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मानक



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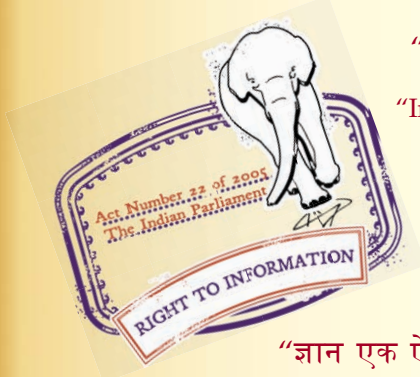
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IS 15222 (2002): Carbon Dioxide as Fire Extinguishing Media for Fire Protection -Specification [CED 22: Fire Fighting]



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भारतीय मानक

आग से बचाव के लिए अग्निशमन के माध्यम के रूप में  
कार्बन डाईआक्साईड — विशिष्टि

*Indian Standard*

**CARBON DIOXIDE AS FIRE EXTINGUISHING MEDIA  
FOR FIRE PROTECTION — SPECIFICATION**

ICS 13.220.10

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

## FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Fire Fighting Sectional Committee had been approved by the Civil Engineering Division Council.

This standard is one of the series giving specifications for fire extinguishing media in common use and which are in need of specification for fire fighting purposes. These specifications are designed to establish that the medium in question has at least a minimum useful fire extinguishing capability and can, therefore, be reasonably used for fire extinguishing purposes.

Annexes A to C of this standard specify methods for determining, respectively, water, oil and total sulphur compounds contents. Annexes D to G provide important information on and give recommendations relating to the safety and use of carbon dioxide, and they should be read carefully by all concerned with this medium.

The composition of the Committee for the formulation of this standard is given at Annex H.

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

# CARBON DIOXIDE AS FIRE EXTINGUISHING MEDIA FOR FIRE PROTECTION — SPECIFICATION

### 1 SCOPE

This standard lays down requirements for carbon dioxide for use as a fire extinguishing medium.

### 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 editions of the standards indicated below:

IS No.	Title
460	Test sieves
(Part 1) : 1985	Wire cloth test sieves ( <i>third revision</i> )
(Part 2) : 1985	Perforated plate test sieves ( <i>third revision</i> )
1117 : 1975	One-mark pipettes ( <i>first revision</i> )
1997 : 1982	Burettes ( <i>second revision</i> )
4152 : 1989	Carbon dioxide cylinders for fire fighting purposes on boardship ( <i>second revision</i> )
7285 : 1988	Seamless steel cylinders for permanent and high pressure liquefiable gases ( <i>second revision</i> )

### 3 DEFINITION

For the purposes of this standard, the following definition shall apply.

#### 3.1 Carbon Dioxide

The chemical compound CO<sub>2</sub> used as a fire extinguishing medium.

### 4 REQUIREMENTS

Carbon dioxide shall comply with the requirements of Table 1, when tested by the appropriate method of test specified in 5.

### 5 METHODS OF TEST

#### 5.1 Safety Warning

Attention is drawn to the need to design equipment for handling carbon dioxide such that it is either capable of withstanding the pressures involved or protected from them.

**Table 1 Requirements**

(Clause 4)

Property	Requirements <sup>1)</sup>
Purity, percent (v/v), <i>Min</i>	99.5
Water content, percent (m/m), <i>Max</i>	0.015
Oil content, ppm by mass, <i>Max</i>	5
Total sulphur compounds content, Expressed as sulphur, ppm by mass, <i>Max</i>	5.0

<sup>1)</sup>Carbon dioxide obtained by converting dry ice to liquid will not usually comply with these requirements unless it has been properly processed to remove excess water and oil.

#### 5.2 Purity

Determine the purity by gas-liquid chromatography using generally accepted laboratory techniques or use a volumetric analyser.

The method used shall be capable of determining the purity with an accuracy of at least 0.1 percent.

The sample shall not constitute more than 10 percent of the original quantity of carbon dioxide contained in the sample container.

#### 5.3 Water Content

Determine the water content by the method specified in Annex A.

#### 5.4 Oil Content

Determine the oil content by the method specified in Annex B.

#### 5.5 Total Sulphur Compounds Content

Determine the total sulphur compounds content by the method specified in Annex C.

### 6 PACKING

6.1 Carbon dioxide shall be packed in gas cylinder conforming to IS 7285 or IS 4152.

### 7 MARKING

7.1 Each container shall be legibly and indelibly marked on the outside with the following information:

- a) Manufacturer's name or trade-mark, if any;
- b) Month and year of manufacture;
- c) 'Carbon Dioxide';

- d) Source, year of manufacture of cylinder and its test pressure;
- e) Empty mass of the cylinder; and
- f) Filled mass of the cylinder.

**7.1.1** Carbon dioxide conforming to this standard may also be marked with BIS Standard Mark.

**7.1.1.1** The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. Details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

## 8 SAMPLING

### 8.1 General

Samples of carbon dioxide needed to perform all the tests required by this standard shall be taken from the same manufacturing lot, using identical sampling procedures.

NOTE— Attention is drawn to the need to design equipment for handling carbon dioxide such that it is either capable of withstanding the pressures involved or protected from them.

### 8.2 Sampling Equipment

Rigid metal connections or flexible reinforced nylon hose should be used throughout the sampling equipment and shall be kept as short as possible. All components shall have a design pressure of not less than 137 bar.

### 8.3 Procedure

#### 8.3.1 General

Two methods of sampling are specified as follows:

- a) Direct sampling, in which the sample is passed to an evaporator and then directly to the analytical apparatus; and
- b) Sampling in cylinders, in which case the sample is transferred in a cylinder to a laboratory.

Other methods may be used provided that they are shown to give equally representative samples on analysis (*see Annexes A to C*).

#### 8.3.2 Direct Sampling

Connect the sampling valve by means of suitable connections (*see 8.2*) to an evaporating device and then via a T-piece (the free leg of which is connected to the dip-tube of a Drechsel bottle containing 50 mm of mercury covered by a layer of water on the carbon dioxide side) to the analytical apparatus. Thoroughly

flush the connections, valves and the evaporating device with carbon dioxide before starting to take the sample.

#### 8.3.3 Sampling in Cylinders

Use a cylinder of water capacity 1.4 kg or 2.0 kg, complying with the requirements of IS 7285 and with a valve at each end.

An internal copper dip-tube of diameter at least 5 mm and of length equal to one-third of the length of the cylinder shall be brazed to the base of one valve, which shall be clearly identified. The cylinder shall be coated internally with tin [containing 1 percent (*m/m*) of lead] applied by hot dipping the cylinder after the walls have been descaled.

First clean the sampling cylinder by removing both valves and washing the inside of the cylinder with carbon tetrachloride. Purge with a current of dry filtered air. Wash with methanol and repeat the purging. Degrease the valves using carbon tetrachloride, then refit them. The methanol and carbon tetrachloride used shall comply with the requirements specified in **B-2**.

Support the cylinder vertically with its dip-tube valve uppermost. Before taking the sample, thoroughly flush the cylinder with a small quantity of liquid carbon dioxide, first through the top valve and then through the bottom valve. Repeat this flushing procedure, and leave the cylinder connected to the liquid carbon dioxide source via its lower valve. Then, with the upper valve closed, open the lower valve to admit liquid carbon dioxide to the cylinder. Partly open the upper (dip-tube) valve and continue filling until carbon dioxide snow is discharged from this valve. Close both valves. Open the top valve several times for brief intervals until only carbon dioxide gas is discharged from it. The free end of the dip-tube inside the cylinder will then be just above the liquid carbon dioxide level in the cylinder.

Samples shall be analyzed as soon as reasonably practicable after collection. To withdraw the sample for analysis, support the sampling cylinder vertically with the dip-tube valve at the top. Connect the bottom valve of the sampling cylinder (liquid carbon dioxide) to an evaporating device and then via a T-piece, the free leg of which is connected to a tube as described in **8.3.2** to the analytical apparatus. Thoroughly flush the connections, valves and the evaporating device with carbon dioxide before starting the analysis.

When sampling for the determination of water content, the connections to be above the dew-point to prevent condensation during purging.

## ANNEX A

### (Clause 5.3)

#### DETERMINATION OF WATER CONTENT

##### A-1 PRINCIPLE

Gravimetric determination of the water content by passing a sample of the gas over phosphorous pentoxide.

##### A-2 APPARATUS AND MATERIAL

###### A-2.1 Two Absorption Tubes

U-shape, the length of the limbs being 100 mm and the diameter of the tubes being 12 mm, fitted with side arms and ground-glass drilled stoppers. The tubes shall be filled with the desiccant (A-2.5) which shall be held in position by small pads of cotton wool.

###### A-2.2 Flow Meter

Float type, suitable for measuring a carbon dioxide flow of 200 ml/min to 2 000 ml/min.

###### A-2.3 Gas Meter

Calibrated for 1 or 2.5 litres per revolution.

###### A-2.4 Test Sieves

Of aperture sizes 425  $\mu\text{m}$  and 600  $\mu\text{m}$ , complying with the requirements of IS 460 (Part 1).

###### A-2.5 Desiccant

Sift powdered glass or clean, dry, washed sand and retain the portion that passes through a test sieve of aperture size 600  $\mu\text{m}$  but is retained on a test sieve of aperture size 425  $\mu\text{m}$

In general, follow the applicable recommendations and requirements of IS 460 (Part 1) and IS 460 (Part 2).

Quickly transfer to a stoppered container (a large weighing bottle or small stoppered jar is suitable) a volume of fresh phosphorus pentoxide and add about half as much by volume of the prepared powdered glass or sand. Vigorously shake the container to mix the components and fill the U-tubes (A-2.1) as quickly as possible with the mixture.

If it is prepared in this way, it should be easy to fill the tube with the desiccant. If it is not easy, it is probable that the phosphorus pentoxide was moist before addition of the powdered glass or sand.

Prepare the desiccant in small quantities, as required.

##### A-3 SAMPLING

Take the sample in a cylinder by the method described in 8.3.3. About 120 g of carbon dioxide is required for each determination.

##### A-4 DETERMINATION

After the evaporating device, connect the exit side of the T-piece to the absorption tubes (A-2.1), the flow meter (A-2.2), and the gas meter (A-2.3) in series, in that order.

Carefully open the regulating valve and absorption tube taps and allow the gas to flow at a rate of about 500 ml/min for 10 min; the carbon dioxide displaces the air in the absorption tubes. Close all taps, disconnect the absorption tubes and wipe the tubes surfaces with a dry, soft cloth. Place the absorption tubes in the balance case, leave for 20 min, then weigh them to the nearest 0.5 mg.

Reconnect the absorption tubes. Note the reading of the gas meter then allow the gas to pass at a steady rate of 500 ml/min to 1 000 ml/min for 1 h.

Close the taps and reducing valve. Note the gas meter reading.

Place the absorption tubes in the balance case, leave for 20 min, then weigh them to the nearest 0.5 mg.

##### A-5 EXPRESSION OF RESULTS

The water content, expressed as a percentage by mass, is given by the formula:

$$\frac{54.29 (m_2 - m_1)}{V}$$

where

$m_1$  = initial mass, in grams, of the absorption tubes;

$m_2$  = final mass, in grams, of the absorption tubes; and

$V$  = volume, in litres, at 20 °C and 760 mmHg of gas passed, read from the gas meter.



## ANNEX B

### (Clause 5.4)

#### DETERMINATION OF OIL CONTENT

##### B-1 PRINCIPLE

Vapourization of a liquid sample and removal of any oil by passing the gas through carbon tetrachloride. Removal of residual oil in the cylinder by washing with more carbon tetrachloride and combination of the two carbon tetrachloride solutions. Spectrometric measurement of the oil content at 3 460 nm (the C-H stretching frequency) by means of an infra-red spectrometer.

##### B-2 REAGENTS

All reagents shall be of recognized analytical grade.

##### B-2.1 Carbon Tetrachloride, Distilled

The reagent shall not show an infra-red absorption peak at 3 460 nm.

##### B-2.2 Standard Oil Solution

Dissolve 0.020 0 g of liquid paraffin in carbon tetrachloride, transfer quantitatively to a 100 ml one-mark volumetric flask and dilute to the mark with carbon tetrachloride.

One ml of this solution contains 200 µg of oil.

##### B-3 APPARATUS

**B-3.1** Two bubblers as shown in Fig. 1.

**B-3.2** Drechsel bottle of capacity 250 ml.

**B-3.3** Flow meter, float type, suitable for measuring carbon dioxide flow of 200 ml/min to 2 000 ml/min.

**B-3.4** Gas meter, calibrated for 1 litre or 2.5 litres per revolution.

**B-3.5** Infra-red spectrometer and accessories, suitable for making measurements at 3 460 nm.

##### B-4 SAMPLING

Take the sample by the method described in 8.3.3. About 700 g to 1 000 g is required for each determination.

NOTE — A set of cylinders should preferably be retained for sampling for the determination of oil content and should not be used for other purposes.

##### B-5 PROCEDURE

##### B-5.1 Preparation of Test Solution

Place 100 ml of the carbon tetrachloride (**B-2.1**) in the Drechsel bottle (**B-3.2**) and 25 ml in each bubbler (**B-3.1**). Support the weighed sampling cylinder with the dip-tube valve at the top, connect the bottom valve of the weighed cylinder to the T-piece

of the evaporating device and then to the Drechsel bottle, the two bubblers, the flow meter and the gas meter in series, in that order, using short rubber connections.

No carbon dioxide shall be allowed to pass to the atmosphere through the outlet of the T-piece.

Weigh the cylinder, totally expand the contents of the cylinder through the absorption train at a flow rate of about 1 000 ml/min, and read the volume of gas passed (this serves as a check on the amount of carbon dioxide used for the test).

##### NOTES

1 Some evaporation of the carbon tetrachloride will take place. If this is excessive, stop the flow of gas and refill the absorption bottles, noting the volume of carbon tetrachloride.

2 In view of the toxic nature of carbon tetrachloride, the effluent gas from this determination should be discharged to the outside air.

Reweigh the sampling cylinder, taking care to use the same valve fittings as at the first weighing. Remove the valve not attached to the dip-tube and wash the inside of the cylinder with 25 ml of the carbon tetrachloride. Wash the interior of the evaporating device and valves with carbon tetrachloride and combine this solution with the cylinder washings and the contents of the bubblers. Make up the combined solutions to some suitable, definite volume.

##### B-5.2 Preparation of Blank Test Solution

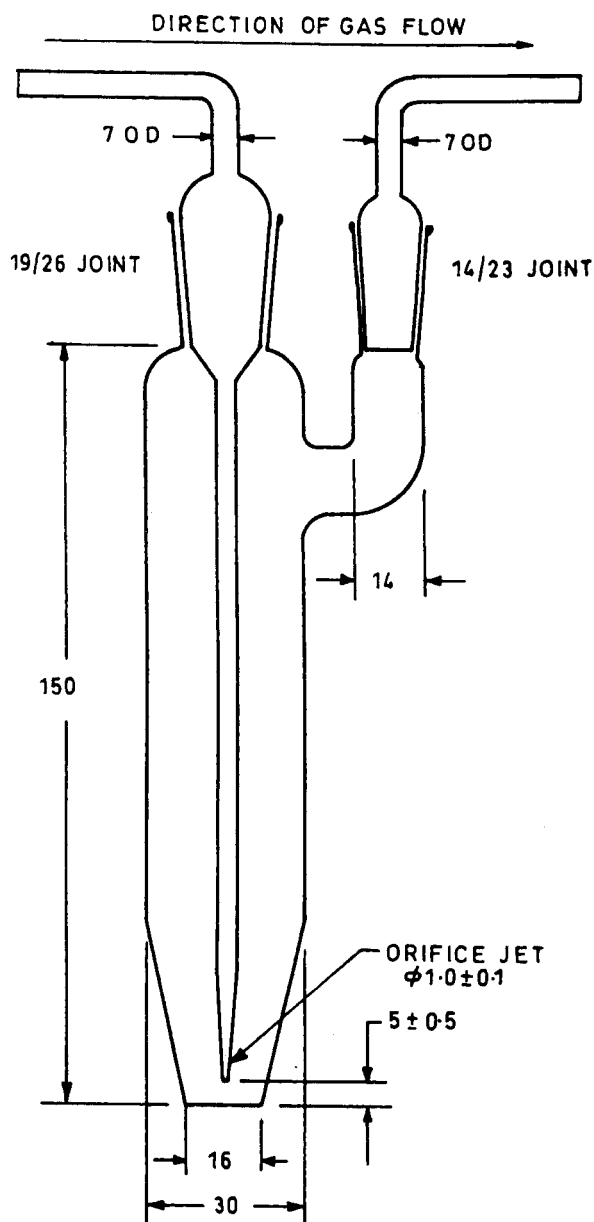
Evaporate a volume of carbon tetrachloride, equal to the total volume (including any additions) of carbon tetrachloride used in the absorption train plus washings, to the volume of the combined solution (see **B-5.1**) and subsequently treat it in the same way as the test solution.

##### B-5.3 Spectrometric Measurements

Following the manufacturer's instructions for the operation of the instrument, determine the absorbances of the test solution and of the blank test solution at the wavelength of maximum absorption (approximately 3 460 nm). From the calibration graph (**B-5.4**), deduce the masses of oil corresponding to the measured absorbances.

##### B-5.4 Preparation of the Calibration Graph

Prepare suitable dilutions of the standard solution (**B-2.2**) to cover the range within which the mass of oil in the sample is expected to be found. Measure the absorbance of each of these solutions as described in **B-5.3**. Prepare a calibration graph by plotting the masses of oil against the corresponding absorbances.



All dimensions in millimetres.

FIG. 1 BUBBLER FOR THE DETERMINATION OF OIL CONTENT

### B-6 EXPRESSION OF RESULTS

The oil content, expressed in parts per million by mass, is given by the formula:

$$\frac{m_3 - m_4}{m_5}$$

where

$m_3$  = mass, in micrograms, of oil in test solution;

$m_4$  = mass, in micrograms, of oil in blank test solution; and

$m_5$  = mass, in grams, of sample taken.

NOTE— The mass,  $m_5$  can be checked by calculation from the mass of 1 litre of carbon dioxide at 20°C and 1 013 mbar (760 mm Hg), which is 1.84 g.

## ANNEX C

### (Clause 5.5)

#### DETERMINATION OF TOTAL SULPHUR COMPOUNDS CONTENT

##### C-1 PRINCIPLE

Reduction of any sulphur compounds present by passing equal volumes of the sample and purified hydrogen over silica wool at 900°C. Removal of the hydrogen sulphide thus produced by passing the gases through neutral cadmium chloride solution. Determination of sulphur by adding a known amount of iodine solution and determining the excess iodine by titration with standard volumetric sodium thiosulphate solution.

##### C-2 REAGENTS

All reagents shall be of recognized analytical grade and the water used shall be distilled water or water of equivalent purity.

##### C-2.1 Hydrogen

Gas produced electrolytically.

##### C-2.2 Hydrochloric Acid

With concentration of 1.18 g/ml.

##### C-2.3 Soda Lime

In lumps which pass a test sieve of aperture size 2 mm but retained on a test sieve of aperture size 1.8 mm.

NOTE — The soda lime should not have been used in other determinations where oxygen has been used, as explosions may occur.

##### C-2.4 Cadmium Chloride

50 g/l neutral solution.

Dissolve 5 g of cadmium chloride in 100 ml of water and add, drop by drop, approximately 1 mol/l solution hydroxide solution until the first cloudiness appears.

##### C-2.5 Sodium Thiosulphate

Standard volumetric solution,  $c(\text{Na}_2\text{S}_2\text{O}_3) = 0.02$  mol/l solution. Hitherto expressed as 0.02 N standard volumetric solution.

##### C-2.6 Iodine

Standard volumetric solution  $c\text{H}_2\text{I} = 0.01$  mol/l solution<sup>1)</sup>.

##### C-2.7 Starch Indicator Solution

Make a paste of 1 g of soluble starch with a little water,

pour the paste with constant stirring into 100 ml of boiling water and boil for 1 min. Allow to cool.

##### C-3 APPARATUS

The apparatus is shown diagrammatically in Fig. 2.

##### C-3.1 Flow Meter

Float type, suitable for measuring hydrogen flow of 200 ml/min to 2 000 ml/min.

##### C-3.2 Flow Meter

Float type, suitable for measuring carbon dioxide flow of 200 ml/min to 2 000 ml/min.

##### C-3.3 Two Furnace Tubes

Made of transparent silica, each 500 mm long, of internal diameter 16 mm with one end reduced to 3 mm internal diameter.

Place a loose packing of silica wool not less than 200 mm long in the tube with a small plug of silica wool near the wide end to reduce radiation heating of the polyvinyl chloride connection.

##### C-3.4 Furnace and Control

A twin-tube furnace, about 460 mm long, to operate at 900°C, and fitted with a thermocouple and temperature indicator.

##### C-3.5 Soda Lime Tower

Or suitable absorption tube.

##### C-3.6 'Y' Tube

##### C-3.7 Bubbler

As shown in Fig. 1.

##### C-3.8 Burette

Of capacity 10 ml, complying with the requirements of IS 1997.

##### C-3.9 Pipette

Of capacity 2 ml, complying with the requirements of IS 1117.

##### C-3.10 Test Sieves

Of aperture size 2 mm and 1.8 mm, complying with the requirements of IS 460 (Part 1).

##### C-4 SAMPLING

Take the sample in a cylinder by the method described in 8.3.3. About 120 g is required for each determination.

<sup>1)</sup> 0.02 N standard volumetric solution.

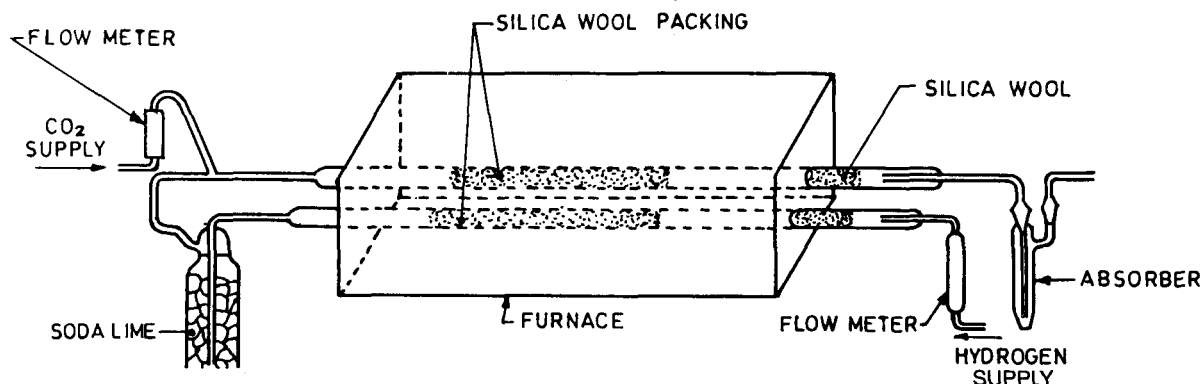


FIG. 2 APPARATUS FOR THE DETERMINATION OF TOTAL SULPHUR COMPOUND CONTENT

Connect the outlet of the evaporating device to the apparatus shown in Fig. 2. All connections shall be as short as possible and shall be made of polyethylene or polyvinyl chloride.

#### C-5 PROCEDURE

Place 25 ml of the neutral cadmium chloride solution (C-2.4) in the absorber and connect it to the apparatus. Pass the hydrogen (C-2.1) at a flow rate of 500 ml/min through the cold furnace tubes for about 5 min to purge the system of air before heating is commenced. Then raise the temperature of the furnace to 900°C.

Pass carbon dioxide and hydrogen into the system at an accurately known and steady flow rate (500 ml/min for each gas) for about 2 h with the furnace maintained at 900°C ± 10°C. Note the times at which the determination was begun and ended or expand a known mass of carbon dioxide through the apparatus.

Disconnect the bubbler and close the hydrogen cylinder. Remove the jet of the absorber and wash it with a small volume of water, adding the washings to the remainder of the cadmium chloride solution. By means of the pipette (C-3.9), add 2 ml of the

standard volumetric iodine solution (C-2.6) to the bubbler, followed by 2 ml of the concentrated hydrochloric acid (C-2.2). Back titrate the excess iodine with the standard volumetric sodium thiosulphate solution (C-2.5), using the starch solution (C-2.7) as indicator.

#### C-6 EXPRESSION OF RESULTS

The total sulphur compounds content, expressed as sulphur in parts per million by mass, is given by the formula:

$$\frac{320 (2.00 - V)}{m_6}$$

where

$V$  = volume, in millimetres, of sodium thio-sulphate solution used; and

$m_6$  = mass, in grams, of sample taken.

NOTE — The mass,  $m_6$  may be obtained by weighing or by calculation using the formula:

$$m_6 = 0.00184 \times A \times t$$

where

$A$  = flow rate, in ml/min, at 20°C and 1013 mbar (760 mm Hg), of carbon dioxide; and

$t$  = time of flow, in minutes.

**ANNEX D***(Foreword)***GENERAL PROPERTIES****D-1 PHYSICAL PROPERTIES**

A number of the important physical properties of carbon dioxide are given in Table 2.

**D-2 ELECTRICAL CONDUCTIVITY**

Carbon dioxide complying with the requirements for purity specified in this standard has a very low electrical conductivity and can be used to extinguish fires involving live electrical equipment.

**D-3 EFFECTS ON MATERIALS**

Carbon dioxide is stable and inert to most common materials.

**D-4 STATIC ELECTRICITY**

In some circumstances, the discharge of carbon dioxide can cause a build-up of static electricity. This can cause

sparks which can be hazardous in an explosive atmosphere.

**Table 2 Physical Properties of Carbon Dioxide**  
(Clause D-1)

Property	Value
Relative molecular mass	44
Sublimation point at atmospheric pressure, °C	- 78.5
Critical temperature, °C	31
Critical pressure, bar	73.8
Critical volume, m <sup>3</sup> /kg	0.002 15
Critical density, kg/m <sup>3</sup>	466.1
Equilibrium vapour pressure at 20°C, bar	57.3
Vapour density at 20°C and 1 bar, kg/m <sup>3</sup>	1.84
Equilibrium vapour density at 20°C, kg/m <sup>3</sup>	774
Triple point, °C	- 56.6
Bar	5.19

**D-5 TOXICOLOGY**

Information on the toxicology of carbon dioxide is given in Annex G.

**ANNEX E***(Foreword)***SAFETY PRECAUTIONS FOR HANDLING**

**E-1** Carbon dioxide is shipped/transported from the manufacturer as a liquefied gas in bulk under pressure at low temperature; and in cylinders under higher pressure at ambient temperatures. All precautions pertaining to the safe handling and operation of containers, piping and equipment under pressure should be observed when filling fire fighting equipment with the medium.

**E-2** During the discharge of containers of carbon dioxide, low temperatures can arise through expansion of the

liquid to gas and solid. This can present a hazard of frost burn. Gloves and eye protection should be worn when transferring carbon dioxide from one container to another.

**E-3** Transfer of carbon dioxide should be carried out in a well-ventilated area or in the open air.

**E-4** Carbon dioxide is much heavier than air and can collect in pits, cellars and low lying areas. Care should be taken when entering such areas on sites where carbon dioxide has been used.

**ANNEX F***(Foreword)***COMPATIBILITY**

Carbon dioxide may be used simultaneously with other types of fire extinguishing media for fire fighting purposes, with no known indications that extinguishing efficiency is affected.

**ANNEX G***(Foreword)***TOXICOLOGY****G-1 GENERAL**

The principal action of carbon dioxide is to cause suffocation, although it is mildly toxic in its own right.

At concentrations of 3 percent to 4 percent (v/v) in air, the respiration rate is increased and headaches can be caused.

At concentrations of 9 percent (v/v), personnel can lose consciousness within minutes, this being preceded by disorientation, visual disturbance, ringing in the ears, tremors, etc.

At a concentration of about 20 percent (v/v), death will follow in 20 min to 30 min.

**G-2 PRECAUTIONS AND TREATMENT**

In practice, concentrations of 30 percent (v/v) or more are employed for total flooding systems. Similarly, high concentrations could be encountered near to the nozzles of hand extinguishers or local application systems. Such concentrations are highly hazardous for persons and special precautions should be taken depending upon the specific conditions of use.

Persons suffering from exposure to carbon dioxide should immediately move or be moved to fresh air. Medical aid should always be sought in the event of such over-exposure.

## ANNEX H

(Foreword)

## COMMITTEE COMPOSITION

## Fire Fighting Sectional Committee, CED 22

<i>Organization</i>	<i>Representative(s)</i>
Ministry of Home Affairs, New Delhi	SHRI OM PRAKASH ( <b>Chairman</b> )
Airport Authority of India, New Delhi	SHRI L. C. GUPTA SHRI H. S. RAWAT ( <i>Alternate</i> )
Andhra Pradesh Fire Services, Hyderabad	SHRI SWARANJIT SEN
Bhabha Atomic Research Centre, Mumbai	CHIEF FIRE OFFICER
Bombay Fire Brigade, Mumbai	CHIEF FIRE OFFICER SHRI G. S. SAWANT ( <i>Alternate</i> )
Central Building Research Institute, Roorkee	DR T. P. SHARMA DR A. K. GUPTA ( <i>Alternate</i> )
Central Industrial Security Force, New Delhi	DEPUTY INSPECTOR GENERAL (FIRE) SHRI S. L. NAGARKAR ( <i>Alternate</i> )
Central Public Works Department, New Delhi	CHIEF ENGINEER (E) I
Centre for Environment and Explosive Safety, Delhi	SHRI A. K. KAPOOR SHRI H. S. KAPARWAN ( <i>Alternate</i> )
Concord Arai Pvt Limited, Chennai	SHRI R. RAMAKRISHNAN
Controllerate of Quality Assurance (Fire), Pune	COL G. P. KRISHNAMURTHY
Defence Research and Development Organization, Delhi	DIRECTOR (FIRE SAFETY) DEPUTY DIRECTOR (FIRE SAFETY) ( <i>Alternate</i> )
Delhi Fire Service, New Delhi	SHRI R. C. SHARMA SHRI SURINDER KUMAR ( <i>Alternate</i> )
Directorate General of Supplies and Disposals, Hyderabad	SHRI M. GANGARAJU SHRI V. K. VERMA ( <i>Alternate</i> )
Engineer-in-Chief's Branch, Army Headquarter, New Delhi	SHRI R. A. DUBAY SHRI AJAY SHANKAR ( <i>Alternate</i> )
Fire and Safety Appliances Company, Kolkata	SHRI S. N. KUNDU
Home (Police Department), Hyderabad	DEPUTY DIRECTOR (FIRE SAFETY)
Home Department (Fire Service), Chennai	DIRECTOR DEPUTY DIRECTOR ( <i>Alternate</i> )
In personal capacity (33/2965-A, Vennala High School, Vennala, Cochin)	SHRI G. B. MENON
In personal capacity (29/25, Rajendra Nagar, New Delhi )	SHRI S. K. DHERI
Institution of Fire Engineers (India), New Delhi	PRESIDENT GENERAL SECRETARY ( <i>Alternate</i> )
Kooverji Devshi & Co (P) Limited, Mumbai	SHRI P. H. SETHNA SHRI N. T. PANJWANI ( <i>Alternate</i> )
K.V. Fire Chemicals, Navi Mumbai	SHRI H. M. SABADRA
Loss Prevention Association of India, Mumbai	MANAGING DIRECTOR SHRI D. K. SARKAR ( <i>Alternate</i> )
Mather and Platt (India) Limited, New Delhi	SHRI DEEPAK AGARWAL
MECON Limited, Ranchi	SHRI R. N. CHACHRA SHRI SUNIL DAS ( <i>Alternate</i> )
Ministry of Home Affairs, New Delhi	SHRI D. K. SHAMI
Newage Industries, Mumbai	SHRI B. J. SHAH SHRI A. M. SHAH ( <i>Alternate</i> )
Northern Railway, New Delhi	SHRI I. M. MANSOORI
Oil and Natural Gas Commission, Dehra Dun	SHRI R. P. SAXENA SHRI NEERAJ SHARMA ( <i>Alternate</i> )

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<i>Organization</i>	<i>Representative(s)</i>
Oil Industry Safety Directorate, New Delhi	JOINT DIRECTOR (PROCESS)
Real Value Appliances Limited, New Delhi	SHRI ASHUTOSH MANGAL
Safex Fire Services Limited, Mumbai	SHRI JITENDRA SHAH SHRI SANDIP SHAH ( <i>Alternate</i> )
State Bank of India, Mumbai	SHRI J. S. GAHLAUT
State Fire Training Centre, Mumbai	DR NAVINCHANDRA JAIN
Steel Authority of India, Rorukela	SHRI B. N. DAS SHRI B. P. DAS ( <i>Alternate</i> )
Steel Authority of India, Bokaro	SHRI A. RAUTELA SHRI C. P. SINGH ( <i>Alternate</i> )
Steelage Industries Limited, New Delhi	SHRI SHIV NATH SHRI V. KAMALANATHA ( <i>Alternate</i> )
Surex Production and Sales (P) Limited, Kolkata	SHRI TARIT SUR SHRI D. NEOGI ( <i>Alternate</i> )
Tariff Advisory Committee, Chennai	SHRI A MUKHERJEE SHRI H. C. MAHESH KUMAR ( <i>Alternate</i> )
Tariff Advisory Committee, Mumbai	SHRI T. R. A. KRISHNANL
Vijay Fire Protection Systems Pvt Limited, Mumbai	SHRI HARISH SALOT
West Bengal Fire Service, Kolkata	SHRI B. PATHAK
BIS Directorate General	SHRI S. K. JAIN, Director & Head (Civ Engg) [Representing Director General ( <i>Ex-officio</i> )]
<i>Member Secretary</i>	
SHRI S. CHATURVEDI	
Joint Director (Civ Engg), BIS	



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