भारतीय मानक

Indian Standard

IS 14518 : 2023

एसीटैल्डिहाइड — सुरक्षा संहिता

(पहला पुनरीक्षण)

Acetaldehyde — Code of Safety

(First Revision)

ICS 71.080.80; 13.300

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Chemical Hazards Sectional Committee, CHD 07

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after by the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council.

Acetaldehyde is an important intermediate in the production of acetic acid, acetic anhydride, ethyl acetate, peracetic acid, chloral, alkylamines, pyridines. Because of its high flammability, a complete knowledge and understanding of the hazards involved is an essential prerequisite to any one handling acetaldehyde. 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 acetaldehyde. This code describes the properties of acetaldehyde 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 acetaldehyde listed in **4** have been taken from literature and have been included for information only. Moreover, these properties pertain to pure acetaldehyde. BIS has published a separate standard IS 15356 : 2003 on the requirements, methods of sampling, and test for acetaldehyde intended for industrial purposes.

This standard was first published in 1998. With a view to update the standard based on the experience of last two 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 sheet SD-43, Acetaldehyde - Manufacturing Chemists Association, Washington;

b) Dangerous Properties of Industrial Materials by Irving Sax VIIIth Edition; and

c) Encyclopaedia of Occupational Health and Safety, ILO, Geneva.

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

In reporting the result of a test or analysis made in accordance with this standard, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Indian Standard

ACETALDEHYDE — CODE OF SAFETY

(First Revision)

1 SCOPE

1.1 This standard covers properties of acetaldehyde, the nature of hazards associated with it and essential information of personal protective equipment, storage, handling, labelling, transport, spillage/leakage and waste disposal, fire prevention and firefighting, training, and health monitoring 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.

2 REFERENCES

The standards given 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 these standards:

IS No.	*Title*
IS 1260 (Part 1) : 1973	Pictorial marking for handling and labelling of goods: Part 1 Dangerous goods
IS 2925 : 1984	Specification for industrial safety helmets (*second revision*)
IS 4155 : 2023	Glossary of terms relating to chemical and radiation hazards and hazardous chemicals (*first revision*)
IS 4167 : 2020	Glossary of items relating to air pollution (*second revision*).
IS 5572 : 2009	Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installation (*third revision*)
IS 8519 : 1977	Guide for selection of industrial safety equipment for body protection
IS 8520 : 1977	Guide for selection of industrial safety equipment for eye, face and ear protection
IS 8807 : 1978	Guide for selection of industrial safety equipment for protection of arms and hands
IS 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 and IS 4167 shall apply.

4 PROPERTIES

4.1 General Information

Colourless liquid with irritant and pungent fruity odour. Its vapours are irritating to the mucous membranes and can be especially dangerous to the eyes. It is a highly flammable chemical. Since it oxidises, reduces, and polymerizes readily, it forms a variety of compounds. Some of these are dangerous.

4.1.1 *Chemical Name* — Acetaldehyde

4.1.2 *Common Name and Synonyms* — Ethanal, Acetaldehyde, Ethyl Aldehyde

4.1.3 *Uses*

Traditionally, acetaldehyde was mainly used as a precursor to acetic acid. This application has declined because acetic acid is produced more efficiently from methanol by the Monsanto and Cativa processes. Acetaldehyde is an important precursor to pyridine derivatives, pentaerythritol, and crotonaldehyde. Urea and acetaldehyde combine to give a useful resin. Acetic anhydride reacts with acetaldehyde to give ethylidene diacetate, a precursor to vinyl acetate, which is used to produce polyvinyl acetate.

4.2 Identification

4.2.1 *Formula* — C_2H_4O

4.2.2 *CAS Number* — 75-07-0

4.2.3 *UN Number* — 1089

4.2.4 *UN Class* — UN Hazard class 3

4.2.5 *Hazchem Code* — 2YE

4.3 Physical Properties

4.3.1 *General*

Colourless liquid with irritant and pungent fruity odour. Its vapours are irritating to the mucous membranes and can be especially dangerous to the eyes.

4.3.2 *Molecular Mass* — 44.053 g/mol

4.3.3 *Physical State* — liquid

4.3.4 *Colour* — colourless

4.3.5 *Odour* — pungent, fruity odour

4.3.6 *Boiling Point* — 20.8 °C

4.3.7 *Melting Point* — (-)123.37 °C

4.3.8 *Vapour Density* (*Air = 1*) — 1.52

4.3.9 *Specific Gravity*

a) Liquid (water = 1) — 0.784 g/cm^3

4.3.10 *Viscosity at 20 °C* — 0.21 mPa.s

4.3.11 *Vapour Pressure at 20 °C* — 740 mmHg

4.3.12 *Heat of Combustion* — (-) 1168.79 kJ/mol

4.3.13 *Refractive Index at 20 °C* — 1.3116

4.3.14 *Solubility in Water* — freely soluble in water

4.3.15 *Solubility in Other Solvents* — Miscible with ethanol, ether, benzene, toluene, xylene, turpentine, acetone, slightly soluble in chloroform.

4.3.16 *Light Sensitivity* — No change

4.4 Chemical Properties

4.4.1 *Reactivity*

Acetaldehyde is extremely reactive. Easily oxidised and reduced. Violent condensation with acetic acid, acid hydrides alcohols, anhydrous ammonia, phenol and sodium hydroxide. Violent reaction with halogens, hydrogen sulphide, ketones. Violent exothermic reaction with oxygen. Can be easily polymerized to form paraldehyde and metaldehyde. Can be regenerated from paraldehyde by mild heating in the presence of mineral acids. These reactions can be violent even in presence of traces of sulphuric acid. Acetaldehyde decomposes rubber on extended contact.

Risk of ignition. Vapours can form explosive mixtures with air. May form explosive peroxides. The material is stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.

Violent reaction with alkali hydroxide (caustic alkali), alcohols, amines, ammonia (NH_3), acetic anhydride, iron, iodine, ketone, phenol, phosphorus, acids, chlorates, nitrate, oxidisers, perchlorates, oxygen.

In liquid state acetaldehyde is non-corrosive to most metals. It oxidises readily, however, particularly in vapour state, to acetic acid.

4.4.2 *Polymerisation*

Polymerization may occur. Avoid heat, dust, strong oxidising or reducing substances, strong acids and alkalis.

4.4.3 *Allotrope Formation* — Not available

4.4.4 *Corrosion Properties* — In liquid state acetaldehyde is non-corrosive to most metals. It oxidises readily, however particularly in vapour state, to acetic acid.

4.5 Fire and Explosion Hazard Properties

4.5.1 *Auto Ignition Temperature* — 175 °C

4.5.2 *Flash Point* — (-) 40 °C (open cup), (-) 37.77 °C (closed cup)

4.5.3 *Upper Explosive Limit* — 57 percent volume

4.5.4 *Lower Explosive Limit* — 4 percent volume

4.5.5 *Fire Risk*

Extremely flammable. Extremely volatile, vapour is heavier than air and may travel a considerable distance to a source of ignition and

flash back. Vapour/air mixtures are explosive, explosion-proof electrical equipment and lighting required. Do not use compressed air for filling, discharging, or handling. Use non-sparking hand tools. Contact with air generates explosive peroxides. The substance may polymerize under the influence of acids and alkaline hydroxides in the presence of trace metals (iron). This generates fire and explosion hazard. The substance is a strong reducing agent. It reacts violently with oxidants, strong acids, halogens and amines. This generates fire or explosion hazard.

4.6 Electrical Hazard

Zone 1, Class A (*see* IS 5572).

5 HEALTH HAZARD AND TOXICITY INFORMATION

5.1 General Information

Pure acetaldehyde, particularly in its vapour phase, is a local irritant in its action upon body tissues. The vapour is irritating to the eyes, nose, throat and respiratory tract. Acetaldehyde can spontaneously decompose or polymerise to form explosive peroxide when heated distilled, evaporated and contaminated. Acetaldehyde contaminated with other aldehydes such as, crotonaldehyde is more irritating than acetaldehyde alone. It leaves serious inflammation in the eyes, which may be followed by blurring of vision. Skin contacts to be removed promptly. If not, the skin may become reddened and later become white and wrinkled followed by peeling of skin. Shows chronic intoxication similar to that of chronic alcoholism. However, there is no storage in the body since it is rapidly oxidised, metabolised and eliminated.

5.2 Routes of Entry

5.2.1 *Skin* — Acetaldehyde is slightly irritant, risk of absorption via the skin. Long term use can cause erythema and burns.

5.2.2 *Eyes* — Causes serious eye irritation and prolonged contact may cause conjunctivitis. May cause transient corneal injury.

5.2.3 *Ingestion* — Gastrointestinal complaints, vomiting, nausea.

5.2.4 *Inhalation* — Irritant effects, cough, dyspnoea, pulmonary oedema. Can irritate the lungs, higher exposure may cause a build up a fluid in the lungs.

5.2.5 *Long Term Effects* — Acetaldehyde exposure via ingestion and metabolism of alcohol has been reported to cause bronchoconstriction.

5.3 Toxicity Information

Acetaldehyde being highly volatile, emits toxic vapours. Available toxicity values areas are as following:

5.3.1 *Threshold Limit Value* (*TLV*) — 25 ppm (45 mg/m^3)

5.3.2 *Time Weighted Average* (*TWA*) — 20 ppm (36 mg/m^3)

5.3.3 *Short Term Exposure Limit* (*STEL*) — 150 ppm (270 mg/m^3)

5.3.4 *Immediately Dangerous to Life or Health* (*IDLH*) — 2 000 ppm

5.3.5 *Lethal Dose 50* (*LD50*) (*median dose*) — 1 930 mg/kg (rat, oral)

5.3.6 *Lethal Concentration 50 LC50* (*median concentration*) — 13 000 ppm (rat), 17 000 ppm (hamster)

5.3.7 *Inhalation* (*Acute toxicity*) — LC50 (rat) 13 300 ppm/4 h

5.4 Antidote

5.4.1 A disulfiram-like drug, the prototypical drug of this group is disulfiram, which acts as an acetaldehyde dehydrogenase inhibitor, preventing the metabolism of acetaldehyde into acetic acid.

5.4.2 The drug disulfiram inhibits acetaldehyde dehydrogenase, an enzyme that oxidizes the compound into acetic acid. Metabolism of ethanol forms acetaldehyde before acetaldehyde dehydrogenase forms acetic acid, but with the enzyme inhibited, acetaldehyde accumulates. If one consumes ethanol while taking disulfiram, the hangover effect of ethanol is felt more rapidly and intensely. As such disulfiram is sometimes used as a deterrent for alcoholics wishing to stay sober.

5.5 Health Effects

5.5.1 *Signs and Symptoms*

Acetaldehyde is used in the manufacture of acetic acid, perfumes, and flavours. It is also an

intermediate in the metabolism of alcohol. It has a general narcotic action and also causes irritation of mucous membranes. Large doses may cause death from respiratory paralysis.

5.5.2 *Acute Toxicity*

5.5.2.1 *Systemic effects*

Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the respiratory tract. This may result in tissue lesions. This substance is possibly carcinogenic to humans.

5.5.2.2 *Local effects*

5.5.2.2.1 *Skin*

Acetaldehyde causes mild skin irritation. It can be absorbed through intact skin.

5.5.2.2.2 *Eyes*

It causes severe eye irritation. Eye splashes produce painful but superficial corneal injuries which heal rapidly.

5.5.2.2.3 *Inhalation*

It causes upper respiratory tract and mucous membrane irritation. It decreases the amount of pulmonary macrophages. It may cause bronchitis.

5.5.2.2.4 It may cause pulmonary oedema, often the cause of delayed death. It may affect respiration (dyspnoea) and respiratory arrest and death may occur. It may affect behaviour/central nervous and cause central nervous system depression. Irritation usually prevents voluntary exposure to airborne concentrations high enough to cause CNS depression, although this effect has occurred in experimental animals. It may also affect the peripheral nervous system and cardiovascular system (hypotension or hypertension, tachycardia, bradycardia), kidneys (albuminuria).

5.5.3 *Chronic Toxicity*

5.5.3.1 *Systemic effects*

Acetaldehyde may cause adverse reproductive effects and birth defects (teratogenic) based on animal test data. Animal studies indicate an increased incidence of laryngeal cancer in hamsters and nasal cancer in rats following exposure to acetaldehyde. Acetaldehyde is considered to be potential occupational carcinogens. Symptoms of chronic acetaldehyde exposure may resemble those of chronic alcoholism. Acetaldehyde is a metabolite of ethanol in humans and has been implicated as the active agent damaging the liver in ethanol-induced liver disease.

5.5.3.2 *Local effects*

Exposures to concentrations of acetaldehyde greater than 1 percent in solution were found likely to be irritating to the skin. There is no clear evidence that acetaldehyde sensitizes skin in humans, although animal studies have demonstrated such a response. Prolonged direct skin contact causes erythema and burns. Repeated exposure may cause dermatitis secondary to primary irritation or sensitization.

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 acetaldehyde. 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 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.

6.1.3 Wear clothing to prevent repeated or prolonged skin contact.

6.1.4 Wear goggles to prevent any possibility of eye contact.

6.1.5 Employees should wash promptly when skin becomes wet.

6.1.6 Remove clothing immediately that becomes wet to avoid flammability hazard.

6.1.7 Respiratory protection is essential to prevent inhalation of gas.

6.1.8 Suits made of rubber, neoprene plastic to be used for complete body protection.

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 acetaldehyde. Alternately rubber gumboots must be used while handling acetaldehyde. Leather leg guard is recommended. Shoes should be thoroughly cleaned and ventilated after contamination (*see* IS 10667).

6.2.4 *Body, Skin, Eye 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

Respirator selection should be as follows (at any detectable concentration) based on Assigned Protection Factor (APF):

a) (APF = 10 000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive pressure mode;

b) (APF = 10 000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained positive pressure breathing apparatus; and

c) Escape – (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin style, front or back mounted organic vapour canister.

Any appropriate escape-type, self-contained breathing apparatus.

7 STORAGE, HANDLING, LABELLING AND TRANSPORT

7.1 General

All personnel handling acetaldehyde should use proper personal protective equipment. Appropriate firefighting equipment should be available in the vicinity while handling acetaldehyde. Persons handling acetaldehyde shall have adequate training in use of firefighting equipment.

7.2 Storage

7.2.1 Stainless steel storage tanks are recommended, preferably equipped with cooling coils through which refrigerated brine may be circulated. The storage temperature should be maintained below 20 °C. Large storage vessels should be fitted with temperature gauges and automatic water sprayers.

7.2.2 If stored without refrigeration, a pressure tank is required. The pressure to be maintained by a blanket of nitrogen**.**

7.2.3 Acetaldehyde, particularly under pressure, should be kept away from contact with air to prevent the formation of highly explosive peroxides.

7.2.4 There is also a greater tendency to polymerize under pressure.

7.2.5 Avoid use of copper or copper alloys in tanks, lines, or fittings. There is a possibility of formation of explosive copper compounds.

7.2.6 Do not use ordinary level indicators unless of parallel plate type affording protection.

7.2.7 Storage tanks should be provided with a minimum of 15 m free zone around.

7.2.8 Storage tanks and connecting lines are to be effectively grounded to guard against static charge build-up. If tank trucks are to be unloaded to drums, these also shall be grounded.

7.2.9 Defective electrical fittings should be attended to in the acetaldehyde handling area.

7.2.10 When filling a tank, a dip tube extended to the bottom of the tank which is being filled will minimize splashing and static charge build-up.

7.3 Handling

7.3.1 The low boiling point of the liquid makes it difficult to handle without considerable vapour losses. To minimize this, a closed system should be used.

7.3.2 Do not apply air pressure to transfer acetaldehyde.

7.3.3 Provision for emergency venting should be made. Vent should be connected to a scrubber of a flare system.

7.3.4 Avoid use of copper or copper alloys in pipelines or fittings. There is a possibility of formation of explosive copper compounds.

7.3.5 Wear chemical goggles, respiratory protective devices such as, canister type masks, airline mask, depending on the situation. Use of barrier cream on hands and exposed parts of the body is recommended.

7.3.6 Due to polymerization choking of equipment's, lines, relief devices etc, is possible. These are to be inspected and cleaned regularly.

7.3.7 Acetaldehyde drums should be opened only after thorough cooling below 20 °C.

7.3.8 Adequate ventilation shall be provided in the acetaldehyde handling area to keep concentration well below 100 ppm. Water showers and eye wash fountain systems shall also be provided in this area.

7.3.9 Material Safety Data Sheet (MSDS) should be available at the sites handling acetaldehyde.

7.3.10 In acetaldehyde handling plants, jumpers should be used on the flanged lines for electrical continuity. Insulation should be used in vessels and pipelines to keep acetaldehyde cool. Special seals should be provided in the centrifugal pump.

7.4 Labelling

7.4.1 Each container (including tankers) should carry an identifying label or stencil 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 "FLAMMABLE LIQUID".

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

7.5 Transport

7.5.1 Containers generally used for transport of acetaldehyde are as following:

7.5.1.1 *Tankers* — which are pressure vessel and insulated.

7.5.1.2 *Metal barrels or drums*

7.5.1.3 Acetaldehyde is highly flammable, and its UN Number is 1089, UN hazard class 3 and EAR (Haz- chem Code - 2YE).

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.

7.5.2 *Unloading Tankers*

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

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

7.5.3 *Unloading Drums*

Acetaldehyde drums should be opened only after thorough cooling below 20 °C. Ground and bond containers when transferring material.

7.5.4 *Driver*

Only driver trained in acetaldehyde handling should be employed for transportation of acetaldehyde.

Driver should carry TREM card when vehicle is on road.

8 SPILLAGE, LEAKAGE AND WASTE DISPOSAL

8.1 General

All personal attending to spill/leak should use proper personal protective equipment and firefighting equipment while handling acetaldehyde leak or spillage.

8.2 Spillage

8.2.1 *Genera/Information*

8.2.1.1 Always proceed with caution. Acetaldehyde vapours are irritating to the mucous membranes and can be especially dangerous to the eyes. It is a highly flammable chemical. Since it oxidises, reduces, and polymerizes readily, it forms a variety of compounds. Some of these are dangerous.

8.2.1.2 Restrict access to area. Keep unprotected personnel away and upwind of spill area. Avoid contact with spilled product. Protect sewers and waterways from contaminated runoff. Notify proper authorities. Plan response such that all physical contact and inhalation of acetaldehyde avoided.

8.2.2 *Land Spill* (*Spill on Land*)

8.2.2.1 *Containment*

Stop leak if you can do it without risk. Contact your local fire department. Eliminate all sources of ignition and static, restrict access to area until completion of clean-up procedure. Wear adequate protective equipment, use self-contained breathing apparatus in confined poorly-ventilated areas. Large quantities should be absorbed on to sand, vermiculite or an equivalent absorbent material and removed to a safe area for disposal. Flush the contaminated area with plenty of water. Incineration is the recommended method of disposal.

8.2.2.2 *Consequence*

Acetaldehyde vapours are heavier than air and may spread along the floors. Development of hazardous combustion gases or vapours possible forms explosive mixtures with air at ambient temperature.

8.2.2.3 *Mitigation*

8.2.2.3.1 The following steps should be taken:

a) Remove all ignition sources;

b) Ventilate area to disperse gas;

c) If in gaseous form, stop flow of gas; and

d) If in liquid form, for small quantities absorb on paper towels/rags.

8.2.2.3.2 Evaporate in safe place (fume hood). Allow sufficient time for vapours to completely clear hood ductwork, then burn the waste in a location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber. Acetaldehyde should not be allowed to enter a confined space such as a sewer, because of possibility of an explosion.

8.2.3 *Water Spill* (*Spill in Water*)

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 dissolve in water. Contaminated water can be filled in tanker or other containers for recovery of acetaldehyde.

8.2.3.2 *Mitigation*

Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (possibility of hazardous reaction with metals/chemicals). Take up carefully with liquid-absorbent material. Dispose of properly. Clean up affected area.

8.3 Leakages

8.3.1 *General Information*

Do not breathe vapour/spray. Avoid contact with skin and eyes. Provide adequate ventilation. Avoid or remove ignition source.

8.3.2 *Leak from the Tanker/Drum*

Attempt should be made to plug/isolate the leak using all prescribed personal protective equipment's, without taking any risk. The area should be cordoned. The area around the incident should be vacated to avoid exposure to other personnel. If possible, transfer the tanker contents to another empty, clean tank.

8.3.3 *Caution*

Acetaldehyde is highly flammable and highly volatile. Protect from ignition sources such as open fire, static discharge, defective electric wiring or equipment. Flooding with water will dilute the acetaldehyde to the point where it will not support combustion.

8.4 Waste Disposal

8.4.1 Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in ignition as this material is highly flammable. Licensed professional waste disposal service should dispose off this waste. Large quantity can be given to 'recycler' for recovery of acetaldehyde.

8.4.2 Water in contact with acetaldehyde should be chemically treated before allowing it to flow out of the plant.

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

9 FIRE PREVENTION AND FIRE FIGHTING

9.1 General

Acetaldehyde may explode when heated. Empty containers retain product residue, liquid and vapour. Closed containers may rupture and explode during runaway polymerization. Accumulation of vapour increase risk of explosion. Vapours accumulate in low areas. Thermal decomposition can lead to release of irritating gases and vapours. Vapours may travel to a source of ignition and flash back. Sensitive to static discharge.

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

9.2 Prevention

9.2.1 Remove heat, sparks, and all sources of ignition. Use explosion-proof equipment. Test for peroxide formation before distillation or evaporation. Test for peroxide formation or discard after 1 yr.

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. Ensure adequate ventilation.

9.3 Fire Fighting

Use water, dry chemical, chemical foam, carbon dioxide or alcohol resistant foam. For large fires water may be in-effective.

10 TRAINING

10.1 Safety in handling acetaldehyde 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 supervision. Employee education and training should emphasize the need of handling acetaldehyde 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 acetaldehyde is being handled.

10.2 Before being placed on the job, all new employees should be instructed thoroughly in the proper handling of acetaldehyde. Older employees should be re-instructed periodically.

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

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

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 do and don'ts in emergency and the first-aid measures and should realize the necessity for the prompt application of first-aid in case of contact with acetaldehyde or exposure to its 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 abnormal condition of the mouth or skin to medical department.

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

11.1.2 *Physical Examination*

11.1.2.1 *Pre-placement physical examinations*

Pre-placement medical examination by medical professional is directed towards determining if the person is fit enough to do that particular job. The medical professional may consider physical or mental abilities, sensory acuity, level of skill, functional limitations.

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11.1.2.2 *Periodic examination*

The extent of medical or dental control depends upon the amount of exposure to acetaldehyde. When there is a prolonged exposure to open acetaldehyde, the following procedures are recommended.

11.1.2.3 *Medical examination*

An annual physical examination should be conducted for each employee who is constantly exposed to acetaldehyde. He should be instructed to report any illness, or any disorder of skin that he experiences.

11.2 First Aid

11.2.1 *General Principles*

First-aid treatment should be started at once in all cases of contact with acetaldehyde. Refer all injured persons to a physician even when the injury appears to be slight. Give the physician a detailed account of the accident.

First aider is also at risk of exposure to acetaldehyde and should wear proper PPEs.

11.2.2 *Contact with Skin*

If acetaldehyde gets on the skin, flush the contaminated skin with water.

If it soaks through the clothing, immediately remove the clothing and flush the skin with water.

11.2.3 *Contact with Eyes*

If acetaldehyde gets into the eyes immediately wash the eyes with large quantity of water for at least 15 min, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be used when working with this chemical.

11.2.4 *Ingestion*

If acetaldehyde has been swallowed and the person is conscious, immediately give large quantity of water to drink. After the water has been swallowed, make the person to vomit by having him touch the back of his throat with his finger. Do not give anything by mouth to an unconscious person nor induce to vomiting. Get medical attention immediately.

11.2.5 *Inhalation*

11.2.5.1 Move the exposed person to fresh air immediately and administer oxygen if available.

11.2.5.2 If breathing has stopped, give artificial respiration.

11.2.5.3 Keep the affected person warm and at rest.

11.2.5.4 Get medical attention as soon as possible.

1l.2.6 *First-Aid Kit*

No additional medicine to be kept in first aid kit for acetaldehyde.

11.3 Medical Treatment

No information available.

12 ADDITIONAL INFORMATION

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

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Chemical Hazards Sectional Committee, CHD 07

Organization	*Representative(s)*
In Personal Capacity (*1204, Bhumika Residency Sector 20 Block no. 21 Roadpali Klambolinode, Navi Mumbai - 410218*)	SHRI K. S. RAMPRASAD **(*Chairperson*)**
Alkali Manufacturers Association of India, Mumbai	SHRI K. SRINIVASAN SHRI H. S. DAS (*Alternate*)
Bhabha Atomic Research Centre, Mumbai	MS GARIMA SINGH SHRI NISHITH GOSH (*Alternate*)
Central Food Technological Research Institute, Mysore	DR DANDAMUDI USHARANI DR PRASANNA VASU (*Alternate*)
Central Leather Research Institute, Chennai	DR M. SURIYANARAYANAN
Centre for Fire, Explosives and Environmental Science, Government of India, Min of Defence, New Delhi	SHRI S. P. DOBHAL DR AARTI BHATT (*Alternate*)
Crop Care Federation of India, New Delhi	SHRI P. N. KARLEKAR DR J. C. MAJUMDAR (*Alternate*)
Defence Research and Establishment, (DRDO), Gwalior	DR PRABHAT GARG DR VIRENDRA VIKRAM SINGH (*Alternate*)
Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Government of India, New Delhi	DR VISHAL CHOUDHARY
Department of Space (ISRO), Bengaluru	SHRI MURALEEKRISHNAN R. MS LAKSHMI V. W. (*Alternate*)
Directorate General Factory Advice Service and Labour Institutes, Mumbai	SHRI H. M. BHANDARI SHRI P. G. SATPUTE (*Alternate*)
Gas Industries Association, Mumbai	SHRI SUNIL KHER SHRI ANOOP TANDON (*Alternate*)
Hindustan Unilever Limited, Mumbai	SHRI SANJAY HARLAKA SHRI RAKESH WADALKAR (*Alternate*)
Indian Chemical Council, Mumbai	DR C. NANDI DR RAKESH KUMAR (*Alternate*)
Indian Institute of Chemical Technology, Hyderabad	DR BANKUPALLI SATYAVATHI DR SRIPADI PRABHAKARC (*Alternate*)
Indian Institute of Petroleum, Dehradun	DR NEERAJ ATRAY DR PANKAJ KUMAR KANUJIA (*Alternate*)

Organization	*Representative(s)*
Indian Institute of Technology, Mumbai	PROF SANDIP ROY
Indian Institute of Technology, Chennai	DR SACHIN GUNTE
Indian Institute of Toxicology Research, Lucknow	DR D. K. PATEL DR SHEELENDRA PRATAP SINGH (*Alternate*)
Indira Gandhi Centre for Atomic Research, Kalpakkam	DR K. K. SATPATHY
Institute of Chemical Technology, Mumbai	DR G. D. YADAV DR B. M. BHANAGE (*Alternate*)
Ministry of Environment and Forest, New Delhi	SHRI VED PRAKASH MISHRA DR DINESH RUNIWAL (*Alternate*)
National Chemical Laboratory, Pune	DR VIJAY V. BOKADE DR M. MUTHUKRISHNAN (*Alternate*)
National Institute of Occupational Health, Ahmedabad	DR B. RAVICHANDRAN
National Institute of Technology, Thrichi	PROF S. P. SIVAPIRAKASAM DR SREEJITH MOHAN (*Alternate*)
National Safety Council, Navi Mumbai	SHRI A. Y. SUNDKAR SHRI K. D. PATIL (*Alternate*)
Oil Industry Safety Directorate (Min of Pet and Natural Gas), Delhi	SHRI DEVENDAR M. MAHAJAN
Pesticides Manufacturer and Formulators Association of India, Mumbai	DR ARCHANA KUMARI DR SANDIP SINGH (*Alternate*)
Petroleum and Explosives Safety Organisation, Nagpur	SHRI M. K. JHALA DR YOGESH KHARE (*Alternate*)
Safety Appliances Manufacturers Association, Mumbai	SHRI MOHAMMAD SHRI DEVANG MEHTA (*Alternate*)
Shriram Institute for Industrial Research, Delhi	DR JAGDISH KUMAR DR DEEP SHANKAR CHATTERJEE (*Alternate*)
Tata Chemicals Ltd, Mithapur, Distt, Jamnagar	SHRI SNEHASHISH A. CHAKRABORTY SHRI D. K. THAKUR (*Alternate*)
In Personal Capacity (*I-4/2/6, Parijat C.H.S., Spaghetti, Sector-15, Kharghar, Navi Mumbai - 410210*)	SHRI S. SOUNDARARAJAN
BIS Directorate General	SHRI AJAY K. LAL, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (CHEMICAL) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
MS SHUBHANJALI UMRAO
SCIENTIST 'B'/ASSISTANT DIRECTOR
(CHEMICAL), BIS

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