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Indian Standard

शीतगृह सहित सामान्य भंडारगृह और गोदाम की अग्नि सुरक्षा — रीति संहिता

(दूसरा पुनरीक्षण)

Fire Safety of General Storage and Warehousing Including Cold Storages — Code of Practice

(Second Revision)

ICS 13.220.01; 55.220

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Fire Safety Sectional Committee, CED 36

FOREWORD

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

Fires in storage and warehouse buildings represent a significant percentage of the total number of fire outbreaks and almost invariably escalate to serious proportions. If fire starts when the storage/warehouse building is closed, it often remains undetected for some time and by then, it assumes serious proportions. The principal causes of outbreak of fire in a storage/warehouse building are careless smoking, electrical sources, spontaneous ignition, falling of sparks/embers from external source, carrying out of dangerous operations, like welding, cutting, spray painting, etc, either in the storage/warehouse building or in buildings communicating with the storage/warehouse buildings, use of naked lights for cooking, faulty electrical installations, storage of different goods which would be hazardous in combination.

The three primary considerations in providing adequate and reasonable fire protection and safeguards for storage occupancies are, the fire behaviour of stored materials, their storage arrangement, and the type of building itself. Once a fire occurs in a storage/warehouse building, the fire propagation and duration depend primarily on these factors. The earlier a fire is detected, controlled and extinguished, the lesser the damage will result.

Frequency of fire outbreaks and losses suffered as a result, may be considerably reduced if proper attention is paid to various aspects affecting fire safety, such as fire resistive construction, compartmentation, proper layout, size and height of the building, provision of smoke and heat ventilation, drainage arrangements, regulating the quantity and type of stocks in any particular storage/warehouse building, segregation of stocks having a varying fire risk, size and height of piles, provision of adequate aisles, separation of storage and process activities, minimizing exposure hazards by proper layout of the building, etc. Automatic fire detection, alarm and protection arrangements are of utmost importance because storage/warehouse buildings are normally occupied only by comparatively a smaller number of people during working hours and hardly any or at all during non-working hours. When the value in a fire area is extremely high, it will be desirable to sub-divide it by one or more structurally independent fire walls.

Cold storage or cold warehouse buildings are used primarily for extended storage of food products at low temperatures which prevent or retard spoilage. Depending on the products or processes, temperature in cold storage is maintained below 4 °C. Despite such low temperatures, cold storage warehouses are not immune to fire hazards. In fact, the low temperatures present unusual fire prevention and control problems which may assume serious proportions when such premises are located outside municipal limits where access to fire tenders and compliance to byelaws are doubtful. Combustible materials in such warehouses include cork or expanded plastic insulation, wooden dunnage, pallets, boxes, fireboard and paper containers and wrappings, etc.

Although fire frequency in such premises, is relatively low, considering the presence of large fire potential, the fire protection arrangements for the cold storage warehouses have to be of the same standard as for the normal storage occupancies.

Many combustible materials such as grains, sugar, starch, flour, etc, are handled and stored in bulk. These are generally stored in bulk in silos, bins, etc. Such special storage practice is not covered under this standard.

Many major fires have occurred in warehouses and storage buildings, causing both significant property and business interruption losses. The incidence of fire in warehouse buildings is generally less than in manufacturing areas, but the impact in financial and business terms can often be disproportionately higher.

A detailed risk assessment is a key element of an effective fire safety strategy. This will identify the fire hazards and the potential for property and business interruption losses and lead to the preparation of an effective risk control program for the premises.

(*Continued on third cover*)

Indian Standard

FIRE SAFETY OF GENERAL STORAGE AND WAREHOUSING INCLUDING COLD STORAGES — CODE OF PRACTICE

(Second Revision)

1 SCOPE

1.1 This standard covers the essential requirements of fire safety of warehouses and storage premises. Warehouse accommodation is discussed generally and includes general storage warehouses on manufacturing sites as well as retail warehouses. Also, this standard may help provide an understanding of the hazards associated with material handling operations within a warehouse.

1.2 This standard also covers the essential requirements of fire safety of cold storages.

NOTE — The provisions of this Standard are to be regarded as supplementary to the provisions laid down under the *Indian Petroleum Rules and Indian Explosive Rules*, 2008 in case of materials to which those rules are applicable.

2 REFERENCES

The standards listed in Annex A contain provisions, which through references in this text constitute provisions 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.

3 TERMINOLOGY

For the purpose of this standard the following definitions in addition to those given in IS 8757 shall apply:

3.1 Authority — An organization, office or individual responsible for enforcing the requirements of a standard, or for approving equipment, materials, an installation, or a procedure.

3.2 Cold Storage — A warehouse, or a portion of a warehouse, where the ambient temperature of the storage area is constantly maintained below 4 °C.

3.3 General Storage — An auxiliary structure used to store raw materials and finished goods in any occupancy.

3.4 Insulation Boards — Building materials used for thermal insulation of cold storages.

3.5 Ordinary Hazard Goods — Goods which are give off a considerable volume of smoke. Ordinary hazard goods are general commodities that are found in most of the storage buildings and is the basis for general requirements of this standard. All storage commodities given in **5.7** of IS 15105 shall be considered as ordinary hazard goods.

3.6 High Hazard Goods — Goods which are likely to have explosive, flammable, toxic, infectious, or corrosive properties and pose a risk to public safety, health, property and the environment.

NOTE — High hazard goods are dangerous goods requires greater deal of attention in their storage and have not been addressed in this standard adequately. Dangerous goods given in IS 1446 and IS 18149 shall be treated as high hazard goods.

3.7 Separating Walls — Fire rated walls built according to specification laid down in IS 1642. The walls provide complete separation of one building from another or part of a building from another part of the same building to prevent any communication of fire or any access or heat transmission to wall itself which may cause or assist in the combustion of materials of the side opposite to that portion which may be on fire.

3.8 Smoke Vents — Openings, fitted with shutters operated manually or through automatic means, used for removal of smoke from a fire.

4 LOCATION

4.1 Warehouse facilities including its location shall be so arranged to minimize external fire exposure, have an adequate water supply for firefighting purposes, and allow for easy access to local fire services.

4.2 Wherever possible, the buildings and open storage sites shall be at least 30 m away from a railway line, siding or yard used by locomotives.

4.3 Buildings within municipal limits of a city or town shall not be used for storage of fireworks, gun powders and other explosives, nitrocellulose, vegetable fibres and flammable liquids having flash point less than 65 °C without obtaining prior approval from appropriate authority.

5 COMPOUNDS

5.1 Whenever the storage/warehouse building is located in its own compound the area of the compound shall conform to the requirements given in **7** with regard to inter-distances between various facilities.

5.2 Roadways alongside the storage/warehouse buildings shall not be less than 6 m in width, and a turning radius of minimum 9 m shall be provided for fire engine movement. The gates of the compound shall be of adequate width to allow easy access to fire engine and in no case shall it measure less than 6 m. Moreover, to allow unobstructed passage of fire engines through main entrance sufficient headroom with minimum clearance of 4.5 m shall be provided.

5.3 At least two distantly located gate openings to the above description shall be available.

5.4 Storage/warehouse buildings shall be located at least 6 m away from the compound wall.

6 BUILDING CONSTRUCTION

6.1 When constructing a new storage/warehouse or implementing significant modifications to an existing storage/warehouse structure, discussions shall be held with appropriate authorities, insurers, etc at an early stage regarding the level of fire protection required. The building shall be constructed in accordance with SP 7 (Part 4) in all respects.

6.2 General Storage and Warehouse Buildings

6.2.1 Storage/warehouse buildings used for storage of high hazardous goods shall conform to Type 1 of the fire resistance grading of buildings specified in IS 1642, while those used for storage of ordinary hazard goods shall conform at least to Type 2.

6.2.2 The maximum compartment size of any warehouse (single or multi-storeyed) shall not exceed 2 000 m^2. Where the area exceeds 2 000 m^2, fire rated separating walls (at least 120 min fire rating) shall be constructed to provide compartmentation within the warehouse. However, for a fully sprinkler protected storage/warehouse building the maximum compartment size may be increased to 5 000 m^2.

NOTE — For storage of high hazard goods, the maximum size of compartmentation shall not exceed 750 m^2.

6.2.3 Attention shall be given to the effective protection of openings in compartment walls, including those for conveyor systems.

6.2.4 Storage/warehouse buildings shall be either detached or provided with fire separating walls when attached to other buildings as follows:

6.2.4.1 When situated detached, distance of at least 6 m shall be maintained between storage/warehouse buildings storing commodities having differential fire hazards that is, ordinary hazard and high hazard commodities. Where there is a constraint to maintain minimum distance of 6 m, the facing wall(s) and opening(s) therein shall be fire rated for at least 60 min and any door or window openings and overhanging roof eaves if any, shall also comply with various requirements specified in **6.7.1** of SP 7 (Part 4) in all respects.

6.2.4.2 When situated detached, distance of at least 15 m shall be maintained between warehouses storing commodities having differential fire hazards that is, ordinary hazard and high hazard commodities. Where there is a constraint to maintain minimum distance of 15 m (which shall in no case be less than 6 m), the facing wall(s) and opening(s) therein shall be fire rated for at least 120 min and any door or window openings and overhanging roof eaves if any, shall also comply with various requirements specified in **6.7.1** of SP 7 (Part 4) in all respects.

6.2.5 Buildings used for storage of high hazard goods should be of single storeyed structure and in no case shall exceed 2 storeys and 15 m in height.

6.2.6 Buildings used for storage of ordinary hazard goods can be permitted up to 24 m height but no floor within the building shall exceed 15 m in height.

NOTE — The local fire service authorities may consider additional height restrictions and exemptions subject to guidance available in **3.4.4** of SP 7 (Part 4).

6.2.7 The ceiling heights of individual storeys shall be held to a minimum, dictated by both the nature of commodity stored and the material handling system in use. In no case, however, this height shall exceed 15 m, subject to provision of automatic sprinkler system.

6.2.8 Each floor of storeyed storage buildings including basement floor shall also be compartmented as per provisions stated in 6.2.2 above for separating walls.

6.2.9 All staircases, lift or hoist walls shall be of the enclosed type, separated from the storage compartments by separating walls of at least 60 min and any openings therein shall be protected by fire doorsets conforming to IS 3614.

6.2.10 *Floor Drainage*

The floors shall be of watertight construction and scuppers of not less than 20 cm^2 cross-sectional area shall be provided at no more than 6 m intervals or as required to take care of maximum water discharge from hydrant/sprinkler system.

6.2.11 *External Drainage*

External drains of not less than 250 mm width and 300 mm depth shall be provided along the side of each building and so constructed that any flow of water from the building be directed to a suitable ground tank or reservoir or public drainage system in the vicinity not leading to a natural water source.

No external drainage of warehouses storing high hazard goods shall be connected to public drainage system which leads directly to a natural water source.

6.2.12 *Smoke Vents*

Roofs of single storeyed storage/warehouse building shall be fitted with automatic or manually operated smoke vents of approved type. The sizes of the vents, their distribution, etc shall be according to relevant Indian Standard(s).

NOTE — For fully sprinklered buildings smoke vents If provided, should be manually operated type only.

6.2.13 *Normal Ventilation*

In addition to requirements specified in 6.2.12 arrangements shall be provided for adequate normal ventilation of the storage/warehouse building, which would depend on the size and construction of buildings and shall be according to relevant Indian Standard(s).

6.2.14 *Means of Exit*

6.2.14.1 Every storage/warehouse building shall have a minimum of two exit doorways, and at the rate of one exit doorway per every 30 m length of the external walls of the building.

6.2.14.2 The means of exit as well as the exit ways etc, shall be as per the guidelines given in the SP 7 (Part 4) in all respects except for the maximum travel distances, which are specified as below:

Sl No.	*Type of Goods*	*For Non-Sprinklered Building*	*For Fully Sprinklered Building*
(1)	(2)	(3)	(4)
i)	Ordinary hazard goods	60 m	90 m

Table (*Concluded*)

Sl No.	*Type of Goods*	*For Non-Sprinklered Building*	*For Fully Sprinklered Building*
(1)	(2)	(3)	(4)
ii)	High hazard goods	30 m	45 m

6.2.14.3 No doors or other openings shall be allowed in the separating walls between any two storage/warehouse buildings other than those with fire door sets with appropriate fire rating (*see* IS 3614).

6.3 Cold Storage Buildings

6.3.1 The building used for storage of ordinary hazard goods should conform to Type 2 of IS 1642. If used for storage of high hazard goods, it should conform to Type 1 of IS 1642.

6.3.2 The building may be of storeyed construction provided with alternate means of escape. The height of the building shall not exceed 15 m for the single storey building. The building height shall not exceed 18 m for multi storey building and the floor-to-floor height shall not be less than 6 m.

6.3.3 The floor area of an individual compartment divided by separating walls shall not exceed 750 m^2.

6.3.4 The wall and ceiling heat insulating materials used shall be non-combustible (*see* IS 3808). Wall and/or ceiling sandwich ceiling panels that use either polyurethane or polystyrene plastics should be listed for minimal fire contribution, otherwise special protection will be needed to protect against an uncontrolled fire. Combustible materials, when used for walls or ceilings, should be protected by an approved thermal barrier. For polystyrene materials the barrier may also be either 15 mm gypsum wallboard or 20 mm fire retardant plywood supported by studs attached to the framing. The thermal barrier should extend for a height of at least 1.5 m above the level of each floor or stage. The boards if laid over floors should also be coated with minimum 15 mm thick cement plaster or covered with a wearing slab of reinforced concrete bonded with cement mortar and laid over bitumen spread evenly over insulating material.

6.3.5 Where installation of automatic sprinklers is a requirement, they should be provided below false ceilings and the voids above the false ceilings should also be similarly protected if the space exceeds 1 m in vertical height, and if less, by provision of fire

stops at a distance not exceeding 20 m. Installation shall be designed and erected as per latest version of IS 15105.

6.3.6 When the commodities stored in racks exceed the height permissible for ceiling-only sprinkler protection, supplemental in-rack sprinklers shall be installed in accordance with **12.5** of this standard and IS 15105.

6.3.7 Where automatic sprinklers are not a requirement, a well-designed automatic fire alarm system, conforming to IS 2189 shall be installed, covering the area above false ceiling as wall.

6.4 Separating Walls

6.4.1 Separating walls shall be provided between:

a) a storage warehouse and a packing warehouse;
b) a storage warehouse and a process building;
c) a storage warehouse and boiler house or where naked flames are used; and
d) an ordinary hazard storage/warehouse and a high hazard storage/warehouse.

6.4.2 Separating walls shall also be constructed to form storage compartments in accordance with 6.2.2 and 6.2.3 as applicable.

6.4.3 Separating walls shall be provided between cold storage buildings and their air-conditioning plant and other machine rooms.

6.4.4 Separating walls shall conform to various requirements specified in **6.7.1** of SP 7 (Part 4) in all respects.

7 DISTANCES

7.1 No outdoor storage shall be allowed within 15.0 m of a storage/warehouse building unless all doorways in the facing sides are protected with either fire-resistant doors or shutters or a drencher system, and all windows or other openings protected with wired glass or a drencher system.

NOTE — Necessity of adhering to these provisions may be waived by the authority in cases where the outdoor storage is of non-combustible materials.

7.2 In no case shall any outdoor storage be allowed within 6.0 m of a storage/warehouse building obstructing any access to the building.

7.3 Additional requirements related to distances between warehouses of various types shall be as per 6.2.4.

8 STORAGE ARRANGEMENTS

8.1 General

8.1.1 The combustibility of the stock and packaging, the nature of the operations, the internal layout and the method of storage have a major influence on the risks presented. All materials shall be handled and stacked with due regard to the materials characteristic.

8.1.2 Materials shall be so stacked that:

a) internal spread of fire is minimized;
b) they are easily accessible for firefighting and salvage operations; and
c) portions of the material which in case of fire may constitute an added hazard may be removed easily.

8.1.3 Neat stacking and good housekeeping shall be always maintained.

8.1.4 Materials which by reason of their bulk cannot ordinarily be placed in storage buildings, namely, coal, baled cork, timber logs, grass bamboos and raw or scrap rubber, shall be stored outside.

8.1.5 Materials which are particularly susceptible to water damage shall be stored on skids, pallets, elevated platforms, or such other devices of at least 100 mm to a maximum of 200 mm in height.

8.1.6 Racks, shelves and pallets should be of non-combustible construction.

8.1.7 Toxic materials shall be stored separately. Firefighting water from this area which cannot be led to storm water drain without treatment shall be collected separately or led to effluent treatment pond.

8.1.8 A concrete pit on ground shall be made at a finished place to collect all the waste materials like empty packing boxes, used cotton waste, etc.

8.1.9 It is necessary to obtain material safety data sheets of commodities stored from the supplier and storage practice shall be strictly as per the data sheets for the type of commodity (both external and internal storage).

8.2 Indoor Storage

8.2.1 *Aisles and Passageways*

8.2.1.1 Aisles and passageways shall be maintained at reasonable intervals to provide convenient access

to all portions of storage. The best possible access shall be provided for firefighting, both within the warehouse and externally. Access width of at least 1 m shall be provided along the walls and aisles shall be at least 2.5 m wide or *see* **9.22.8(b)** of IS 15105.

8.2.1.2 These passageways or aisles shall be so spaced that the total content of individual stacks does not exceed 700 m^3. In case of baled fibres or other combustible goods, however, aisles shall be placed at intervals not exceeding 15.0 m.

8.2.1.3 The passageways or aisles shall be of sufficient width for the removal or transfer of material and in general shall have a minimum width of 2.5 m or *see* **9.22.8(b)** of IS 15105.

8.2.1.4 As far as practicable, passageways and aisles shall be located opposite doors or window openings in the exterior walls and no goods shall be deposited within 2 m of any such opening so as not to cause difficulties in the way of effective operation of water jets from hoses connected to hydrant points or from fire engines.

8.2.1.5 Wall aisles, that is, the aisles alongside walls shall be of sufficient width to permit passage of an employee. In case of storage of baled fibre products and all other water absorbent materials in bales, the width of wall aisles shall not be less than 1.0 m (*see* **8.2.1.1**).

8.2.1.6 Free-standing block storage arrangements may restrict access for firefighting. It is therefore important, based on a risk assessment, that a limitation is placed on the maximum area of such storage and based on that, suitable storage blocks shall be created.

8.2.1.7 Where fire doors are installed for the protection of openings in compartment walls (where compartmentation is done as per **6.2.2**), a clear radius on each side of the opening shall be created in which no combustible goods are placed, to prevent the spread of fire by radiated heat. The safe distances involved will vary considerably, depending on the size and type of door or shutter. Stored goods shall not obstruct the free movement of fire doors.

8.2.1.8 Thorough study shall be done to identify the potential hazards of the various materials stored. Recommendations from the supplier's material safety datasheets shall be strictly adhered to.

8.2.1.9 Where high hazard materials are stored, such as oxidising chemicals, flammable liquids and aerosol products, special considerations apply. Manufacturers' material safety data sheets shall also be consulted, and information shall be readily available to the emergency services. Before storing such materials, it is recommended that insurers/authorities are consulted, in order that necessary risk control measures can be clearly established and implemented.

8.2.1.10 High hazard goods shall be thoroughly inspected on arrival. A safe holding area shall be available to quarantine any defective or damaged containers pending their safe disposal.

8.2.1.11 Bulk stocks of combustible packaging materials shall be kept to a minimum. Where necessary, such materials shall be contained in a separate building, or in a separate fire compartment within the main warehouse.

8.2.1.12 All loose-fill combustible packaging such as shredded paper, wood-wool and polystyrene beads, etc shall be contained in lidded steel bins.

8.2.2 *Stack Heights*

8.2.2.1 Stack shall not be piled so high as to make them unstable under fire fighting conditions and in general they shall not be more than 3 m in height where no automatic sprinklers are installed. In high-bay storehouses where the stack heights exceed 3 m, appropriate automatic sprinkler system shall be provided as per IS 15105. In any case, the maximum height of stacks shall not exceed the provisions in IS 15105. In no case, however, the clearance of the top of the highest storage level from undersides of the lowest beams, girder or other ceiling projections shall be less than 1 m. A colour band shall be painted on the walls/structural members of the storage/warehouse building indicating the maximum height to which materials are to be stacked.

8.2.2.2 Where automatic sprinkler protection is provided for the storage/warehouse building, a clearance of at least 1.0 m shall be maintained between highest storage level and the sprinkler deflector, throughout the storage/warehouse building.

8.2.2.3 Selection of the type of sprinkler protection, type of sprinkler heads and their design shall be governed by the type of commodity, layout of storage, height of roof and the height of storage and attention is drawn to guidelines in IS 15105 in this regard.

8.2.3 *Forklift Trucks*

Forklift trucks are commonly used in warehouse operations. Whether powered by battery, diesel or liquefied petroleum gas, significant fire hazards may arise. Forklift operation and maintenance shall be

strictly as per the guidelines provided by the supplier. For the charging of battery-operated forklifts following should be followed:

a) The charging area should be situated outside and provided with adequate covering for weather;

b) If the indoor charging is unavoidable, the same shall be compartmentalised with 2 h fire resistant rating and should be accessible from outside. The charging room should be positioned near the external wall of warehouse to facilitate proper ventilation; and

c) Where forced ventilation is provided, the same shall be designed for 12 ACPH.

8.3 Outdoor Storage

8.3.1 Wherever possible goods shall be stored on raised brick or concrete platforms. In case this is not possible, the storage site shall be kept free from accumulation of unnecessary combustible materials. Weeds and grass shall be kept down and regular system provided for periodic clean-up of area.

8.3.2 The storage area shall be surrounded by a fence or other suitable means to prevent access of unauthorized person. Adequate number of gates shall be provided to such barriers to permit ready access of fire apparatus.

8.3.3 Materials shall be stacked in as low and small piles as possible in respect of the particular type of materials stored.

8.3.4 The maximum height of piles shall not exceed 10.0 m.

8.3.5 The maximum quantity of material stored in a single pile will depend on the commodity stored.

8.3.6 The piles shall be separated by aisle ways, the width of which shall equal the height of the higher pile, but not less than 3.0 m.

8.4 Floor Loads

For any building, floor loads as originally designed shall not be exceeded. For water absorbent materials, normal floor loads be reduced to take this into account.

8.5 Segregation of Materials

8.5.1 High hazard and ordinary hazard materials shall be segregated from each other.

8.5.2 Materials which may be hazardous in combination shall be stored separately in segregated areas.

8.5.3 Materials which emit large amount of smoke and/or toxic gases shall be stored in separate well-ventilated storage/warehouse buildings.

8.5.4 For the storage of certain materials, for example, fats, waxes, sulphur, resins, bitumen, pitch, and rubber which are solids at ordinary temperature but melt easily under heat of fire, precautions shall be taken against propagation of fire from point to point and from floor to floor through stairs, lift wells, pipes or ducts. The same precautions shall be taken with oils and spirits and flammable liquids in general.

8.5.5 Gas cylinders, which are liable to explode when exposed to a fire, shall be stored in detached buildings segregated from all other storages by separating walls.

8.5.6 Contaminating commodities, such as poisons, dyes, tanning extract, gums, and soda ash shall not be stored along with or on floor above food stuff storage.

8.5.7 Fire hazard characteristics of stored materials (data sheets) shall be ascertained beforehand. Where complete information is lacking, the materials shall be assumed to be high hazard and segregated accordingly.

NOTE — Specific safety requirements in respect of certain high hazard commodities such as rubber, gas, cylinders, acids, chemicals, flammable liquids, rolled paper, films, etc are not dealt with here.

9 MACHINERY

9.1 Mechanical Handling Equipment

9.1.1 Mobile appliances powered by petrol or diesel or petrol/diesel engines.

9.1.1.1 The fuel tanks of such equipment should be permanently attached to the appliance and so placed or guarded as to minimize risk of mechanical injury.

9.1.1.2 Induction system of all petrol motors/engines should be provided with flame arrestors.

9.1.1.3 The exhaust system should be provided with spark arrestors and so designed and located in such a way as to prevent discharge of flame and sparks or hot gases on to combustible materials and contact of any part of the system with such materials.

9.1.1.4 Filling or emptying of fuel tanks shall not be done in any warehouse or within 6.0 m of any storage of combustible materials.

9.1.1.5 A master switch shall be fitted to disconnect the battery from the electrical system.

9.1.1.6 Every appliance shall carry an approved suitable extinguisher like dry powder or halo carbon clean agents wherever available or carbon dioxide type. These shall conform to the relevant Indian Standards.

9.1.2 *Storage Battery Driven Runabout Trucks*

Construction of electrical equipment of this type of vehicles shall comply with IS 1646.

9.2 Refrigerating Machinery

9.2.1 All the refrigeration equipment and electric wiring shall conform to the relevant Indian Standards.

9.2.2 Refrigerant used shall be of non-combustible in nature.

10 ELECTRICAL INSTALLATIONS

10.1 General

10.1.1 Time and again, electrical equipment and installation have played a significant role in fire occurrence and losses. Installation of electrical equipment shall be carried out considering both life safety and fire safety in storage premises. The installation and maintenance of electrical wiring and equipment shall comply with the provisions laid down in IS 1646 and SP 30. Additional provisions as given in this standard shall also be complied with wherever applicable. For the fire safety of cable runs *see* IS 12459.

10.1.2 A main switch with indicator lamp shall be provided near the entrance so that total power to warehouse could be cut off, during fire conditions, if required.

10.1.3 Automatic disconnection of circuits shall be ensured as stipulated in *CEA Regulations*, 2023 and SP 30, before a fault creates a fire accident. To ensure this, every building shall have a TN-S type system earthing with protective multiple earthing and protective equipotential bonding by interconnecting the exposed and extraneous conductive parts including structural steel and foundation steel.

10.1.4 Where roof top solar PV is installed, the DC wiring shall be made with double insulated wires in order to safeguard against series and parallel arching. The combiner boxes also shall fulfil the requirements of double insulation. *See* also SP 30 (Part 8).

10.1.5 Lightning protection shall be carried out as per IS/IEC 62305 (Part 1), (Part 2), (Part 3), and (Part 4) and SP 7. Radioactive air terminals shall not be allowed. Any other kind of air terminal like dissipation system/early streamer emission (ESE) air terminal/controlled streamer emission (CSE) air terminal shall not be acceptable.

10.2 Lighting Wiring

10.2.1 The following requirements shall receive attention:

a) Selection of equipment and their installation shall comply with the requirements of SP 30 and IS 1646 in all respects;

b) Electrical verification as per SP 30 shall be carried out at least once in a year by competent and well-informed personnel to determine whether the installation remains safe in all respects (considering the small or big expansions and additions made during the previous year) and corrective action shall be taken to restore safety levels;

c) Some important issues that shall be borne in mind before undertaking electrical safety audit are as follows:

   1) Appropriate fuse ratings;

   2) Leakage, insulation, and earthing provisions;

   3) Safety/protection against overloading of installation;

   4) Portable electrical equipment;

   5) Physical surroundings in which the equipment are used (for example, wet or dusty atmospheres);

   6) Protection against short circuit;

   7) Temperature rating and mechanical strength of flexible cables; and

   8) Deployment and maintenance of suitable personal protective equipment.

10.2.2 The electrical wiring other than that for portable lamps shall be in screwed steel conduits or shall be of mineral insulated copper or aluminium sheathed cable with or without PVC serving. In case of cold storages, the wiring shall be of mineral insulated copper or aluminium sheathed cables with or without PVC serving.

10.2.3 In case of warehouse storing fibrous goods, flammable liquids, nitrocellulose, fireworks or

explosives, all switches and control equipment shall be located outside the storage/warehouse building. All portable lamps used shall be of 24 V with adequate protection.

10.2.4 The electrical wiring in these cases also be installed externally as far as possible, excepting for the stretches required for connection to fittings.

10.2.5 Every lighting fitting shall be affixed to either the wall or roof at not more than 450 mm below roof of the storage/warehouse building. In case of sprinklered storage/warehouse buildings each light fitting shall be either above the level of the sprinklers heads or be not less than 300 mm below that level *see* also IS 15105.

10.2.6 All light fittings shall have a minimum clearance of 0.75 m from highest stacking level.

10.2.7 In case of warehouse storing high hazard goods, all switches and control equipment shall be located outside warehouse and shall be of flame proof construction conforming to the relevant statutory rules.

10.2.8 All fittings in such situations shall be of approved type of flame proof construction.

10.3 Mains-Operated Electrical Stackers

10.3.1 The wirings on the stackers shall be enclosed in screwed steel conduits.

10.3.2 Each wall socket shall be separately switch controlled and both switch and sockets shall be enclosed in watertight iron case or cases. The plug and socket shall be of 3-pin type, the third pin being for earthing purposes. The plug should also be of head shield type, whilst the socket should be provided with screwed brass cover and the plug with a screwed brass ring to render the apparatus watertight whether the plug is inserted or not.

10.3.3 Interlocked plugs and switches may be used, provided they comply with 10.3.2.

10.3.4 The flexible connection to the stacker shall be made with tough rubber compound sheathed trailing cable. The sheathing should have some additional mechanical protection, such as hard cord braiding. The trailing cable shall contain an earthing core to which all iron cased apparatus on the stacker and its frame shall be connected and earthed through plugs.

10.4 Overhead Electrical Travelling Cranes and Runways

10.4.1 Besides complying with IS 1646, requirements of 10.4.2 to 10.4.4 of this standard shall also be complied with.

10.4.2 All switchgears and fuses shall be completely enclosed in iron cases and an emergency switch provided to isolate the crane during inspection, cleaning, and repairs.

10.4.3 The driving motors shall be of totally enclosed type.

10.4.4 All wiring in connection with this type of equipment, other than bars, copper collectors or trolley wires shall be enclosed in screwed steel conduits.

11 ILLUMINATION

All storage/warehouses shall have an illumination of at least 50 lux.

12 FIRE FIGHTING ARRANGEMENTS

12.1 General

Storage/warehouse premises shall be provided with systems and equipment as specified in **5** and Table 7 of SP 7 (Part 4) as applicable. These include:

a) Portable extinguishers (IS 2190);
b) Internal small bore hose reels;
c) Hydrant systems with yard hydrants and wet risers (IS 3844 and IS 13039);
d) Automatic sprinkler systems (IS 15105); and
e) Fire alarm systems (IS 2189).

NOTE — Foam spray system may be provided for the flammable/chemical storage.

12.2 Hand Appliances

Portable or wheeled fire extinguishers conforming to IS 15683 and IS 16018 shall be provided and distributed in suitable locations in the vicinity of these storage/warehouse premises in accordance with the provisions contained in IS 2190. Appropriate type of extinguishers shall be provided in various areas commensurate with the type of hazard posed by the nature of stored materials.

12.3 Hose Reels

Hose reels shall be provided at all floor levels along with hydrants in wet risers. Water supply for hose reels can be tapped from the pressurized hydrant system.

12.4 Hydrant System

12.4.1 As fires in storage premises require large

quantities of water for firefighting, a well-designed hydrant system consisting of fire hydrants and static water tanks and pumping conforming to IS 13039 and Table 7 of SP 7 (Part 4) shall be provided based on the area occupied by the storage buildings.

12.4.2 Yard hydrants shall be provided along the entire contour of all the warehouse/storage buildings as well as open storage areas. Their installation, spacing, piping, etc shall be in accordance with IS 13039.

12.4.3 Risers (wet or dry) shall be provided for upper floors if provided. Number of risers depends upon the area of the floor. Their installation, piping, etc shall be in accordance with IS 13039.

12.4.4 In case of single storey buildings with one mezzanine floor used under this standard category of buildings with steel roof, then the provision of overhead fire water tank should be excluded in such case, the terrace tank water capacities to be included in ground water storage tank (along with pump requirements) conforming to Table 7 of SP 7 (Part 4).

NOTE — Source of energy for fire pumps — All main pumps may be allowed to be diesel engine prime mover, based on poor/unreliable availability of good quality electricity, maintenance capability of user, etc subject to approval of the fire authorities.

12.5 Automatic Sprinkler System

12.5.1 Sprinkler system, where required, shall be provided strictly in accordance with IS 15105. Where differences exist, provisions of this standard shall take precedence.

12.5.2 All storage/warehouse buildings, where single largest undivided floor area (un-compartmented) exceeding 2 000 m^2 in floor area shall be protected with an automatic sprinkler protection in accordance with IS 15105.

12.5.3 Automatic sprinkler system shall be installed throughout the storage building in accordance with the hazards posed and classification of the stored materials.

12.5.4 Sprinklers shall also be provided under large outdoor canopies, platforms, and docks where significant amounts of combustible materials are stored and handled.

12.5.5 Sprinklers are required for all areas either directly or indirectly in communication with the storage premises.

12.5.6 Sprinkler systems shall need to be hydraulically calculated.

12.5.7 Type of sprinkler protection vary in accordance with the storage practices like roof height, type of storage like free standing, storage racks, etc. Protection philosophy shall conform to various provisions in the IS 15105.

12.5.8 In special cases, (such as automatic storage retrieval systems, mixed use occupancies, robotics in warehousing, etc) wherein no specific design guidelines are available in IS 15105 or other relevant Indian Standards, then the user shall submit a detailed design engineered fire solution based on established international practices and then local fire services authority for approval.

12.6 Fire Alarm System

12.6.1 All storage/warehouse buildings, where single largest undivided floor area (un-compartmented) not exceeding 2 000 m^2 in floor area shall be protected with a fire alarm system as per IS 2189, backed up with manual call points.

12.6.2 All storage/warehouse buildings, where single largest undivided floor area (un-compartmented) exceeds 2 000 m^2 in floor area, shall be protected with a fire alarm system in accordance with IS 2189 and IS 15908 in all respects. Entire storage/warehouse building shall be provided with automatic detectors appropriate to the type of hazards posed. In addition, manual call points shall also be provided as per the above standards. Where differences exist, provisions of this standard shall take precedence.

12.6.3 For large open area sites, a well-designed manual fire alarm system shall also be provided as per the standard.

12.7 Besides the first-aid firefighting equipment, all fixed fire protection systems installed in the storage buildings/areas shall be subjected to periodical inspections and maintenance so as to ensure their proper functioning in case of emergency, if necessary, through a maintenance contract with any approved agency.

12.8 In large storage installations consisting of several storage/warehouse buildings especially involve costly or hazardous goods or stores of vital national interest, it may be necessary to provide a full-time fire brigade with appropriate major fire-fighting equipment with the premises.

12.9 Location of all fighting equipment like hydrant valve, landing valve, hand appliances, etc shall be indicated on the building plot plan and displayed prominently at the entrance of the storage/warehouse buildings.

13 GENERAL SAFETY PROVISIONS AND HOUSEKEEPING

13.1 Good housekeeping methods will lower the chances of a fire occurrence and as such the accumulation of combustible materials in the storage premises shall be monitored continuously.

13.2 Good housekeeping is also essential to reduce the chances of escape routes and fire doors from being blocked or obstructed.

13.3 Predictable nature of the day-to-day activities shall allow systems to be developed for dealing with waste and other combustible materials. However, such materials shall not be allowed to accumulate in the escape routes.

13.4 Waste and garbage containers shall be kept at least 6 m from the face of the storage buildings.

13.5 Following notices shall be displayed in prominent places:

a) Instruction to the staff; and

b) Prohibition of smoking except in selected buildings.

13.6 Use of naked flames, welding, cutting and spray-painting operations, shall not be allowed excepting in detached buildings specifically set apart for those purposes.

13.7 Fuel tanks for mobile material handling appliances shall not be filled anywhere excepting separate building for that purpose.

13.8 Road vehicles shall not be allowed to stand inside the storage/warehouse buildings or in the vicinity of outdoor storage sites with engines running.

13.9 All storage/warehouse buildings and compounds shall be swept clean every day and systematic removal of weeds from the compound shall be enforced.

13.10 Every storage/warehouse building shall be thoroughly inspected before it is closed. If possible, all such buildings which were opened during the day shall be reopened and re-inspected 60 min after their closure after that they shall be finally closed.

13.11 All fire check doors shall be kept shut when not needed and after the end of day's work. Vision slits may be provided (with proper security safeguards) in the external doors to enable the security staff on patrolling duty to promptly detect any outbreak of fire within the building.

13.12 Shutters of door and window openings shall be made reasonably secure against entry of unauthorized persons.

13.13 Even temporary storage of commodity in the open shall not be allowed if such storage obstructs access to storage/warehouse buildings doors, hydrant points and sprinkler valves.

13.14 In all bulk storage premises, it shall be necessary to formulate a fire emergency plan laying out in detail the method of alerting and actions to be taken by different personnel of the premises in case of a fire outbreak, and the procedure for getting outside assistance.

14 ALTERATION/CONSTRUCTION OF NEW BUILDING WITHIN THE EXISTING PREMISES

14.1 When storage/warehouse buildings are undergoing refurbishment or alteration, fire occurrence is a possibility. Hence it is necessary continuously monitor the impact of the building work on the general fire safety precautions, such as the increased risk from quantities of combustible materials and accumulated waste and maintaining adequate means of escape. The following risks shall be monitored, and contingency measures shall be in place before allowing building alterations and extensions:

a) Welding, oxy acetylene cutting, blow lamps, portable grinders, etc;

b) Combustible storage;

c) Storage of combustibles inside or inside the vicinity of escape routes thus blocking the escape routes;

d) Temporary electrical wiring;

e) Disconnection of existing fire warning systems;

f) Dismantling of fire separating walls, removal of fire doors, passive protection assemblies, etc; and

g) Presence of work personnel unfamiliar with the site conditions.

14.2 Fire safety team shall monitor the situation continuously and work permit systems shall be in place for hot work, cold work, height work, etc. Safety checklists shall be available and the same shall be followed seamlessly. Firefighting installation shall be in place for any eventuality and emergency.

15 SMOKING

Carelessly discarded cigarette butts and other smoking materials are usual causes of a major fire. Discarded cigarette butts can smoulder for several hours in storage occupancies, especially when surrounded by combustible material. Many fires are started several hours after the smoking materials have been emptied into waste bags and left for future disposal. Hence smoking shall be totally prohibited within 15 m of the buildings occupied as storage of any kind.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No./Other Standards	*Title*
IS 1446 : 2024	Dangerous goods — Classification (*third revision*)
IS 1642 : 2013	Fire safety of buildings (general): Details of construction — Code of practice (*second revision*)
IS 1646 : 2015	Fire safety of buildings (general): Electrical installations — Code of practice (*third revision*)
IS 2189 : 2008	Selection, installation and maintenance of automatic fire detection and alarm system — Code of practice (*fourth revision*)
IS 2190 : 2010	Selection, installation and maintenance of first-aid fire extinguishers — Code of practice (*fourth revision*)
IS 3614 : 2021	Fire doors and doorsets — Specification (*first revision*)
IS 3808 : 1979	Method of test for non-combustibility of building materials (*first revision*)
IS 3844 : 1989	Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises (*first revision*)
IS 8757 : 2021	Glossary of terms associated with fire safety (*second revision*)
IS 12459 : 2024	Fire safety in cable runs — Code of practice (*first revision*)
IS 13039 : 2014	External hydrant systems provision and maintenance — Code of practice (*first revision*)
IS 15105 : 2021	Design, installation and maintenance of fixed automatic sprinkler fire extinguishing systems — Code of practice (*first revision*)
IS 15683 : 2018	Portable fire extinguishers — Performance and construction — Specification (*first revision*)
IS 15908 : 2021	Selection, installation and maintenance of control and indicating equipment for fire detection and alarm system — Code of practice (*first revision*)
IS 16018 : 2012	Wheeled fire extinguishers — Performance and construction — Specification
IS 18149 : 2023	Transportation of dangerous goods — Guidelines
IS/IEC 62305-1 : 2010	Protection against lightning: Part 1 General principles
IS/IEC 62305-2 : 2010	Protection against lightning: Part 2 Risk management
IS/IEC 62305-3 : 2010	Protection against lightning: Part 3 Physical damage to structures and life hazard
IS/IEC 62305-4 : 2010	Protection against lightning: Part 4 Electrical and electronic systems within structures
SP 7 (Part 4) : 2016	National Building Code of India 2016: Part 4 Fire and life safety
SP 30 : 2023	National Electrical Code of India 2023 (*second revision*)

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Fire Safety Sectional Committee, CED 36

Organization	*Representative(s)*
In Personal Capacity (*K-33-A, Green Park, First Floor, New Delhi*)	SHRI S. K. DHERI **(*Chairperson*)**
Advance Firetec and Research Lab Private Limited, New Delhi	SHRI SUBIR K. NANDI SHRIMATI INDU SHARMA (*Alternate*)
Automotive Research Association of India, Pune	SHRI CHARUDATTA S. SHRI R. D. CHAUDHARI (*Alternate*)
Bennett Coleman and Company Limited, New Delhi	SHRI PURUSHOTAM SINGH
Centre for Fire Explosive & Environment Safety (CFEES), Delhi	SHRI PANKAJ CHAWLA
CSIR - Central Building Research Institute, Roorkee	DR SHORAB JAIN SHRI NAWAL KISHORE BANJARA (*Alternate*)
Delhi Metro Rail Corporation Limited, Delhi	SHRIMATI PAPIYA SARKAR MS RASHMI BHARDWAJ (*Alternate*)
Directorate General of Quality Assurance, New Delhi	CONTROLLER DCQA - FFE (*Alternate*)
Engineers India Limited, New Delhi	SHRI GYASUDDIN SHRI DINESH DEBBARMA (*Alternate* I) SHRI ARVIND HARISH S. (*Alternate* II)
F.M. Engineering International India Branch, Bengaluru	SHRI SRIKANTH YAJJALA SHRI ARVIND RAMACHANDRAN (*Alternate*)
Fire and Combustion Research Center, Jain University, Bengaluru	SHRI C. S. BHASKAR DIXIT
Fire and Security Association of India, Chennai	SHRI RAJNISH AGGARWAL SHRI SURESH MENON (*Alternate*)
Fire Safe India Foundation, Mumbai	SHRI M. V. DESHMUKH
Fyrprotek (Fire Engineers and Consultants), New Delhi	SHRI GULSHAN KHURANA
Goa Fire Services, Panaji	DIRECTOR
Hilti India Private Limited, New Delhi	SHRI RAGHAVENDRA KUMAR SHRI ASHISH MITTAL (*Alternate*)
Indian Association of Structural Engineers, New Delhi	SHRI MANOJ K. MITTA SHRI SITARAM AGGARWAL (*Alternate*)
Indian Institute of Technology Roorkee, Roorkee	PROF VISHAL KUMAR PROF UMESH KUMAR SHARMA (*Alternate*)
Institute of Fire Engineers India, New Delhi	SHRI U. S. CHHILLAR PRESIDENT (*Alternate*)

Organization	*Representative(s)*
Maharashtra Fire Services, Mumbai	SHRI SANTOSH S. WARICK SHRI KIRAN HATYAL (*Alternate*)
Ministry of Home Affairs, New Delhi	SHRI PRASHANT LONKAR SHRI MORESHWAR KUDKILWAR (*Alternate*)
NTPC Limited, New Delhi	SHRI SANTOSH KUMAR JHA SHRI DOONDESHWAR V. (*Alternate*)
Pacific Fire Controls, New Delhi	SHRI RAKESH KUMAR ARORA SHRI DAKSH ARORA (*Alternate*)
Reliance India Limited, Mumbai	SHRI UMESH KHANDALKAR SHRI MUKESH CHANDRA KUMAR (*Alternate*)
Siderise India Private Limited, Mumbai	SHRI NEERAJ NAYYAR SHRI DONEL DIPPI (*Alternate*)
State Disaster Response and Fire Services Department, Government of Telangana, Hyderabad	SHRI C. LAKSHMI PRASAD SHRI G. V. NARAYANA RAO (*Alternate*)
UL India Private Limited, Bengaluru	MS MONALISA DAS SHRI V. MANJUNATH
In Personal Capacity (*D-317, 2nd Floor, Nirman Vihar, New Delhi*)	SHRI R. C. SHARMA
In Personal Capacity (*27A, Tapovan Senior Citizens Foundation, Coimbatore*)	SHRI T. R. A. KRISHNAN
In Personal Capacity (*House No. 1933, Sector-4, Urban Estate, Gurugram*)	DR K. C. WADHWA
BIS Directorate General	SHRI DWAIPAYAN BHADRA, SCIENTIST 'E'/DIRECTOR AND HEAD (CIVIL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRI RAJESH CHOUDHARY
SCIENTIST 'B'/ASSISTANT DIRECTOR
(CIVIL ENGINEERING), BIS

(*Continued from second cover*)

It is important to recognize that fire risks can change with time and that the process of risk assessment needs to be an ongoing activity. This will ensure that any alterations in risk are correctly identified and that the fire safety strategy is modified as necessary.

Absolute fire safety is not attainable in practice. The objective of this standard is to specify measures, which shall reduce the damage to life and property to a minimum.

The standard covering essential requirements of fire safety of general storage, warehouse, and cold storage buildings. This standard was first published in 1967, subsequently revised in 1991 based on the experience gained. In this revision, the following significant changes have been made:

a) Title of the standard has been changed to 'Fire safety of general storage and warehousing including cold storages — Code of practice' which is in line with the National Building Code of India 2016;

b) Height of stacks within storage/warehouse buildings whether sprinkler protected or not has been revised;

c) Compartmentation size within storage/warehouse buildings whether sprinkler protected or not has been revised;

d) Travel distance for ordinary and high hazard goods has been revised;

e) Requirements of firefighting arrangements have been updated with inclusion of sprinklers for certain category of warehouses;

f) The height of the cold storage buildings has been increased for multi-storey buildings;

g) Fire safety provisions have been added for the charging of battery-operated forklifts;

h) Fire safety provisions for electrical installations has been made more elaborative; and

j) Fire safety requirements with respect to alteration/construction of new building within the existing premises have been included.

Nothing in this standard shall be construed to prohibit better type of fire protection or greater degree of rescue provision by providing better life safety measures.

Provisions of this standard are supplementary to the relevant statutory requirements as laid down in *Factories Act, the Petroleum Rules, the Gas Cylinder Rules, Central Electricity Authority* (*Measures Relating to Safety and Electric Supply*) *Regulations*, 2023, etc.

This standard contributes to the United Nations Sustainable Development Goal 9, SDG 9: 'Industry, innovation and infrastructure'. The standard addresses the requirements for fire safety of general storage, warehouse, and cold storage. Ensuring quality and sustainable infrastructure.

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

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 specified value in this standard.

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