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SPECIFICATION FOR RESPIRATORS, CHEMICAL CARTRIDGE

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SPECIFICATION FOR RESPIRATORS, CHEMICAL CARTRIDGE

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Indian Standard

SPECIFICATION FOR RESPIRATORS, CHEMICAL CARTRIDGE

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 14 March 1977, after the draft finalized by the Industrial Safety Advisory Committee had been approved by the Executive Committee.

0.2 Use of respiratory protective equipment for health protection is the last line of defence. Many industrial operations give rise to air borne contaminants in low concentrations which cause nuisance more often than pose a serious threat to life and health. Respiratory protection is desirable in such situations. It is essential that the respiratory protective device be suitably tested in the laboratory under simulated conditions and the defects, if any, removed so that desired protection is afforded during actual use.

0.3 In the preparation of this standard, assistance has been obtained from the following publications:

AS CZ 18-1968 Specification for respiratory protective devices. Standards Association of Australia.

BS 2091-1969 Specification for respirators for protection against harmful dusts, gases and scheduled agricultural chemicals. British Standards Institution.

IC 7600 Approval system for respiratory protective devices. The Bureau of Mines, USA.

0.4 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.

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1. SCOPE

1.1 This standard prescribes the requirements and methods of test for chemical cartridge respirators with full face mask or half mask face piece

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

or mouth piece for use in atmospheres not immediately dangerous to life or health and containing gases or vapours with or without particulate contaminants.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 8437-1977* shall apply. The following definitions are reproduced for ready reference.

2.1.1 *Chemical Cartridge Respirator* — It is a completely assembled device with either a full face mask/half-mask face piece or mouth piece and one or more cartridges designed to provide respiratory protection against low concentrations of gases and vapours, with or without particulate contaminants, which are not immediately dangerous to life or health.

2.1.2 *Atmospheres (Concentrations) Not Immediately Dangerous to Life or Health* — Includes those which may produce discomfort immediately or chronic type of poisoning or affectation after repeated exposures or acute diverse physiological symptoms after prolonged exposure.

3. CLASSIFICATION OF CHEMICAL CARTRIDGE RESPIRATORS

3.1 Chemical cartridge respirators are classified according to the specific gas(es) or vapour(s) they are designed to protect against as given in Table 1.

TABLE 1 CLASSIFICATION OF CARTRIDGE RESPIRATORS AND SUGGESTED MAXIMUM USE CONCENTRATIONS

Type of Chemical Cartridge Respirator	Suggested Maximum Use Concentration
(1)	(2)
	parts per million
Amines	100 (Note 1)
Amine derivatives	30 (Note 1)
Ammonia	300
Chlorine	10
Hydrogen chloride	50
Organic vapours (Note 2)	1 000 (Note 1)
Sulphur dioxide	50

Note 1 — Suggested maximum use concentrations shall be lower for amines, amine derivatives, and organic vapours which produce conditions immediately dangerous to life or health at concentration lower than those given above.

Note 2 — For use against amines, amine derivatives or organic vapours with poor warning properties or which generate high heats of reaction with sorbent material in the cartridge.

*Glossary of terms relating to respiratory protective devices.

4. DESIGN AND CONSTRUCTION

4.1 Design and Construction — The design and construction of the chemical cartridge respirator shall be such that it will provide protection against low concentrations of relatively non-toxic gases and vapours as given in Table 1. Factors of design and construction which should be evaluated are (a) safety; (b) distribution of weight; (c) durability of construction; (d) practicability of wearer use including comfort; (e) field of vision; (f) fit of mouth piece, nose clip and face piece; and (g) performance during investigation and testing, including any adverse effects on the wearer by chemical cartridge respirator.

4.2 Component Parts

4.2.1 The chemical cartridge respirator shall consist of (a) a full face/half face piece held securely in position with a head harness, (b) an outlet valve or outlet valve assembly, (c) a chemical cartridge or cartridges and inlet valve assembly, and (d) a chemical cartridge holder.

4.2.2 All component parts shall be designed, constructed and fitted in such a manner that they will not create a hazard to the wearer. Replacement parts shall be easily installed and shall maintain the effectiveness of the chemical cartridge respirator. The chemical cartridge respirator shall be so constructed as to readily permit inspection and repair of functional parts. All parts requiring cleaning and disinfection shall be readily accessible. Chemical cartridge respirator parts in contact with the wearer's body shall be of non-irritating compositions.

4.2.3 All materials used in construction, fabrication, or assembly of cartridges and filters shall not be damaged by normal handling.

4.2.4 A substantial and durable container shall be provided for the chemical cartridge respirator and for the predetermined number of replacement cartridges and filters sold as a unit.

4.2.5 When a particulate filter is a part of a chemical cartridge respirator, it shall be located on the inlet side of the cartridge (upstream from the sorbent). The filter may be incorporated in or firmly attached to the cartridge.

4.2.6 When two cartridges are used in parallel, their sorbent capacity and resistance to airflow shall be equal.

4.2.7 When a flexible breathing tube is a part of the chemical cartridge respirator, it shall not restrict free head movement, disturb face piece fit or otherwise interfere with wearer's activity. It shall not shut off airflow because of kinking or chin or arm pressure.

5. PERFORMANCE REQUIREMENTS

5.1 Breathing Resistance — Resistance to airflow shall be measured at the face piece or mouth piece before and after the test. The chemical cartridge respirator shall be mounted on a test fixture with air flowing at a continuous rate of 85 litres per minute. The resistance to breathing shall not be more than the limits given in Table 2.

TABLE 2 EXHALATION AND INHALATION RESISTANCE TO AIR FLOW (*MAXIMUM*)

Sl No.	Type of Chemical Cartridge Respirator	Inhalation Resistance		Exhalation Resistance
		Initial	Final	
(1)	(2)	(3)	(4)	(5)
		mm H_2O	mm H_2O	mm H_2O
i)	Mask or mouth piece, for gases, vapours, and gases and vapours	35	45	20
ii)	Mask or mouth piece, for gases, vapours, or gases and vapours, dust, fumes, and mist	45	65	20

5.2 Exhalation Valve Leakage — The dry inhalation valve seat shall be subjected to suction of 25 mm H_2O while in normal operating position. Leakage between the valve seat shall not exceed 30 ml per minute.

5.3 Face Piece Fit Tests — The complete chemical cartridge respirator shall be fitted to the faces of three persons having varying facial shapes and sizes. The face piece or mouth piece fit test using positive or negative pressure, recommended by the manufacturer and described in the instructions shall be used. Any chemical cartridge respirator part which has to be removed to perform the face piece or mouth piece fit test shall be replaceable without special tools and without disturbing the face piece or mouth piece fit. The face piece or mouth piece fit test shall be performed by each person prior to tests described below.

5.3.1 If the manufacturer specifies face piece size or sizes of his respirator(s), with accompanying approximate measurements of faces they are designed to fit to, provision shall be made to provide test subjects to suit those facial measurements.

5.3.2 Each person wearing a chemical cartridge respirator shall enter a chamber containing 100 ppm *iso*amyl acetate vapour for half face piece and 1 000 ppm *iso*amyl acetate vapour for full face piece and shall remain in the chamber for 8 minutes while performing the following activities:

a) 2 minutes — nodding and turning head
b) 2 minutes — calisthenic arm movements
c) 2 minutes — running in place
d) 2 minutes — pumping air with an air pump into 0·1 m^3 cylinder,

5.3.3 No person shall detect the odour of *iso*amyl acetate vapour during the test.

5.3.4 The face or mouth piece may be adjusted, if necessary, in the test chamber before starting the test.

5.4 Face Piece Leakage Test

5.4.1 Each of three persons wearing two different respirators fitted to the face (a total of 6 wearings and 6 different respirators) shall enter a chamber containing 100 parts per million of dichlorodifluoromethane and remain inside for 15 minutes and perform the following activities:

a) 3 minutes — nodding and turning head and coughing
b) 1½ minutes — smiling
c) 1½ minutes — frowning
d) 3 minutes — talking
e) 3 minutes — deep and shallow breathing
f) 3 minutes — pumping air with a hand pump into 0·1 m^3 cylinder.

Air samples shall be taken continuously from inside the face piece or mouth piece. The average concentration of dichlorodifluoromethane in the sample shall not exceed 5 percent of the test concentration.

5.5 Dust, Fumes and Mist Test — Cartridges containing, or having attached to them filters for protection against dust, fumes, and mist, excepting mist of paints, lacquers, and enamels, shall be tested to determine their ability to protect against the inhalation of gases and vapours according to the relevant requirements of this standard and that of dust respirators (*see* Indian Standard specification for filter type dust, fume and mist respirators (*under preparation*). However, the maximum allowable resistances of complete dust, fume, mist, gas, vapour, and gas and vapour, chemical cartridge respirators shall be as described in this standard (Table 2).

5.6 Bench Tests — Cartridges shall meet the requirements of the bench tests made on an apparatus that allows the test atmosphere at 65 ± 5 percent relative humidity and room temperature 27 ± 2°C to enter the cartridges continuously at predetermined concentrations and rates of flow, and that has means for determining the test life of cartridges.

5.6.1 When two cartridges are used in parallel in a chemical cartridge respirator, the test shall be performed with the cartridges arranged in parallel and the test requirements shall apply to the combination and not to the individual cartridges.

5.7 Gas and Vapour Test — The appropriate test concentration of the gas or vapour in air containing 50 percent relative humidity shall be

prepared and passed through the cartridge(s) at rates of flow given in Table 3. The life of cartridge shall be taken as exhausted when the gas or vapour is detected in air sampled after passage through the cartridge. The cartridges shall be tested as follows:

a) Three cartridges or pairs of cartridges shall be removed from their containers and tested as received from the manufacturer,

b) Two c artridges or pairs of cartridges shall be equilibrated at room temperature by passing air at relative humidity 25 percent at a flow rate of 25 litres per minute for 6 hours,

c) Two cartridges or pairs of cartridges shall be equilibrated by passing air at relative humidity 85 percent through them at a flow rate of 25 litres per minute for 6 hours.

These equilibrated cartridges shall be resealed, kept in an upright position at room temperature and tested within 18 hours.

6. MARKING

6.1 Chemical cartridge respirators tested according to and meeting the requirements of this standard shall be marked as follows:

6.1.1 *Respirator* — The respirator shall be marked with the following:

a) The manufacturer's name, trade name or registered mark;

b) The month and year of manufacture;

c) An indication of the gas or gases against which the cartridge(s) will give protection;

d) An indication of the type of particulate contaminant against which the respirator will give protection; and

e) A warning as follo ws:

'WARNING'

DO NOT USE:

1) In highly toxic atmosphere;

2) In confined spaces;

3) Where there may be a deficiency of oxygen;

f) Instructions for use; and

g) The ISI Certification Mark.

6.1.2 *Face Piece* — Every face piece shall be marked with the following:

a) The manufacturer's name, trade-name or registered mark;

b) The size of the face piece;

c) The year of manufacture.

TABLE 3 CARTRIDGE BENCH TESTS REQUIREMENTS

(*Clause* 5.7)

Cartridge Type	Test Condition	Gas or Vapour to be used for Testing	Test Atmosphere		No. of Tests	Performance Required	
			Concentration	Flow rate		Penetration	Minimum Life
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				litres/minute		ppm	minutes
Ammonia	As received	Ammonia	1 000	64	3	50	50
Ammonia	Equilibrated	Ammonia	1 000	32	4	50	50
Chlorine	As received	Chlorine	500	64	3	5	40
Chlorine	Equilibrated	Chlorine	500	32	4	5	40
Hydrogen chloride	As received	Hydrogen chloride	500	64	3	5	50
Hydrogen chloride	Equilibrated	Hydrogen chloride	500	32	4	5	50
Methyl amine	As received	Methyl amine	1 000	64	3	10	30
Methyl amine	Equilibrated	Methyl amine	1 000	32	4	10	30
Organic vapours	As received	Carbon tetrachloride	1 000	64	3	5	50
Organic vapours	Equilibrated	Carbon tetrachloride	1 000	32	4	5	50
Sulphur dioxide	As received	Sulphur dioxide	500	64	3	5	30
Sulphur dioxide	Equilibrated	Sulphur dioxide	500	32	4	5	30

6.1.3 *Cartridge* — Each cartridge shall be marked with the following:

a) The manufacturer's name and registered trade-mark, if any;

b) The cartridge or a label on it shall be of a colour prescribed in IS : 8318-1977*;

c) Minimum working life and shelf life;

d) Appropriate markings given below in bold letters:

1) **'Cartridge for** _____ **'**
Name of the atmospheric contaminant

2) **'For respiratory protection in atmospheres containing not more than** _____ **by volume of**
(concentration)
'
_____
(Name of atmospheric contaminant)

3) **'Do not use in atmospheres containing less than 16 percent oxygen by volume'.**

The above information shall be permanently attached or imprinted on the cartridge.

7. PROCESS CONTROL

7.1 Procedures for quality control during production shall be followed (*see* IS : 397 (Part I)-1972†.

*Colour identification markings for air purifying canisters and cartridges.

†Method for statistical quality control during production: Part I Control charts for variables (*first revision*).

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