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Indian Standard

CODE OF PRACTICE FOR FIRE SAFETY OF CHEMICAL INDUSTRIES

PART 1 RUBBER AND PLASTIC

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CODE OF PRACTICE FOR FIRE SAFETY OF CHEMICAL INDUSTRIES

PART 1 RUBBER AND PLASTIC

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CODE OF PRACTICE FOR FIRE SAFETY OF CHEMICAL INDUSTRIES

PART 1 RUBBER AND PLASTIC

0. FOREWORD

0.1 This Indian Standard (Part 1) was adopted by the Indian Standards Institution on 30 October 1985, after the draft finalized by the Fire Safety Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The hazards of fire and explosion in chemical industries can be considerably lowered by adoption of certain predetermined fire-safety measures with regard to proper planning of buildings, choice of proper materials and components, electrical equipment, good storage practice and making suitable provisions for fire detections and suppression. This standard has, therefore, been formulated to give necessary guidance in this respect to the various chemical industries. Based on the risk the various chemical industries have been grouped and sub-grouped. This standard is therefore formulated in various parts and sections so as to cover each such groups/sub-groups. This part covers group relating to rubber and plastic.

0.3 In reporting the result of measurement made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

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1. SCOPE

1.1 This standard (Part 1) covers the essential requirements for the fire safety of chemical industries covering (a) Rubber Processing Compounding and Rubber Derivalities (b) Resin Manufacturing, Condensation, Polymerisation, etc.

2. LOCATION

2.1 To minimize the possible damage from explosion or fire protection from both, to nearby property and community, the factory should have enough open space (*see* **2.3**) around.

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

2.2 The factory buildings should be at least 30 m away from a railway siding, yard or lines, preferably on the prevailing up wind side of the tracks. Distance may be reduced to 10 m if these rail tracks are serviced by diesel or electrical locomotives.

2.3 The factory buildings should be at least 30 m away from any public building, dwelling house, warehouse or other manufacturing establishments.

3. PLOT LAYOUT

3.1 A fencing or compound wall should be erected around the plot.

3.2 The plot should be of adequate size of house the manufacturing and storage and utility buildings with provision for future expansion without causing any congestion. The plot should be kept free of combustible materials, such as grass, weeds and other vegetations, scrap paper wood, sawdust, etc.

3.3 The factory should have roads not less than 6 m wide in between the blocks of buildings to allow free movement of fire engines and rescue appliances.

3.4 The main gate of the factory should be such that a clear width and head room of 4·5 m is available for city fire brigade appliances.

3.5 The minimum distance between any two buildings (from wall to wall) used for manufacturing purposes using combustible and flammable materials should preferably be 15 m and in no case less than 8 m.

3.6 Buildings separated by not less than 15 m of distance may communicate an enclosed passageway of non-combustible construction provided tha such enclosed passageways are specially designed for the release of intert nal pressures resulting from an explosion and each opening between-sections separating walls are protected by fire-check door conforming to IS : 3614 (Part 1)-1966* with not less than one hour rating.

3.7 Transformer, electric generator, or boilder, any or all of these should be at least 15 m away from the manufacturing building.

3.8 Residential and office buildings should be at least 20 m away from the nearest manfacturing building.

4. CONSTRUCTION

4.1 There should be separate buildings for raw materials, processes and for finished products. Each building should be sub-divided into smaller compartments as necessary by compartment walls. The communicating doors in walls compartment should be provided with fire-check doors [*see* IS : 3614 (Part 1)-1966*] with rating not less than two hours.

*Specification for fire check doors: Part 1 Plate, metal covered and rolling type.

4.2 The compartment walls should be of sound construction of non-combustible material and shall have the same fire resistance as walls of the main buildings.

4.3 No permanent openings should be provided in separating walls except for fire check doors.

4.4 Buildings used for manufacturing purposes should have a fire resistance equivalent to that of Type I construction, as specified in IS : 1642-1986*.

4.5 Buildings used as godowns should have a fire resistance equivalent to that of Type II construction, as specified in IS : 1642-1986*.

4.6 Utility buildings should have a fire resistance equivalent to that of Type III construction, as specified in IS : 1642-1986*.

4.7 Manufacturing and storage buildings should preferably be single storeyed. They should be as low as possible, and in any case not more than 10 m measured from the average surrounding ground level to the highest point of roof. Wooden flooring should be prohibited, except when laid on a concrete or masonry floor without any intervening space. Adequate means of escape should be provided (*see* IS : 1644-1986†).

4.8 Stairs, elevators and other means of exit should be protected by non-combustible fire resisting enclosures, raising fire resistance rating equal to that of the building. Each opening in the enclosures should be fitted with fire check doors (*see* **4.1**).

4.9 Where combustible dusts are produced in process, the building interior should preferably be smooth without beams, sill and the like to prevent accumulation of dust.

4.10 Compartments in which the operations involve handling rubber, plastic, sulphur or combustible dust should be kept separate from other sections. Such compartments should be of non-combustible fire resistive construction with adequate explosion venting system above the head level (*see* IS : 1642-1986*).

4.11 Roofs should be directly supported on walls without any intermediate columns or posts. The roof covering should be as light as possible but it should be fire resistant. Roofs of corrugated iron sheets should either be galvanized or painted with aluminium paint. Corrugated asbestos sheets should be inserted along the lower edges of roof near the walls at intervals of 6 m to facilitate entry through the roof for fire fighting purposes. If underside of the roof is to be painted, only fire-retardant

*Code of practice for fire safety of buildings (general): Details of construction (*first revision*).

†Code of practice for fire safety of buildings (general): Exit requirements and personal hazard (*first revision*).

paint should be used. Such roofs should be leak-proof and no piping and other equipment should be supported on them. Where roofs are provided with skylight, these should conform to the requirements given in IS : 1642-1986*.

4.12 Whenever roof is planned as a part of explosion venting method, this should be of fragile materials and should be so fixed that it can provide adequate venting of explosion shock waves (*see* IS : 1642-1986*).

4.13 Godowns should be of single storeyed construction.

4.14 Adequate ventilation should be provided for the processing and storage blocks with due regard to the nature of materials handled.

4.15 Doors should be of non-combustible materials and of self-closing fire-resistant type conforming to IS : 3614 (Part 1)-1966†. Doors for exit should lead to the open (*see* IS : 1644-1986‡).

4.15.1 There should be at least two doors arranged to open outward (opposite to each other) in each room or at least two widely separated alternate exit to corridors or to the outside. In process buildings a minimum of three doors should be provided. These doors should be protected against damage by lorries or blockage.

4.16 There should be no external windows or openings except the ones required for lighting and ventilation.

4.16.1 Where explosion risk is involved, windows should be fitted with plain glass. They should be hinged or pivoted so as to open outward if an explosion occurs and should be provided with devices to prevent opening otherwise (*see* IS : 1642-1986*).

4.17 The floor of manufacturing area should be waterproofed. When flammable liquids are stored or used, it should be curved and drained to a point of safe-discharge to safeguard property and to prevent against damage by over-flow of flammable liquids or by water in the event of fire.

4.17.1 Floor areas should be compartmented by fire resisting walls with self-closing double fire doors, to avoid large floor areas where combustible materials are stored or processed.

4.18 In multi-storeyed structures aisle space should be identified on the outside of the wall under the window sill by means of 25 cm diameter yellow dot to indicate location of ladder for the access of fire fighters.

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*Code of practice for fire safety of buildings (general): Details of construction (*first revision*).

†Specification for fire check doors: Part 1 Plate, metal covered and rolling type.

‡Code of practice for fire safety of building (general): Exit requirements and personal hazard (*first revision*).

4.18.1 All the aisles should be of 1·5 m width and where mechanical handling equipment is used, they should be of 2·5 m width minimum. Aisles should be kept free of storage and obstructions.

4.19 The various areas should be separated by fire walls to provide the following:

a) Raw and semi-finished material storage area,

b) Moulding, extrusion or processing area,

c) Finished material storage, and

d) Maintenance and utilities area.

4.20 In order to properly ventilate a room where manufacturing processes are carried out involving flammable vapours or combustible rubber or plastic dusts, air inlets and outlets may be provided in the compartmentation walls.

4.21 Exhaust fans should be provided to remove flammable vapours and combustible dusts from inside the buildings to outside in a manner to prevent drift back into the building through air intake equipment of the building.

5. ELECTRICAL INSTALLATIONS

5.1 All electrical installations should be in accordance with IS : 1646-1982* and there shall be separate source of supply to main and ancillary connections.

5.2 All electric motors and lighting fittings, and switches should be flame proof and dust-proof in hazardous areas as defined as per IS : 5572 (Part 1)-1978†.

5.3 Provision should be made for remote control of all electrical circuits so that the current for lighting and power in the buildings and facilities can be switched off by switches outside the building at a distance of 1·25 m from the nearest doorway. Provision may also be made for switching off the whole factory by switches located at one or more central points, such as the office or watchman's cabin.

5.4 Electrical switches should not be mounted on any machine which produces excessive vibration, while in operation.

5.5 All incoming feeders from main sub-station should be through underground cables.

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*Code of practice for fire safety of buildings (general): Electrical installations (*first revision*).

†Classification of hazardous areas (other than mines) for electrical installations: Part 1 Areas having flammable gases and vapours (*first revision*).

6. STORAGE AND HANDLING OF MATERIALS

6.1 Solid materials should be stored in outside areas provided no hazardous chemical reactions occur due to moisture or direct sun.

6.2 Bulk storage of combustible, whether raw materials or finished products should be kept separate from manufacturing areas.

6.3 Only minimum materials required for batch or shift operation should be stored in work areas.

6.4 Vessel used for storage of products having a flash point below 65°C should be vented to the outside of the building.

6.5 It should be ensured that no flammable liquids or vapours can be present in the buildings or sections used for storage of combustible materials.

6.6 Flammable liquid drum storage should be located at least 20 m from all buildings and other storage unless separated therefrom by solid masonry walls (*see* **4.4**).

6.7 Access drives and areas in the vicinity of the drum storage should be smoothly paved to prevent absorption of flammable liquids. Drums should be stacked at intervals of 5 m of separations to permit effective approach.

6.8 All combustible open storage areas should be fenced and openings should by provided for fire fighting purposes.

6.9 Outdoor storage areas should be graded to drain spills away from buildings and other exposures. Catch basins should be flame trapped to prevent flame travel or ignition in exposure areas.

6.10 Flammable liquid tanks should be surrounded by bunds of sufficient height to contain the entire contents in case of rupture. Adequate drainage facility should be provided to carry liquid to some areas where it can burn without endangering adjacent buildings or other storage.

6.11 Tanks should be substantially supported either by resting on the ground or on masonry supports. If possible, the tanks be underground full or partially. Wood or steel supports without adequate fire protection should not be permitted.

6.12 All openings to tanks except required vents should be kept securely closed. The vents open to atmosphere should be fitted with flame arresters or pressure vacuum vents. Each tank should be clearly marked regarding its capacity, flammability and nature of contents.

6.13 All tanks should be suitably earthed to dissipate static charge. The tanks should be fabricated using welded joints in preference to riveted ones.

6.14 Expanded foams stored in the curing storage pose fire hazard. Adequate aisle space preferably with sprinkler protection should be provided for each such storage.

6.15 All storage areas should be protected with sprinkler system otherwise unless, storage building should be located at least 20 m away from flammable liquid storage, combustible material in open, or any other building or highway.

6.16 Electrical fork lift trucks should be used in preference to diesel or petrol driven fork lift truck which prevent a fire hazard in areas where polystyrene foam is stored. In case the latter is used, the exhaust pipes from the trucks should be so directed that neither hot gases nor pipes are permitted to contact the foam materials or containers.

6.17 Safety containers with anti-flash device and self closing spouts (safety cans) should be used. Open containers should not be used.

6.18 Drums of solvents should not be stored in working areas.

6.19 Sources of ignition should be kept away from the operations.

6.20 Any motor for the grinder or blower should be located above the floor to prevent accumulation of grinding dust.

6.21 Exhaust fans should be provided to prevent excessive accumulation of dust (if visible in air, it is to be considered as excessive).

6.22 In manufacturing rubber and plastic goods, volatile chemicals such as carbon bio-sulphide, benzene, toluene, vinyl acetate and ethyl acetate are highly hazardous to cause fire and explosion which should be stored in closed, buildings with ventilation at floor level.

7. PROCESSING

7.1 Effective cooling arrangement should be provided for removal of heat in shredding, grinding, mastication, kneading and similar operations to prevent combustion of materials.

7.2 Provision should be made to control temperature with trip set for a predetermined temperature with alarm to shut heating, element, steam where applicable.

7.3 Provision of built in water sprayers and steam nozzles should be made to extinguish drier fires.

7.4 Rubber crumbs or fines sticking on inner sides of equipment and rubber fines accumulation should be avoided to prevent spontaneous ignition.

7.5 To reduce dust in atmosphere, a dust removal or exhaust system should be provided with hoods located at each operating point where dust is released.

7.6 All equipment such as hoppers, storage bins, collectors, conveyers, ducts, grinders and blenders should be dust tight.

7.7 All material separation chambers and dust collectors should be located outside of building.

7.8 No open flame, naked lights, smoking, electric or gas cutting and welding should be permitted within the building cotaining equipment for polymer process or in flammable tankage areas.

7.9 All hot work that is welding, cutting, grinding, etc, which can provide a source of ignition should be conducted only after observing safely controlled conditions with written approval from appropriate authority (*see* IS : 3016-1982*).

7.10 All equipments should be earthed to ensure effective dissipation of static charges.

8. FIRE FIGHTING

8.1 Fire fighting operation in plastics and rubber pose problem due to dense smoke, highly toxic fumes, explosion hazards, exothermic reactions and slippery floors. Most substances are non-water absorbent and on burning flow freely, cause slippery floors and block drains and water outlets.

8.2 Automatic fire alarm should be provided to alert all persons for necessary actions (*see* IS : 2189-1976†).

8.3 Sprinkler installation in high piled storage should be hydraulically balanced with adequate water supply together with curtain board and automatic roof venting. The sprinkler heads shall have adequate discharge for controlling fire.

8.4 Self contained breathing apparatus [*see* IS : 10245 (Part 2)-1982‡] should be kept readily available for personal safety as polymer based products on fire produce heavy smoke, carbon dioxide, carbon monoxide and other poisonous fumes, such as nitro fumes; chlorinated plastics

*Code of practice for fire precautions in welding and cutting operations (*first revision*).

†Code of practice for installation of automatic fire alarm system using heat sensitive type fire detectors (*first revision*).

‡Specification for open-circuit breathing apparatus, Part 2.

evolve highly toxic and poisonous hydrocyanic gas. The fumes given off as a result of burning of fluorocarbons polytetrafluoroethylene give traces of vapour on the depolymerization of the material into its monomer and other fluorine containing compounds which can produce polymer fume fever. The fine dust produced during disintegration may give rise to similar symptoms. Operating personnel should be trained for use of breathing apparatus.

8.5 To permit effective distribution of water from sprinklers or hose lines, the heights of stacks should not exceed 4 m. The sprinkler heads should have a clearance of at least 1 m between the tops of stacks and the underside of the lowest beam, girders or other obstruction.

8.6 First aid appliances comprising of water CO_2 (*see* IS : 940-1976*) foam (*see* IS : 933-1976†) and dry chemical powder (*see* IS : 2171-1985‡) extinguisher should be provided and maintained (*see* IS : 2190-1979§).

8.7 Personal protective equipment should be provided and maintained in good condition for all employees to protect them against inhalation or ingestion of and contact with harmful substances.

8.8 Fire fighting foam selected should be suitable for intended use, taking into consideration the characteristics of the liquid.

8.9 The fire hydrant installation should have direct connection with city/town/supply main, fitted with fire hose connections (*see* IS : 903-1984||). Provision of suitable static water tank for fire fighting should be made with static fire pump to discharge not less than 2 250 l/min at 7 kgf/cm^2 (*see* IS : 9668-1980¶).

9. SIGNS

9.1 'No smoking' sign written in large letters on a background of contrasting colours should be conspicuously displayed in the vicinity of the processing tank farm and storage area. Boards indicating stock of flammable/hazardous material should be displayed at places accessible from outside at all tanks and storages.

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*Specification for portable chemical fire extinguisher, water type (gas pressure) (*second revision*).

†Specification for portable chemical fire extinguisher, foam type (*second revision*).

‡Specification for portable fire extinguishers, dry powder type (*second revision*).

§Code of practice for selection, installation and maintenance of portable first-aid fire extinguishers (*second revision*).

||Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner (*third revision*).

¶Code of practice for provision and maintenance of water supplies for fire fighting.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 $kg.m/s^2$
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2