical potentials is necessary.

16.2 Putting into Service (*See* **7**)

a) Prior to filling, a vessel that is empty or depressurized shall be purged with an inert gas. Purging shall be continued until required levels of purity is reached to prevent possibility of explosive mixture formation during filling; and
b) The purge gas shall be warm and dry in order to expel moisture from the vessel.

16.3 Location (*See* **8**)

a) Vessels shall not be located underground, indoors or enclosed spaces; and
b) Filling, usage or storage in indoor or enclosed spaces is not permitted.

16.4 Transport (*See* **9**)

a) Before transportation ensure pressure in cryogenic vessel is within acceptable limit [recommended is lower than 50 percent of maximum allowable working pressure (MAWP)] and all the connections are suitably capped or plugged;
b) Transportation in elevators or lifts is not allowed; and
c) Transportation in enclosed passenger or cargo compartments of vehicle is not allowed.

16.5 Filling (*See* **10**)

a) Before starting the trans-filling, the earthing conductor shall be connected, integrity of the earthing system checked and the filling hose(s) purged free of air and impurities; and
b) Filling shall only be undertaken outdoors in designated areas.

16.6 Change of Service (*See* **12**)

Cryogenic vessels designed and used for flammable fluid service should not be transferred to oxidizing or inert gas service, without proper purging, cleaning and verification by competent personnel.

16.7 Taking Out of Service (*See* **13**)

Vessel shall be purged with inert gas until the flammable gas concentration in the inert gas is below of the lower explosive limit of flammable gas in air.

16.8 Maintenance and Repair (*See* **14**)

Where maintenance and repair work requires the vessels to be rendered inert, they shall be emptied using a safe procedure and purged with inert gas until the concentration of flammable gas in the inert gas is below the lower explosive limit of the flammable gas in air.

17 EMERGENCY EQUIPMENT /PROCEDURES

Emergency procedures shall be prepared to cover fire or any other hazardous events, example spills, which can occur. It is advisable that emergency procedures be prepared in conjunction with the emergency services and that local conditions be taken into consideration.

The procedure shall consider:

a) Properties of the cryogenic fluids;

b) Quantities involved;
c) Local topography; and
d) Design of the vessel.

The procedure shall include:

a) List of emergency equipment required;
b) Nomination of back-up personnel/organizations for managing emergencies and procedures for contacting them both during and outside working hours; and
c) Immediate self-help actions required (shut down, sounding alarms, evacuation from the area, summoning help, etc).

Procedures shall be readily available to all personnel involved, regularly practiced and inspected periodically (updated if required).

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Gas Cylinder Sectional Committee, MED 16

Organization	*Representative(s)*
Petroleum and Explosive Safety Organization, Nagpur	SHRI P. KUMAR **(*Chairperson*)** SHRI K. S. RAO (*Alternate* I) SHRI P. SEENIRAJ (*Alternate* II)
All India Industrial Gases Manufacturers Association, New Delhi	SHRI SAKET TIKU SHRI K. R. SAHASRANAM (*Alternate*)
Ashok Leyland Limited, Chennai	SHRI VED PRAKASH GAUTAM SHRI FAUSTINO V. (*Alternate*)
Automotive Research Association of India, Pune	DR S. S. THIPSE SHRI S. D. RAIRIKAR (*Alternate*)
Bharat Heavy Electricals Limited, Project Engineering Management, Noida	SHRI SAYAN ROY SHRI KARAN YADAV (*Alternate*)
Bharat Petroleum Corporation Limited, Mumbai	SHRI RAJWINDER SINGH PANESAR SHRI AAKASH AGARWAL (*Alternate*)
Bhiwadi Cylinders Private Limited, New Delhi	SHRI MANVINDER SINGH SHRI SUNIL K. DEY (*Alternate*)
Directorate General of Quality Assurance, Ministry of Defence, New Delhi	COL SABIR HUNDEKAR
Everest Kanto Cylinder Limited, Mumbai	SHRI AYUSH PAWAR SHRI GHANSHYAM GOYAL (*Alternate* I) SHRI A. S. V. S. PRASAD (*Alternate* II)
Gujarat Gas Limited, Ahmedabad	SHRI DHARMESH SAILOR SHRI RAVI RAVIPALLI (*Alternate*)
Hindustan Petroleum Corporation Limited, Mumbai	SHRI RAKESH G. KHADE SHRI SHIVA SHANKAR (*Alternate* I) SHRI DINESH PANGTEY (*Alternate* II)
Ideal Engineers Hyderabad Private limited, Hyderabad	SHRI SATISH KABRA SHRI KUNAL KABRA (*Alternate*)
Indian Oil Corporation Limited, Mumbai	SHRI BIDHAN CHANDRA JENA SHRI CHANDRAKANT GHATOL (*Alternate*)
Indraprastha Gas Limited, New Delhi	SHRI RAKESH KISHAN AGRAWAL SHRI BIMAL KARAN (*Alternate* I) SHRI AVIRAL RAJEEV (*Alternate* II)
INOX India Limited, Vadodara	SHRI DEEPAK V. ACHARYA SHRI NITIN JANSARI (*Alternate*)

Organization	*Representative(s)*
International Industrial Gases Limited, Howrah	SHRI DEVENDRA K. GARG SHRI NIKHILESH K. GARG (*Alternate*)
Jai Maruti Gas Cylinders Private Limited, Gwalior	SHRI MANU K. NIGAM
Kosan Industries Limited, Surat	SHRI BHUPINDER SINGH SHRI GIRISH K. DESAI (*Alternate*)
Linde India Limited, Kolkata	SHRI RAMANA VUTUKURU
LPG Equipment Research Centre, Bengaluru	SHRI T. D. SAHU SHRI SANTOSH KUMAR GUPTA (*Alternate*)
Mahanagar Gas Limited, Mumbai	SHRI S. MURALI SHRI MILIND M. RANADE (*Alternate* I) SHRI SACHIN GUMASTE (*Alternate* II)
Maruti Suzuki Indian Limited, Gurugram	SHRI GURURAJ RAVI SHRI ARUN KUMAR (*Alternate* I) SHRI RAJESH KUMAR (*Alternate* II)
Research and Development Estt (Engineers), Pune	SHRI TAMHANKAR RAVINDRA
Society of Indian Automobile Manufacturers, New Delhi	SHRI K. K. GANDHI SHRI AMIT KUMAR (*Alternate*)
Steel Authority Of India Limited (SAIL), Research & Development Centre for Iron & Steel, Ranchi	SHRI K. K. SINGH SHRI SANTOSH KUMAR (*Alternate*)
Tata Motors Limited, Pune	SHRI PALLIPALAYAM GOWRISHANKAR SHRI SHAILENDRA DEWANGAN (*Alternate*)
Tekno Valves, Kolkata	SHRI Y. K. BEHANI SHRI ROHIT BEHANI (*Alternate*)
Trans Valves (India) Private Limited, Hyderabad	SHRI GAURAV JAIIN SHRI PRADEEP KUMAR MATHUR (*Alternate*)
Vanaz Engineers Private Limited, Pune	SHRI S. J. VISPUTE SHRI A. S. WAGH (*Alternate*)
BIS Directorate General, New Delhi	SHRI RAJNEESH KHOSLA, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (MECHANICAL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRI PRASOON YADAV
SCIENTIST 'B'/ASSISTANT DIRECTOR
(MECHANICAL ENGINEERING), BIS

Low Pressure Gas Cylinders Subcommittee, MED 16:2

Organization	*Representative(s)*
Hindustan Petroleum Corporation Limited, Mumbai	SHRI DEBASHISH CHAKRAVERTY **(*Convener*)**
All India Industrial Gases Manufacturers Association, New Delhi	SHRI SAKET TIKU SHRI K. R. SAHASRANAM (*Alternate*)
Bharat Petroleum Corporation Limited, Mumbai	SHRI RAJWINDER SINGH PANESAR SHRI AAKASH AGARWAL (*Alternate*)
Bhiwadi Cylinders Private Limited, New Delhi	SHRI MANVINDER SINGH SHRI SUNIL K. DEY (*Alternate* I) SHRI RAJNEESH CHOPRA (*Alternate* II)
Directorate General of Quality Assurance, Ministry of Defence, New Delhi	COL SABIR HUNDEKAR
Hindalco Industries Limited, Mumbai	SHRI SOURABH MANOHAR SHRI DEVESH KUMAR (*Alternate*)
Hindustan Petroleum Corporation Limited, Mumbai	SHRI RAKESH G. KHADE SHRI SHIVA SHANKAR (*Alternate* I) SHRI DINESH PANGTEY (*Alternate* II)
Ideal Engineers Hyderabad Private limited, Hyderabad	SHRI SATISH KABRA SHRI KUNAL KABRA (*Alternate*)
Indian Oil Corporation Limited, Mumbai	SHRI BIDHAN CHANDRA JENA SHRI CHANDRAKANT GHATOL (*Alternate*)
Jai Maruti Gas Cylinders Private Limited, Gwalior	SHRI ASHOK K. NIGAM SHRI MANU K. NIGAM (*Alternate*)
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Shri Shakti Cylinders Private Limited, Hyderabad	SHRI D. V. RAJASEKHAR MD YUNUS GEELANI (*Alternate*)
Steel Authority of India Limited (SAIL) - Salem Steel Plant, Salem	SHRI M. PRABAKARN SHRI N. K. VIJAYVARGIA (*Alternate*)
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Vanaz Engineers Private Limited, Pune	SHRI S. J. VISPUTE SHRI A. S. WAGH (*Alternate*)

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