इंटरनेट मानक

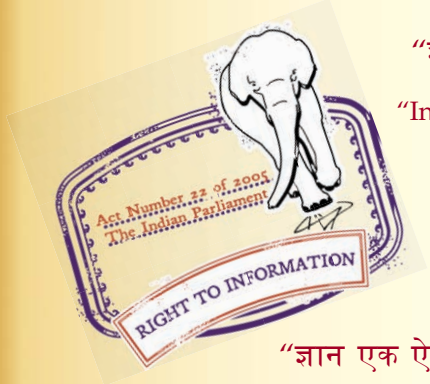
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 15821 (2008): Gaseous Fire Extinguishing Systems--Physical Properties and System Design--CF3I Extinguishant. ICS 13.220.10



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

IS 15821 : 2008

भारतीय मानक

गैसीय अग्नि शमन पद्धतियाँ —भौतिक गुणधर्म और प्रणाली अभिकल्पना — सी एफ$_3$आई शमन पद्धतियाँ

Indian Standard

GASEOUS FIRE EXTINGUISHING SYSTEMS — PHYSICAL PROPERTIES AND SYSTEM DESIGN— CF_3I EXTINGUISHANT

ICS 13.220.10

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

October 2008

Price Group 3

Fire Fighting Sectional Committee, CED 22

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.

It is important that fire protection of a building or part be considered as a whole. CF_3I total flooding systems form only a part of the available facilities. However, it should not be assumed that their adoption necessarily remove the need to consider supplementary measures, such as provision of portable fire extinguishers or mobile appliances for first aid or emergency use or measures to deal with special hazards.

CF_3I is recognized as effective for extinguishing all classes of fires within limits specified in 4 of IS 15493. It does not cover the design of explosion suppression system. Nevertheless, it should not be forgotten in the planning of comprehensive schemes that there may be hazards for which this technique is not suitable.

Agent dump/discharge test may be replaced by enclosure integrity test unless required by legal requirement. Complete system should be approved by any recognized/independent authority.

In the formulation of this standard, assistance has been derived from ISO 14520-2 : 2000 'Gaseous fire extinguishing systems — Physical properties and system design — Part 2: CF_3I Extinguishant'.

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

GASEOUS FIRE EXTINGUISHING SYSTEMS — PHYSICAL PROPERTIES AND SYSTEM DESIGN — CF_3I EXTINGUISHANT

1 SCOPE

1.1 This standard sets out general requirement for design and installation of total flooding fire extinguishing system employing CF_3I gas and specific requirements of physical and chemical properties. This standard is applicable for single as well as distributed supply system that is local and total flooding system.

1.2 This standard covers CF_3I system operating at nominal pressure of 2.5 MPa.

2 REFERENCE

The following standard contains provision which, through reference in this text, constitutes provisions of this standard. At the time of publication, the edition indicated was 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 the standard given below:

IS No.	*Title*
15493 : 2004	Gaseous fire extinguishing systems — General requirements

3 CHARACTERISTICS AND USES

3.1 General

Extinguishant CF_3I shall comply with the specification given in Table 1 and the physical properties are given in Table 2. CF_3I is a colourless, almost odourless, electrically non-conductive gas with a density approximately seven times that of air.

Chemical formula	CF_3I
Chemical name	Trifluoroiodomethane

Table 1 Specification for CF_3I
(*Clauses* 3.1 *and* 4.3.4)

Sl No.	Property	Requirements
(1)	(2)	(3)
i)	Purity	99.9 percent by mass, *Min*
ii)	Acidity	1×10^{-6} by mass, *Max*
iii)	Water content	6×10^{-6} by mass, *Max*
iv)	Non-volatile residue	100×10^{-6} by mass, *Max*
v)	Suspended matter or sediment	Non-visible

Table 2 Physical Properties of CF_3I
(*Clauses* 3.1 *and* 4.3.4)

Sl No.	Property	Units	Value
(1)	(2)	(3)	(4)
i)	Molecular mass	—	195.9
ii)	Boiling point at 0.101 3 MPa (absolute)	°C	−22.5
iii)	Freezing point	°C	−110
iv)	Critical temperature	°C	122
v)	Critical pressure	MPa (Abs)	4.04
vi)	Critical volume	cm^3/mol	225.0
vii)	Critical density	kg/m^3	871
viii)	Vapour pressure, 20°C	MPa (Abs)	0.465
ix)	Liquid density, 20°C	kg/m^3	2.096
x)	Saturated vapour density, 20°C	kg/m^3	8.051
xi)	Specific volume of superheated Vapour at 0.101 3 MPa and 20°C	m^3/kg	0.124

NOTE — CF_3I extinguishes fires mainly by chemical means but by some physical means also.

4 USE OF CF_3I SYSTEMS

4.1 CF_3I systems may be used for extinguishing fires of all classes within the limits specified in 4 of IS 15493. The extinguishment requirements per volume of protected space are shown in Table 3 for various levels of concentrations.

Table 3 CF_3I Total Flooding Quantity
(*Clauses* 4.1 *and* 6.3)

Sl No.	Temperature T °C	Specific Volume S m^3/kg	CF_3I Mass Requirements per Unit Volume of Protected Space m/V (kg/m^3)							
			Design Concentration (By Volume) Percent							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
			3 Percent	4 Percent	5 Percent	6 Percent	7 Percent	8 Percent	9 Percent	10 Percent
i)	-25	0.101 3	0.305 3	0.411 3	0.519 6	0.630 1	0.743 0	0.858 4	0.976 3	1.096 9
ii)	-20	0.103 8	0.298 0	0.401 4	0.507 0	0.614 9	0.725 1	0.837 7	0.952 8	1.070 4
iii)	-15	0.106 3	0.290 9	0.392 0	0.485 1	0.600 5	0.708 1	0.818 0	0.930 4	1.045 3
iv)	-10	0.108 8	0.284 3	0.383 0	0.483 7	0.586 7	0.691 8	0.799 2	0.909 0	1.021 2
v)	-5	0.111 3	0.277 9	0.374 4	0.472 9	0.573 5	0.676 3	0.781 3	0.888 6	0.998 3
vi)	0	0.113 8	0.271 8	0.366 1	0.462 5	0.560 9	0.661 4	0.764 1	0.869 1	0.976 4
vii)	5	0.116 3	0.265 9	0.358 3	0.452 6	0.548 8	0.647 2	0.747 7	0.850 4	0.955 4
viii)	10	0.118 8	0.260 3	0.350 7	0.443 0	0.537 3	0.633 6	0.732 0	0.832 5	0.935 3
ix)	15	0.121 3	0.255 0	0.343 6	0.433 9	0.526 2	0.620 5	0.716 9	0.815 3	0.916 0
x)	20	0.123 8	0.249 8	0.336 6	0.425 1	0.515 6	0.608 0	0.702 4	0.798 9	0.897 5
xi)	25	0.126 3	0.244 9	0.329 9	0.416 7	0.505 4	0.596 0	0.688 5	0.783 1	0.879 7
xii)	30	0.128 8	0.240 1	0.323 5	0.408 6	0.495 6	0.584 4	0.675 1	0.767 9	0.862 7
xiii)	35	0.131 3	0.235 6	0.317 3	0.400 8	0.486 1	0.573 3	0.662 3	0.753 2	0.846 2
xiv)	40	0.133 8	0.231 1	0.311 4	0.393 4	0.477 1	0.562 5	0.649 9	0.739 2	0.830 4
xv)	45	0.136 3	0.226 9	0.305 7	0.386 1	0.468 3	0.552 2	0.638 0	0.725 6	0.815 2
xvi)	50	0.138 8	0.222 8	0.300 2	0.379 2	0.459 9	0.542 3	0.626 5	0.712 5	0.800 5
xvii)	55	0.141 3	0.218 9	0.294 9	0.372 5	0.451 7	0.532 7	0.615 4	0.699 9	0.786 3
xviii)	60	0.143 8	0.215 1	0.289 8	0.366 0	0.443 9	0.523 4	0.604 7	0.687 8	0.772 7
xix)	65	0.146 3	0.211 4	0.284 8	0.359 8	0.436 3	0.514 5	0.594 4	0.676 0	0.759 5
xx)	70	0.148 8	0.207 8	0.280 0	0.353 7	0.429 0	0.505 8	0.584 4	0.664 7	0.746 7
xxi)	75	0.151 3	0.204 4	0.275 4	0.347 9	0.421 9	0.497 5	0.574 7	0.653 7	0.734 4
xxii)	80	0.153 8	0.201 1	0.270 9	0.342 2	0.415 0	0.489 4	0.565 4	0.643 1	0.722 4
xxiii)	85	0.156 3	0.197 9	0.266 6	0.336 7	0.408 4	0.481 6	0.556 3	0.632 8	0.710 9
xxiv)	90	0.158 8	0.194 8	0.262 4	0.331 4	0.402 0	0.474 0	0.547 6	0.622 8	0.699 7
xxv)	95	0.161 3	0.191 7	0.258 3	0.326 3	0.395 7	0.466 6	0.539 1	0.613 2	0.688 8
xxvi)	100	0.163 8	0.188 8	0.254	0.321 3	0.389 7	0.459 5	0.530 9	0.603 8	0.678 3

NOTE — This information has been obtained from ISO 14520-2.

Symbols:

m/V — agent mass requirements (kg/m^3); that is mass, m in kilograms of agent required per cubic metre of protected volume V to produce the indicated concentration at the temperature specified;

V — net volume of hazard (m^3); that is the enclosed volume minus the fixed structures impervious to extinguishant:

$$m = \left[\frac{c}{100 - c}\right]\frac{V}{S}$$

T — temperature (°C), that is the design temperature in the hazard area;

S — specific volume (m^3/kg); the specific volume of superheated CF_3I vapour at a pressure of 0.101 3 MPa may be approximated by the formula:

$$S = k_1 + k_2 T$$

where

$k_1 = 0.113\ 8$

$k_2 = 0.000\ 5$

c — concentration (percent), that is the volumetric concentration of CF_3I in air at the temperature indicated and at a pressure of 0.101 3 MPa absolute.

4.2 The extinguishing concentrations and design concentrations for *n*-heptane and surface Class A hazards are shown in Table 4. Concentrations for other fuels are shown in Table 5 and inerting concentrations are shown in Table 6.

Table 4 CF_3I Extinguishing and Design Concentrations (By Volume)

(*Clauses* 4.2, 4.3.1 *and* 6.3)

Fuel	Extinguishment	Minimum Design
(1)	(2)	(3)
n-Heptane	3.0 percent	3.9 percent

NOTE — This information has been obtained from ISO 14520-2.

Table 5 CF_3I Extinguishing and Design Concentrations for Other Fuels

(*Clause* 4.2)

Sl No.	Fuel	Extinguishment Percent	Minimum Design Percent
(1)	(2)	(3)	(4)
i)	Acetonitrile	1.7	2.2
ii)	Aviation gasoline	3.7	4.8
iii)	*n*-Butanol	3.3	4.3
iv)	*n*-Butyl acetate	2.5	3.3
v)	Diesel No. 2	3.3	4.3
vi)	Ethanol	3.0	3.9
vii)	Ethyl acetate	3.0	3.9
viii)	Ethylene glycol	2.4	3.1
ix)	Gas (unleaded, 7.8 percent ethanol)	3.6	4.7
x)	Hydraulic fluid No. 1	2.3	3.0
xi)	JP-4	3.3	4.3
xii)	JP-5	3.2	4.2
xiii)	Methane	2.0	2.6
xiv)	Methanol	3.8	4.9
xv)	Methyl ethyl ketone	4.4	5.7
xvi)	Methyl isobutyl ketone	2.9	3.8
xvii)	Propane	3.0	4.3
xviii)	Pyrrollidine	2.8	3.6
xix)	Turbo hydraulic oil 2380	2.1	2.7
xx)	Xylene	5.5	7.2

NOTE—This information has been obtained from ISO 14520-2.

Table 6 CF_3I Inerting and Design Concentrations (By Volume)

(*Clause* 4.2)

Fuel	Inertion	Minimum Design
(1)	(2)	(3)
Propane	6.5 percent	7.2 percent

NOTE — Inerting concentrations were determined in accordance with the requirements of IS 15493.

4.3 Special Application

The principle of extinguishing is identical to the one with portable extinguisher.

4.3.1 *Design Concentration*

The agent shall be used only for unmanned areas like rim seal fire protection of floating roof tanks. The quantity of CF_3I released in that area is at over kill rate However, the CF_3I extinguishing and design concentration is given in Table 4.

4.3.2 *System Design*

System design for rim seal fire protection of floating roof tank is given below:

The protection system broadly consists of container, feed lines, ring mains/laterals as required, spray nozzles, signalling equipment and cables, heat detection and activation devices. The protection system can defect, control and extinguish the fire and also simultaneously give audio visual indication on the control panel. A typical diagram of CF_3I automatic rim seal fire protection system is given in Fig. 1.

4.3.3 *Discharge Time*

Unlike total flooding system discharge time of 10 s, for local application system of CF_3I discharge time depends on the size of cylinder or glass bulb used. The discharge time therefore ranges from 20 s to 45 s for 10 to 40 kg cylinders.

4.3.4 *Quality Check*

The gas (CF_3I) quality be tested as per Table 1 and Table 2 and also G.C. supplied by the supplier of the agent. The commissioning be performed after leak testing installation by pressurization by Nitrogen only at 2.5 times more than working pressure and be kept under pressure for 48 h. After leak testing the system can be filled with CF_3I and pressurized at 1 MPa at 20°C and 1.2 MPa at 35°C. Checking of correct pressure of CF_3I gas in the cylinder is done by pressure switch in the cylinder giving a signal to the control panel. Pressure can also be read from pressure gauge mounted on the CF_3I cylinder. Checking of correct quality of gas in cylinder is done by level switch mounted in the cylinder giving signal to control panel.

5 SAFETY OF PERSONNEL

5.1 Any hazard to personnel created by the discharge of CF_3I shall be considered in the design of the system. Potential hazards can arise from the following:

a) Extinguishant itself,

b) Combustion products of the fire, and

c) Breakdown products of the extinguishant resulting from exposure to fire.

5.2 Toxicological information for CF_3I is shown in Table 7.

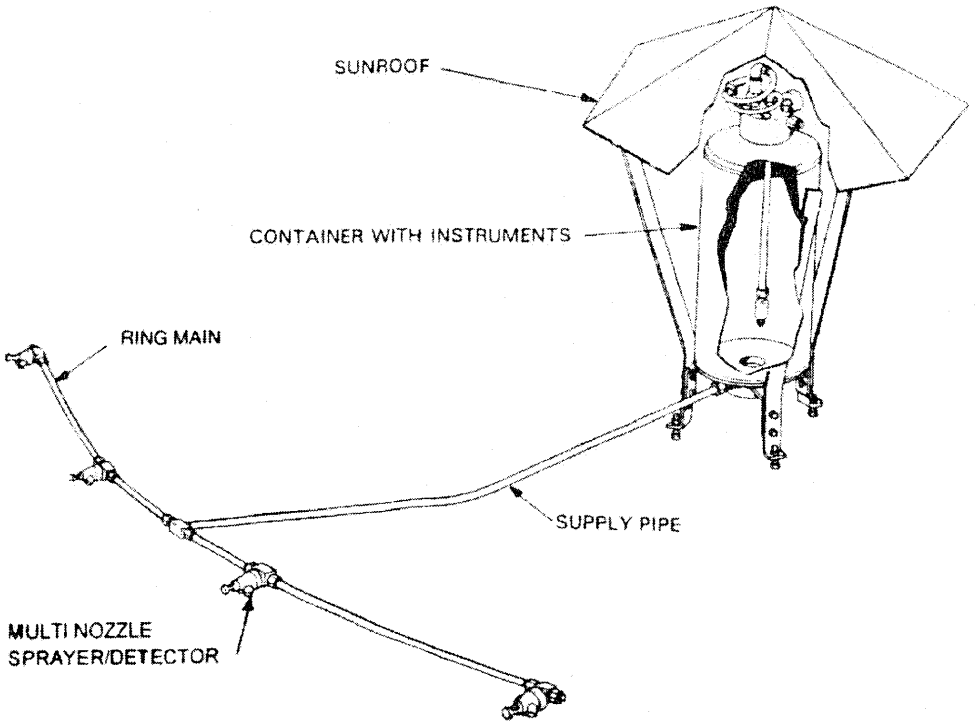


Fig. 1 TYPICAL DIAGRAM OF CF_3I AUTOMATIC RIM SEAL FIRE PROTECTION SYSTEM

Table 7 Toxicological Information for CF_3I
(*Clause* 5.2)

Sl No.	Property	Value Percent
(1)	(2)	(3)
i)	LC_{50}	27.4
ii)	ALC	>12.8
iii)	No observed adverse effect level (NOAEL)	0.2
iv)	Lowest observed adverse effect level (LOAEL)	0.4

NOTE — LC_{50} is the concentration lethal to 50 percent of a rat population during a 15 minutes exposure. ALC is the approximate lethal concentration for a rat population during a 4 h exposure.

5.3 Since the design concentration exceed the LOAEL under normal design conditions, CF_3I shall only be used for normally unoccupied areas such as rimseal fire protection of floating roof tanks, aircraft engine nacelles etc. For minimum safety requirements, *see* 5 of IS 15493.

6 SYSTEM DESIGN

6.1 Fill Density

The fill density of the container shall not exceed the values shown in Table 8.

Exceeding the maximum fill density may result in the container becoming liquid full, with the effect that an extremely high rise in pressure occurs with small increases in temperature, which could adversely affect the integrity of the container assembly.

The relationships between pressure and temperature are shown in Fig. 2 for various levels of fill density.

Table 8 Storage Container Characteristics for CF_3I
(*Clause* 6.1)

Sl No.	Property	Value
(1)	(2)	(3)
i)	Maximum fill density, kg/m^3	1.680
ii)	Maximum container working pressure at 50° C, MPa	3.55
iii)	Super pressurization at 20°C, MPa	1

NOTE — Reference should be made to Fig. 1 for further data on pressure/temperature relationships.

6.2 Super Pressurization

Containers shall be super pressurized with nitrogen with a moisture content of not more than 60×10^{-6} by mass to an equilibrium pressure of 2.5 MPa at a temperature of 20°C.

6.3 Extinguishant Quantity

The quantity of extinguishant shall be the minimum required to achieve the design concentration within the hazard volume at the minimum expected temperature, determined using Table 3 and provisions laid down in IS 15493.

The design concentrations shall be that specified for relevant hazards shown in Table 4. This includes a 1.3 safety factor on the extinguishing concentration.

Consideration should be given to increasing this for particular hazards, and seeking advice from the relevant authority.

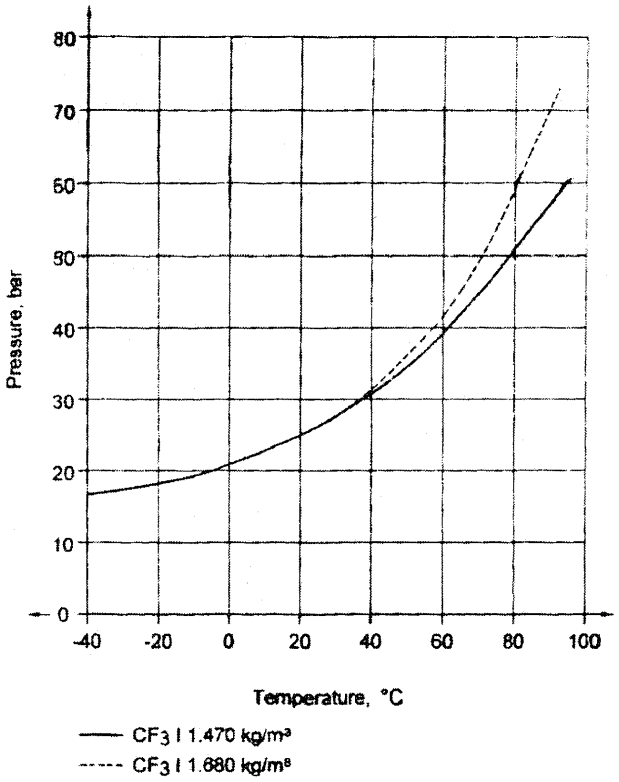


FIG. 2 TEMPERATURE/PRESSURE GRAPH FOR CF_3I PRESSURIZED TO 2.5 MPa WITH NITROGEN AT 20°C

MGIPF—13 Deptt. of BIS/2008—300 Books

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act,* 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc: No. CED 22 (7347).

Amendments Issued Since Publication

Amendment No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in
Telegrams : Manaksanstha (Common to all offices)

Regional Offices: Telephone

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002 — 2323 7617, 2323 3841

Eastern : 1/14, C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi, KOLKATA 700054 — 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022 — 260 3843, 260 9285

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 — 2254 1216, 2254 1442, 2254 2519, 2254 2315

Western : Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400093 — 2832 9295, 2832 7858, 2832 7891, 2832 7892

Branches : AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

Printed at Government of India Press, Faridabad