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Draft Indian Standard

Acetone Code of Safety
(*Second Revision*)

भारतीय मानक मसौदा

ऐसीटोन - सुरक्षा संहिता
(*दूसरा पुनरीक्षण*)

(ICS 71.080.80)

Chemical Hazards Sectional Committee, CHD 07

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FOREWORD

(Formal Clause to be added later)

Acetone is the most important member of the homologous series of aliphatic ketones and is well established in many industries, both as a solvent and as an intermediate in chemical synthesis. Because of its high flammability, a complete knowledge and understanding of the hazards involved is an essential prerequisite to any one handling acetone. The elimination of accidents is vital to public interest. Accidents produce social and economic loss, and impair individual or group productivity. Realization of this loss has led the authorities to devote a good deal of attention to safety education. Apart from general precautions, some typical precautions are required to be taken during manufacture, storage, and handling of acetone. This code describes the properties of acetone and nature of hazards associated with it. The standard also prescribes safety measures for controlling hazards and essential information on symptoms of poisoning, first-aid, medical treatment, storage, handling, labelling and employee safety. This standard is intended to guide the users in the recognition of these hazards and in establishing safe handling procedures.

The properties of acetone listed in clause 4 have been taken from literature and have been included for information only. Moreover, these properties pertain to pure acetone. BIS has published a separate standard IS 170: 2020 intended for industrial purposes.

This standard was first published in 1974. With a view to update the standard based on the experience of last five decades and on the currently available data the Committee felt a need to revise the standard. In this revision general properties, safety measures for controlling hazards, and essential information on symptoms of asphyxiation, first-aid, medical treatment, storage, handling, labelling and employee safety have been incorporated.

The various clauses of the standard have been aligned with the format being applied for all Indian Standards on Code of safety of chemicals.

In the preparation of this code of safety assistance have been derived from the following publications:

- a) Chemical safety data sheets – SD-16, Manufacturing Chemists Association 1825 Connecticut Avenue, Washington D.C. 2009;
- b) Sax's Dangerous Properties of Industrial Materials, Volume Three, Tenth Edition, Richard J. Lewis Sr., Wiley-Interscience Publication, 2000;
- c) IPCS-International Program on Chemical Safety, 2004 edition; and
- d) AERB SAFETY GUIDELINES NO. AERB/SG/IS-3.

1 SCOPE

1.1 This code describes the properties of acetone, the nature of hazards associated with it and essential information on storage, handling, packing, labelling, and disposal of waste, cleaning and repairing of containers, selection and training of personnel, personal protective equipment, and first-aid.

1.2 This code does not, however, deal with specifications for design of buildings, chemical engineering, plants, method and ingredients used in the manufacture, equipment for waste disposal and operation control.

NOTE — Attention of the users of this code is directed to the fact that the production, storage, transport, import and export of acetone in India is controlled by the Chief Controller of Explosives of the Government of India under 'The Inflammable Substances Act 1952'.

2 REFERENCES

The Indian Standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards:

<i>IS No.</i>	<i>Title</i>
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1260 (Part 1): 1973	Pictorial Marking for Handling and Labelling of Goods: Part 1 Dangerous Goods
2925: 1984	Specification for industrial safety helmets (<i>second revision</i>)
4155: 1966	Glossary of terms relating to chemical and radiation hazards and hazardous chemicals
8519: 1977	Guide for selection of industrial safety equipment for body protection
8520: 1977	Guide for selection of industrial safety equipment for eye, face and ear protection
8807: 1978	Guide for selection of industrial safety equipment for protection of arms and hands
10667: 1983	Guide for selection of industrial safety equipment for protection of foot and leg

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 4155 shall apply.

4 PROPERTIES

4.1 General Information

The most hazardous property of acetone is its extreme flammability. Acetone burns with yellow bright flames. At temperatures greater than acetone's flash point, air mixtures of acetone may explode or cause a flash fire. Vapours can flow along surfaces to distant ignition sources and flash back. Static discharge may also ignite acetone vapours, though acetone has an extremely high ignition initiation energy point and therefore accidental ignition is rare. Exposure to high vapour concentrations may cause eye, nose and throat irritation, and narcotic (anaesthetic) symptoms such as headache, drowsiness, and incoordination. Acetone liquid produces transient eye irritation

4.1.1 Chemical Name — Acetone.

4.1.2 Common Name & Synonyms – Acetone, dimethyl ketone, Dimethyl carbonyl, Propanone, 2-Propanone, β ketopropane and Pyroacetic spirit, Ketone propane.

4.1.3 Uses

Acetone is a good solvent for many plastics and some synthetic fibres. It is used for thinning polyester resin, cleaning tools used with it, and dissolving two-part epoxies and superglue before they harden. It is used as one of the volatile components of some paints and varnishes. As a heavy-duty degreaser, it is useful in the preparation of metal prior to painting or soldering, and to remove rosin flux after soldering.

4.2 Identification

4.2.1 *Formula* — C_3H_6O .

4.2.2 *CAS Number* — 67-64-1

4.2.3 *UN Number* — 1090

4.2.4 *UN Class* — 3 (flammable liquid)

4.2.5 *Hazchem Code* — 2YE

4.3 Physical Properties

4.3.1 *General*

The material is stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.

4.3.2 *Molecular Mass* — 58.08 g/mol

4.3.3 *Physical State* — Liquid.

4.3.4 *Colour* — Colourless.

4.3.5 *Odour* — Pungent, irritating, floral, cucumber like

4.3.6 *Boiling Point* — 56.05 °C at 760 mmHg.

4.3.7 *Melting Point* — (-)94.7 °C.

4.3.8 *Vapour Density* (Air = 1) — 2.0

4.3.9 *Specific Gravity* — 0.7845 g/cm³ at 25 °C

4.3.10 *Viscosity at 25°C* — 0.295 mPa.s

4.3.11 *Vapour Pressure at 25°C* — 30.6 kPa. (~229.518 mmHg)

4.3.12 *Heat of Combustion* — 853.6 kcal/lt.

4.3.13 *Refractive Index* — 1.3588.

4.3.14 *Solubility in Water* — Soluble in all proportions in water.

4.3.15 Solubility in other solvents – Miscible in benzene, diethyl ether, methanol, chloroform, ethanol.

4.3.16 Light Sensitivity – No change.

4.4 Chemical Properties

4.4.1 Reactivity

Incompatible materials— Bases, oxidizing agents, Reducing agents.

Acetone reacts violently with phosphorous oxychloride. Acetone may form explosive mixtures with chromic anhydride, chromyl chloride, hexa-chloromelamine, hydrogen peroxide, nitric acid and acetic acid, nitric acid and sulfuric acid, nitrosyl chloride, nitrosyl perchlorate, nitryl perchlorate, permonosulfuric acid, potassium tert-butoxide, thiodiglycol and hydrogen peroxide.

Acetone shall be stored in gas-tight steel receptacles conforming to Petroleum Rules and fitted with suitable filling apparatus and well-fitting airtight screw plugs or screw caps.

4.4.2 Polymerisation — Will not occur.

4.4.3 Allotrope formation — None.

4.4.4 Corrosion properties

Acetone corrodes Carbon Steel and 13Cr Steel. For Carbon steel corrosion rate is over 1.0 mm/yr (serious corrosion). For 13Cr Steel, corrosion rate is 0.1 to 1.0 mm/yr.

4.5 Fire and Explosion Hazard Properties

4.5.1 Ignition Temperature —Not available

4.5.2 Auto Ignition Temperature — 465 °C.

4.5.3 Flash Point — (-) 20°C.

4.5.4 Upper Explosive Limit – 12.8 volume percent

4.5.5 Lower Explosive Limit – 2.6 volume percent.

4.5.6 Fire Risk

Acetone is highly flammable and its vapours form explosive mixtures with air. Explosive concentration of acetone may be ignited at low energy levels of accumulated static charges.

5 HEALTH HAZARD & TOXICITY INFORMATION

5.1 General Information

5.1.1 Acetone acts primarily as a depressant of the central nervous system. Signs of toxicity following severe intoxication may include ataxia, sedation, and coma. Respiratory depression, gastrointestinal disorders (vomiting and hematemesis), hyperglycemia and ketonemia, acidosis and hepatic and renal damage may also occur. Ingestion of 10 to 20 ml (8-16 g) is generally not toxic. Consumption of 20 g/day for several days resulted in slight drowsiness.

5.1.2 The hazards of acetone include irritation to the eyes, nose, throat, and lungs if the acetone vapour comes into contact with the person. If acetone is ingested, it can cause irritation to the stomach, and consequently lead to vomiting. The vapor released during the ingestion can also cause more severe damage.

5.2 Routes of entry

5.2.1 Skin

Repeated dermal exposure to liquid acetone can cause defatting and drying of the skin, and brittle nails. Chemical burns may develop after prolonged exposure. Prolonged contact with skin may cause redness, itching, irritation and eczema/chapping, and cracking of the skin.

5.2.2 Eyes

Acetone and its vapours are mildly irritating to the eyes and mucous membranes. Corneal erosions are a rare effect after high concentration exposure. It is characterized by a burning sensation, redness, tearing, inflammation, and possible corneal injury.

5.2.3 Ingestion

In an unlikely event if acetone is ingested it could cause systemic toxicity with symptoms like headache, lethargy, slurred speech, lack of coordination. Higher amount of ingestion can be life threatening. Irritating, may cause nausea, stomach pain and vomiting.

5.2.3 Inhalation

Inhalation of vapours may cause nausea, vomiting, headache, excitement, faintness, fatigue, and bronchial irritation may result from inhalation exposure. With high concentration exposures, systemic toxicity can occur similar to that seen with ingestion. May cause irritation to the mucous membranes and upper respiratory tract. In high concentrations, vapors and aerosol mists have a narcotic effect and may cause headache, fatigue, dizziness and nausea.

5.2.4 Long term effects

Systemic toxicity most commonly occurs after ingestion or prolonged or high concentration inhalation, rarely after extensive dermal exposure. Repeated or prolonged exposure to the substance can produce target organs damage.

5.3 Toxicity information

Acetone is highly volatile. Available toxicity values areas following:

- a) Threshold Limit Value (TLV (TWA)) — 2 400 mg/m³
- b) Short Term Exposure Limit (STEL) — 1 780 mg/m³ for 8 h
- c) Immediately Dangerous to Life or Health (IDLH) — 2 500 mg/m³
- d) Lethal Dose 50 (LD₅₀) (median dose) — 5 800 mg/kg (rat, oral) 3 000 mg/kg (mouse, oral), 5 340 mg/kg (rabbit, oral)
- e) Lethal Dose low (LD_{Lo}) (lowest published) — 45 455 ppm (mouse, 1 h)
- f) Inhalation (Rat) LD₅₀ — 5 620 mg/kg

5.4 Antidote

There is no data available.

5.5 Health effects

5.5.1 Signs and Symptoms

Mild acetone poisoning symptoms are headache, slurred speech, lethargy, lack of coordination, sweet taste in mouth. Severe systems are very rare and include coma, low blood pressure, deep stupor.

5.5.2 Acute Toxicity

5.5.2.1. Systemic effect

Acetone if swallowed is harmful to the skin in your mouth and the lining of your oesophagus. Symptoms can be headache dizziness, confusion, nausea, internal injury and stomach pain or vomiting drunkenness loss of coordination difficulty breathing low blood pressure rapid heartbeat fainting.

5.5.2.2 Local effects

Contact with acetone, it has the ability to damage your skin through the depletion of moisture and oils, leaving it dry, brittle, and likely to peel. This would only be considered a minor result of exposure to acetone. Prolonged or repeated skin contact may cause drying, cracking, or irritation. High vapor concentrations may cause drowsiness and irritation of the eyes or respiratory tract.

Eye Contact — Causes moderate to severe irritation. Symptoms include sore, red eyes, and tearing. The vapour also irritates the eyes.

5.5.3 Chronic Toxicity

5.5.3.1 Systemic effects

Can cause dry, red, cracked skin (dermatitis) following skin contact. Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis. May harm the nervous system. Conclusions cannot be drawn from the limited studies available.

5.5.3.1.1 Carcinogenicity — Not available

5.5.3.1.2 Teratogenicity / Embryotoxicity — Not known to harm the unborn child.

5.5.3.1.3 Reproductive Toxicity — Not known to be a reproductive hazard.

5.5.3.1.4 Mutagenicity — Not known to be a mutagen. Humans repeatedly exposed to >750 ppm acetone (>1 782 mg/m³) in an occupational setting reported irritation of the mucous membranes including conjunctivitis, pharyngitis, inflammatory bronchitis, and gastroduodenitis.

5.5.3.2 Local effects — There are no usual chronic local effects.

6 PERSONAL PROTECTIVE EQUIPMENT

6.1 Availability and Use

6.1.1 While personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation and intelligent conduct on the part of employees working with acetone, it is in many instances the only practical means of protecting the worker, particularly in emergency situations. One should keep firmly in mind that personal protective equipment protects only the worker wearing it, and other unprotected workers in the area maybe exposed to danger.

6.1.2 Eye/Face Protection — Wear chemical safety goggles and face shield when contact is possible.

6.1.3 Skin Protection — Avoid repeated or prolonged skin contact. Wear chemical protective clothing e.g. gloves, aprons, boots.

6.1.4 The correct usage of personal protective equipment requires the education of the workers in proper employment of the equipment available to him. Under conditions which are sufficiently hazardous to require personal protective equipment, its use should be supervised and the type of protective equipment selected should be capable of control over any potential hazards.

6.2 Non-Respiratory Equipment

6.2.1 Eye and face Protection

Chemical splash protection as per IS 8520 category H-4. Use of goggles along with full face shield is recommended. Face shield should be of sufficient length to cover the neck portion.

6.2.2 Head Protection

Hard hats should be worn where there is danger of falling objects. If hard hats are not considered necessary, soft-brimmed hats or caps may be worn to give protection against liquid leaks and splashes (*see* IS 2925).

6.2.3 Foot and leg Protection

Leather safety shoes with built-in steel toe caps are recommended for workers handling drums and cans of acetone. Alternately rubber gumboots must be used while handling acetone. Leather leg guard is recommended. Shoes should be thoroughly cleaned and ventilated after contamination (*see* IS 10667).

6.2.4 Body, Skin and Hand Protection

Clothing made of impervious materials may be worn to protect the body against the splashes. Rubber gloves should be worn for hand protection. Fireproof overalls should be worn when operations involving acetone fires are encountered (*see* IS 8519 and IS 8807).

6.3 Respiratory Equipment

6.3.1 The respirator should be selected (upper limit devices) based on Assigned Protection Factor (*APF*) as specified in Table 1.

Table 1 Respirator Selection
(*Clause 6.3.1*)

Sl. No.	Assigned Protection Factor (APF)	Respirator Selection
(1)	(2)	(3)
i.	10 (Up to 2500 ppm)	Any chemical cartridge respirator with organic vapor cartridge(s), or Any supplied-air respirator.
ii.	25	Any powered, air-purifying respirator with organic vapor cartridge(s)
iii.	50	Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister; or any self-contained breathing apparatus with a full facepiece.

6.3.2 Escape

Air purifying full face-piece respirator with a high efficiency particulate filter. Appropriate escape type self-contained breathing apparatus.

7 STORAGE, HANDLING, LABELLING AND TRANSPORT

7.1 General

All personal handling acetone should use proper personal protective equipment. Appropriate fire fighting equipment should be available in the vicinity while handling acetone. Persons handling acetone should have adequate training in use of fire fighting equipment.

7.2 Storage

7.2.1 Storage of any combustible material should not be allowed in the building. Acetone storage tanks should be grounded to prevent danger by lightning.

7.2.2 Storage tanks may be constructed of stainless steel. The storage tanks should be placed in retaining basins, also to be constructed of concrete or welded steel. The basins should be adequate to retain the full contents of the tank or tanks. Water lines should be provided to allow instant flooding of basin.

7.2.3 Sealed tanks should be equipped with frangible discs or safety valves set to release at a predetermined pressure. End of pressure relief line should go out through flame arrester to a safe area. Vent line of tank should go to a cooled condenser to condense the vapours and return it back to tank. An ample safety factor should be allowed to protect the tank itself. Vent of condenser should go to safe area through flame arrestor. Firefighting facilities applicable to the type of tank protected. This can include fire loops with hydrants and monitors in the storage area, foam systems for the individual tanks, and deluge spray systems to keep the exposed surfaces of tanks cool in case of fire in an adjacent tank.

7.2.4 Storage and handling facilities shall be sited in well ventilated areas to prevent the accumulation of pockets of acetone vapour.

7.2.5 Pipelines shall be supported by steel stanchions or concrete sleepers. Wood shall not be used. Pipelines shall have adequate electrical continuity and shall be earthed.

7.3 Handling

7.3.1 General

7.3.1.1 Areas where acetone is handled shall be posted with 'NO SMOKING' and other appropriate warning signs, as required by the operations.

7.3.1.2 If leaks or spills occur, only properly trained personnel shall remain in the area. Leaking containers shall be removed to an isolated, well-ventilated area and the contents transferred to other sound containers. All spills shall be flushed away promptly with water. Excessive quantities of acetone shall not be permitted to enter drains or sewers where there is danger of vapours becoming ignited.

7.3.1.3 All empty tanks or other containers which have contained acetone, except when they are opened for the purpose of cleaning them and rendering them free of acetone vapour, shall be kept securely closed unless they have been thoroughly cleaned.

7.3.2 Tanks

7.3.2.1 Protection against electrostatic charges which can cause ignition. This may include the bonding and grounding of the tank, piping, and other ancillary equipment and the use of bottom or dip-pipe loading to minimize material splashing in the tank.

7.3.2.2 In case flexible hoses is to be used, it should be metal braided hose of appropriate pressure rating. Upbraided hose should not be used.

7.3.2.3 As Acetone is a solvent, the selection of compatible material must prevent the material itself being dissolved. Acetone is a polar solvent and must not be combined with similar materials such as PVC, natural rubber as these elastomers will inherently fail. Compatible materials include most metals, polytetrafluoroethylene (PTFE) and tetrafluoroethylene (ETFE).

7.3.2.4 Acetone is generally pumped from storage tank using suitable pumps. Acetone can be filled in small containers by gravity ensuring containers and transfer pipes are grounded to avoid fire due to static charge.

7.3.2.5 One storage tank equal in capacity to the largest tank in use should be kept free at all times to transfer acetone in case of emergency.

7.3.2.6 Empty drums/containers shall be stored where they will be safe from unauthorised interference and shall be securely closed. It shall be recognized that a container which is empty with only enough of the volatile flammable liquid remaining to wet the inside, may be more dangerous from the stand point of explosion in the container than the container when filled with liquid, owing to the larger volume of explosive mixture that it contains.

7.4 Labelling

7.4.1 Each container (including tankers) should carry an identifying label or stencil as depicted in IS 1260 (Part 1). The storage containers shall be labelled or marked to identify as follows:

- a) Contents of the container;
- b) Name and address of the manufacturer or importer of the hazardous chemical; and
- c) Physical, chemical and toxicological data as per the criteria given in the relevant schedule of the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989. While referring to the statutes, the stipulations given in the subsequent amendments of those statutes shall be taken into account. Manufacturers name with label warnings required by regulations or ordinances form part of the label or placard.

7.4.2 Each drum must be labelled as follows

"DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM ".

7.4.3 Each tanker and each railroad car carrying one or more containers of acetone must bear the "DANGEROUS" placard in addition.

7.5 Transport

Containers generally used for transport of acetone are:

- a) Tankers
- b) Metal Barrels or Drums or Containers.

7.5.1 Unloading Tankers

Unloading stations should be equipped with safety showers. The truck should be spotted accurately and levelled. Stoppers/pegs should be used to avoid movement of truck during unloading. Supplier's instructions for unloading should always be followed and all caution markings on both sides of trucks should be read and observed.

Tanker unloading should be preferably to tank at same level or at lower level. Truck should not be unloaded to a tank at higher elevation.

7.5.2 Unloading Drums

Unloading can be done by gravity/siphoning or using a pump. Ensure that all fittings are tight. Ensure piping and containers are grounded to avoid build-up of static charge.

7.5.3 Driver

Only driver trained in flammable material handling should be employed for transportation of acetone. Driver should carry TREM card when vehicle is on road.

NOTE — If transport of the hazardous chemical is involved it shall be carried out in accordance with the Central Motor Vehicles Rules, 1989. While referring to the statutes, the stipulations given in the subsequent amendments of those statutes shall be taken into account.

8. SPILLAGE, LEAKAGE AND WASTE DISPOSAL

8.1 General

All personal attending to spill/leak should use proper personal protective equipment and fire fighting equipment while handling acetone.

8.2 Spillage

8.2.1 *General Information*

Proceed with caution. Restrict access to area. Keep unprotected personnel away and upwind of spill area to avoid vapour inhalation. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities. Keep inert absorption media readily available.

8.2.2 *Land Spill (Spill on land)*

8.2.2.1 *Containment*

Acetone may be contained by building dikes, digging pit or barrier using earth, and or similar materials. Absorb bulk material with fly ash, cement powder or commercial sorbents. Remove contained product as soon as possible to prevent spread of contamination. Remove trapped material using suction hoses.

8.2.2.2 *Consequences*

Any acetone that escapes may get vapourised or get absorbed in soil or get mixed in waterways.

8.2.2.3 *Mitigation* — Area cleared of spilled acetone should be flushed with water.

8.2.3 *Water Spill (Spill in Water)* — cannot be recovered.

8.2.3.1 *Containment*

Stop use of water. Notify proper authorities to stop water intake or to monitor water for contamination. Spilled product will get dissolved in water.

8.2.3.2 *Mitigation*

Acetone is completely miscible in water. Dilution of contaminated water or holding contaminated water till acetone evaporates. In case concentration of acetone is high, contaminated water to be collected and to be sent for distillation to separate acetone.

8.3 *Leakages*

8.3.1 *General Information*

In case of any leak of acetone from a drum or tank, isolate all ignition sources from immediate area. Do not touch or walk-through spilled material. Stop leak if it can be done without any risk. Arrange to transfer the contents to another tank or drum in case leak cannot be stopped.

Leak from a pipeline or storage vessel- Acetone will form a pool of liquid on the ground. The liquid now can be restricted with earth and then absorbed using absorbents.

8.3.2 *Leak from the Tanker*

If possible, apply a sealant (suitable like M-seal) for minor leak. In case of major leaks, arrange to transfer the material in another tanker or fill in barrels/drums. Dripping leaks should be collected in smaller containers.

8.3.3 Caution

Eliminate all ignition sources (no smoking, flares, sparks or flames) from immediate area. Use PPEs while handling acetone. Remain upwind to avoid acetone inhalation. Use grounded pipes or containers to avoid static charge igniting acetone.

8.4 Waste Disposal

8.4.1 Disposal of container and material should be as hazardous waste. The disposal of waste acetone and of materials contaminated with it shall be carried out according to state and local regulations regarding health and pollution. Waste shall not be discharged to drains. Generally, this waste goes to incinerator having scrubber for scrubbing evolved gases. Waste also can be sent to 'Recyclers' who recover the acetone by distillation.

8.4.2 Water contaminated with acetone should be treated before allowing it to flow out of the plant.

8.4.3 Returnable drums should be thoroughly washed inside and outside with water, drained and cover tightly before returning. Non-returnable containers, before scrapping, should be thoroughly washed with water until all traces of acetone is removed.

9 FIRE PREVENTION AND FIRE FIGHTING

9.1 General

9.1.1 Acetone is combustible. In case of insufficient ventilation and/or in use, may form flammable/explosive vapour air mixture. Solvent vapours are heavier than air and may spread along floors. Places which are not ventilated, e.g. unventilated below ground level areas such as trenches, conduits and shafts, are particularly prone to the presence of flammable substances or mixtures. Vapours are heavier than air, spread along floors and form explosive mixtures with air. Vapours may form explosive mixtures with air.

9.1.2 The detection system shall be able to sense the presence of smoke or heat during the initial growth period of fires. Various types of detectors which operate at predetermined temperatures or which detect the smoke photo-electrically or electronically are employed to suit individual risks. Detectors are made to operate audible or visual alarms or both. They are also linked to the fire authority control room. Good as they are, automatic detection systems only detect the fire after it has started. Since fire patrols often discover conditions which might lead to a fire and correct them in time, consideration shall be given to establishing regular fire prevention patrols in addition to automatic systems.

All personal engaged in fire fighting operation must use appropriate PPEs to prevent exposure.

9.2 Prevention

9.2.1 Fires are controlled by exclusion of air, using water, sand or carbon dioxide extinguishers. High pressure water should not be used, as it would scatter the material, causing secondary fires.

9.2.2 Move container from fire area if without risk. Use water from side and from safe distance to keep fire exposed containers cool.

9.3 Fire fighting

Use water sprays, alcohol resistant foam, dry extinguishing powder, BC-powder, carbon dioxide to fight fire. Do not use water jet.

10 TRAINING

10.1 Safety in handling acetone depends upon the effectiveness of employee education, training and supervision. The education and training of employees to work safely and to use the personal protective equipment and other safeguards provided for them is a responsibility of supervisor. Employee education and training should emphasize the need of safely handling acetone according to the methods outlined in the manual, in order to avoid spilling or splashing, leaks, burns, inhalation of the vapour of burning material, or ingestion. Unauthorised and untrained employees should not be permitted in areas where acetone is being handled.

10.2 Before being placed on the job, all new employees should be instructed and trained to maintain a high degree of safety in handling procedures. Older employees should be re-instructed and trained periodically.

10.3 Each employee shall know the location, purpose and maintenance of personal protective equipment (PPEs) and be thoroughly trained when and how to use it. Each employee shall know the location of safety showers, fountains for flushing the eyes, and hose lines.

10.4 Only reliable, dependable and properly trained employees shall be given the responsibility of all operations involving storage, handling, transport and emergency management involving acetone.

10.5 Employee should be trained to report to the proper authority all suspected leaks or equipment failure.

10.6 They should be instructed to inform to supervisors any signs of illness or skin related problems.

10.7 Each employee should know what to do in emergency and the first-aid measures and should realize the necessity for the prompt application of first aid in case of contact with acetone or exposure to the vapours.

11 HEALTH MANAGEMENT, FIRST-AID AND MEDICAL TREATMENT

11.1 Health Monitoring

11.1.1 *Personal Hygiene*

11.1.1.1 Employees should bath daily after finishing work. They should report any abnormality related to any inhalation or ingestion of acetone to medical department.

11.1.1.2 Food should not be stored or eaten near the place where acetone is being handled.

11.1.2 *Physical Examination*

11.1.2.1 *Pre-placement physical examinations*

Pre-placement medical examination should be directed toward medical fitness of employees for particular occupation.

11.1.2.2 *Periodic examination*

Periodic medical examination aim to detect susceptible workers for whom corrective actions are required before they develop overt occupational diseases. Meanwhile safety and health measures at work should be reviewed for necessary remedial actions.

11.1.2.3 *Medical examination*

An annual physical examination should be conducted for each employee who is constantly exposed to acetone. He should be instructed to report any illness, or any disorder of skin that he experiences. Liver function test and complete blood count on annual basis is recommended.

11.2 First Aid

11.2.1 *General Principles*

First-aid treatment should be started at once in all cases of contact with acetone in any form otherwise further damage may result. Refer all injured persons to a physician even when the effect appears to be slight. Give the physician a detailed account of the accident.

First aider must move the affected person to safe, well ventilated area. First aider also should use PPEs.

11.2.2 *Contact with Skin*

Immediate rinse the skin with water. This may be accomplished by the copious use of running water. Take off contaminated clothing. Provide fresh air. In all cases of doubt, or when symptoms persist, seek medical help.

CAUTION — It should be remembered that small amounts of ingestion or inhalation may not show any harm in an adult person. The affected person should be kept in observation for some time to know development of any symptoms.

11.2.3 *Contact with Eyes*

If even minute quantities of acetone enter the eyes they should be thoroughly washed immediately and copiously with water for a minimum of 15 min. The eyelids should be held apart during the eye washing to ensure contact of water with entire tissue of the surface of the eyes and lids. Afterwards, send the affected person to physician or preferably an eye specialist.

11.2.4 Ingestion

If acetone is swallowed, rinse the mouth with water immediately. Induce vomiting. Immediately shift affected person for medical help. Treatment of acetone poisoning may include stomach pumping, IV fluids, blood tests and a breathing tube, depending on the severity of ingestion.

11.2.5 Inhalation

11.2.5.1 Inhalation of acetone can irritate nose and throat. At high concentration can harm the nervous system. Medical help must be provided in case headache, slurred speech or lethargy

11.2.5.2 Burning acetone in confined area may cause a depletion of the oxygen from the air to a sufficient extent to cause asphyxiation. The patient should be removed at once to fresh air and effective artificial respiration initiated immediately if breathing has ceased. A physician should be called at once.

11.2.6 First-Aid Kit

No additional requirement in first aid kit. Flushing of skin or rinsing of mouth is only first aid in case of acetone poisoning.

11.3 Medical treatment

Washing of skin or eyes using large amount of water. Stomach wash by medical professionals.

12 ADDITIONAL INFORMATION

Additional information essential for particular equipment used for handling of acetone, Security measures to be taken while handling of acetone etc as essential for controlling hazards may be collected and applied.