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भारतीय मानक मसौदा

फॉस्फोरिक एसिड — सुरक्षा संहिता

(IS 6818 का पहला पुनरीक्षण)

Draft Indian Standard

PHOSPHORIC ACID — CODE OF SAFETY

(First Revision of IS 6818)

ICS 13.300; 71.060.30

Chemical Hazards Sectional Committee, CHD 7

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FOREWORD

(Formal clauses to be added later)

Phosphoric acid is a widely used common inorganic acid. Fertilizer industry is the biggest consumer of phosphoric acid. In its pure form, it is used in cosmetic, pharmaceutical, detergent, food and various other industries. The phosphoric acid used is mainly orthophosphoric acid; but condensed acids of the general formula $H_{n+2}P_nO_{3n+1}$ also are being used progressively.

The strength of phosphoric acid is generally expressed in terms of phosphoric pentoxide (P_2O_5) content. The strength of commercial grade acids varies from 20 percent to 85 percent P_2O_5 . Acids, above 65 percent P_2O_5 content, invariably contain condensed phosphates.

Phosphoric acid produced by wet process contains fluorine compounds, either as hydrofluorosilicic acid or hydrofluoric acid in varying ratios. The fluorine content of the acid is generally controlled by factors such as the nature of the ore used, the process of acid extraction, the method of cooling employed during processing.

The properties of phosphoric acid listed in 4 have been taken from literature and have been included for information only. Moreover, these properties pertain to pure phosphoric acid. BIS has published a separate standard IS 798 : 2020 on the requirements, methods of sampling, and test for phosphoric acid of technical, explosive, analytical grades.

This standard was first published in 1973. In this revision, general properties have been incorporated and modifications have been made to update safety measures for controlling hazards, and essential information on symptoms of poisoning, first-aid, medical treatment, storage, handling, labelling and employee safety. In this

revision the title of standard has been modified and two amendments issued to this standard also have been incorporated.

And additionally, during the revision, efforts have been made to harmonize the safety measures mentioned in the standard for controlling hazards, essential information on symptoms of poisoning, Personal protection equipment etc., with the latest and applicable rules such as Hazardous Waste Management Rules, 2016.

There is no ISO Standard on this subject.

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

1 SCOPE

1.1 This standard describes properties of phosphoric acid, the nature of hazards associated with it and essential information on storage, handling, packing, labelling, disposal of waste, cleaning and repair of containers, selection and training of personnel, protective equipment and first aid.

1.2 This standard does not, however, deal with any specification 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 listed in **Annex A** contain provisions which through reference in this text, constitute provisions of this standard. At the time of publications, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

3 TERMINOLOGIES

For the purpose of this standard, the definitions given in IS 4155 and IS 4167 shall apply.

4 INFORMATION

4.1 General Information

Some of the important physical properties of phosphoric acid are given below. Unless specifically noted, the values given are for 100 percent acid.

4.1.1 *Chemical Name* — Orthophosphoric acid.

4.1.2 *Common Name and Synonyms* — Phosphoric acid.

4.1.3 *Uses*

Phosphoric acid is used in manufacturing of soap & detergent, also used in food, pharma, metal treatment & fertiliser industry.

4.2 Identification

4.2.1 *Formula* — H_3PO_4 .

4.2.2 *CAS Number* — 7664-38-2.

4.2.3 *UN Number* — 1805.

4.2.4 *UN Class* — 8.

4.2.5 *Hazchem Code* — 8, Corrosive, Packing (III).

4.3 Physical Properties

4.3.1 *General* — Clear, colourless, odourless, syrupy liquid.

4.3.2 *Molecular Mass* — 97.994 g/mol.

4.3.3 *Physical State* — Liquid.

4.3.3.1 *Anhydrous orthophosphoric acid (H_3PO_4)* — Solid.

4.3.3.2 70 percent to 85 percent solution containing 54 percent to 62 percent P_2O_5 — Viscous liquid.

4.3.4 Colour — Water white liquid/translucent solid.

4.3.5 Odour — Odourless.

4.3.6 Boiling Point — 158 °C approximately (for 85 percent).

4.3.7 Melting Point — 42.22 °C (OSHA values).

4.3.8 Relative Vapour Density (air = 1) — 3.4.

4.3.9 Density at 15.5 °C

4.3.9.1 For 75 percent solution — 1.583.

4.3.9.2 For 85 percent solution — 1.694.

4.3.10 Viscosity — 3.86 mPa.s (40 percent solution at 20 °C).

4.3.11 Vapour Pressure at 20 °C — 0.286 mm Hg.

4.3.12 Heat of Combustion (Higher Value), Kcal/g — No data available.

4.3.13 Refractive Index (at 0 °C and 1 atm)

4.3.13.1 1.34203 at 17.5 °C/D, 10 percent solution.

4.3.13.2 1.35032 at 17.5 °C/D, 20 percent solution.

4.3.13.3 1.35846 at 17.5 °C/D, 30 percent solution.

4.3.14 Solubility in Water at 20 °C — Completely soluble in water.

4.3.15 Solubility in other Solvents — Soluble in alcohol.

4.3.16 Light Sensitivity — No data available.

4.4 Chemical Properties

4.4.1 Reactivity

Phosphoric acid reacts exothermically with bases. It may also react with active metals, including such structural metals as aluminum and iron, to release hydrogen, a flammable gas. Phosphoric acid can initiate the polymerization of certain classes of organic compounds. It react with cyanide compounds to release gaseous hydrogen cyanide. It may generate flammable and/or toxic gases in contact with dithiocarbamates, isocyanates, mercaptans, nitrides, nitriles, sulphides, and strong reducing agents. Phosphoric acid forms explosive mixture with nitromethane. It may reacts violently with sodium tetrahydroborate. In the presence of chlorides can corrode stainless steel to form explosive hydrogen gas. It emits toxic and irritating fumes of oxides of phosphorus when heated to decomposition.

4.4.1.1 Phosphoric acid can react violently with sodium tetrahydroborate, undergoes exothermic reactions with aldehydes, amines, amides, alcohols and glycols, azo-compounds, carbamates, esters, caustics, phenols and cresols, ketones, organophosphates, epoxides, explosives, combustible materials, unsaturated halides, and organic peroxides. Phosphoric acid forms flammable gases with sulphides, mercaptans, cyanides and aldehydes. It also forms toxic fumes with cyanides, sulphide, fluorides, organic peroxides, and halogenated organics. Mixtures with nitromethane are explosive.

4.4.2 Polymerisation

Phosphoric acid may initiate the violent polymerization with azo compounds, epoxides, and polymerizable compounds.

4.4.3 Allotrope formation — No data available.

4.4.4 Corrosion properties

Phosphoric acid is corrosive to ordinary ferrous metals and alloys, particularly when hot. It is also extremely corrosive in presence of copper, of stainless steel (304), of stainless steel (316). Phosphoric acid is highly corrosive in presence of aluminum and non-corrosive in presence of glass.

4.5 Fire and Explosion Hazard Properties

4.5.1 Ignition Temperature — Non-flammable.

4.5.2 Auto Ignition Temperature — No Data available.

4.5.3 Flash Point — No Data available.

4.5.4 Upper Explosive Limit — No Data available.

4.5.5 Lower Explosive Limit — No Data available.

4.5.6 Fire Risk

Phosphoric acid is not combustible. It gives off irritating or toxic fumes (or gases) in a fire.

4.5.7 The limits of detonability of phosphoric acid in air — No Data available.

4.5.8 Flammability

Phosphoric acid itself is non-flammable, but on reaction with metals releases hydrogen which is highly flammable.

5 HEALTH HAZARD & TOXICITY INFORMATION HAZARDS

5.1 General Information

Hazards encountered with phosphoric acid are health hazards and are very rarely explosion and fire hazards. Harmful effects are caused from daily exposures to unsafe concentrations over a prolonged period. The threshold limit value (TLV) of phosphoric acid is 1 mg/m³ of air for 7 h to 8 h work-day and 40 h work-week. The acid on coming into contact with metals liberates hydrogen which is highly flammable.

5.2 Routes of Entry

5.2.1 Skin

Phosphoric acid is corrosive in nature. Exposure to it may cause redness, pain, and severe skin burns. It may also cause blistering leading to permanent scars. A severe exposure to phosphoric acid may cause death.

5.2.2 Eyes

Exposure to lower concentrations of phosphoric acid may cause eye irritation, redness, and pain. Contact with concentrated phosphoric may cause corrosive injury including permanent eye damage or blindness.

5.2.3 Ingestion

In an unlikely event if phosphoric acid is ingested it may cause burn the lips, tongue, throat and stomach. It may also cause nausea, vomiting, stomach cramps and diarrhoea. Permanent damage can result.

5.2.4 Inhalation

Phosphoric acid is not expected to be an inhalation hazard unless heated or misted. If phosphoric acid is heated or misted it can irritate the nose and throat.

5.2.5 Long term effects

At low concentrations, phosphoric acid can cause dry, red, cracked skin (dermatitis) following skin contact.

5.3 Toxicity information

- a) Threshold Limit Value (TLV) — 1 mg/m³.
- b) Short Term Exposure Limit (STEL) — 3 mg/m³.
- c) Immediately Dangerous to Life or Health (IDLH) — 1 000 mg/m³.
- d) Lethal Dose (LD₅₀) (rat), Oral — 1 530 mg/kg.
- e) Lethal Dose (LDL0) (human) Oral — No data available.
- f) Inhalation (Rat) Lethal Concentration (LC) — > 850 mg/m³ per h.
- g) Permissible exposure limits (PEL) — 1 mg/m³, 8 h TWA.
- h) Aquatic Toxicity Lethal Dose (LC₅₀) (mosquito fish) — 138 mg/l duration 96 h.

5.4 Antidote — No Data available.

5.5 Health Effects

5.5.1 Signs and Symptoms

Phosphoric acid can cause severe irritation and burns to every area of contact. It is harmful if swallowed or inhaled.

5.5.2 Acute Toxicity

Acute poisoning results from oral intake and from repeated and continued inhalation of the vapours emitted from the acid.

5.5.2.1 Systemic effects — No data available

5.5.2.2 Local effects

Contact with the acid produces irritation. The presence of fluorine compounds causes ulceration which heals only slowly.

5.5.3 Chronic Toxicity

Phosphoric Acid can irritate the lungs. Repeated exposure may cause bronchitis to develop with cough, phlegm, and/or shortness of breath. Long-term exposure to the liquid may cause drying and cracking of the skin.

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 phosphoric acid. It is, in many instances, the only practical means of protecting the worker, particularly in emergency situations. The personal protective equipment protects only the worker wearing it, and other unprotected workers in the area may be exposed to danger.

6.1.2 Proper training of personnel is essential for the correct usage of personal protective equipment (PPE) in undesired condition. In hazardous condition, it should be supervised that appropriate PPEs are used to handle it. Personal protection equipment shall be kept well clean and at easily accessible areas. After use, these equipments shall be cleaned in water using soap or soda ash.

6.2 Non-Respiratory Equipment

6.2.1 Eye and Face Protection

6.2.1.1 Chemical safety goggles

Plastic Safety goggles which fit snugly around the eyes should always be worn whenever there is danger of severe exposure to phosphoric acid, for example, when cleaning or repairing equipment, taking or handling samples, or cleaning up spills or leaks (*see IS 8520*). Eye and face fountains (*see IS 10592*) or water wash or water sprays should be available in areas where ammonia leaks, spills or splashes may be encountered.

6.2.1.2 Face shields

Plastic shields (full length or 20 cm minimum) with forehead protection may be worn in addition to chemical safety goggles where complete face protection is desirable. Face shields should never be substituted for chemical safety goggles, but both should be worn when a face shield is desirable (*see IS 8520*).

6.2.2 Head Protection

Where there is no danger from falling objects, safety helmets (*see IS 2925*) or 'hard' hats are considered unnecessary, soft brimmed hat or caps should be worn to give protection against liquid leaks and splashes.

6.2.3 Foot and Leg Protection

Leather or rubber safety shoes with built-in steel toe caps are recommended for workers handling drums and cans of phosphoric acid. Rubbers may be worn over leather safety shoes to prevent their contamination. Rubbers should be thoroughly cleaned and ventilated to remove contamination. Do not use contaminated shoes (*see IS 10667*) and (*see IS 15298 (Part 2)*).

6.2.4 Body, skin and hand protection

Wear appropriate chemical protective gloves and clothing to prevent skin exposure. Wear appropriate thermal protective clothing, when necessary (*see IS 8519*).

6.3 Respiratory Equipment

6.3.1 Self-contained breathing apparatus

This apparatus permit the wearer to carry a supply of oxygen or air compressed in the cylinder [*see IS 10245 (Part 1)*] and the self-generating type which produces oxygen chemically (*see IS 15803*). These allow considerable

mobility. The length of time, a self-contained breathing apparatus provides protection varies according to the amount of air, oxygen, or regenerating material carried. Compressed oxygen should not be used where there is danger of contact with flammable liquids, vapours, or sources of ignition, especially in confined spaces, such as tanks or pits.

6.3.2 Air-line masks supplied with clean compressed air

These are suitable for use only where conditions will permit safe escape in case of failure of the compressed air supply. These masks are usually supplied with air pipes to the area from a compressor. It is extremely important that the air supply is taken from a safe source, and that it is not contaminated by oil decomposition from inadequate cooling at the compressor. The safer method is to use a separate compressor of the type not requiring internal lubrication. Pressure reducing and relief valves as well as suitable traps and filters, shall be installed at all mask stations.

Better control of air quality pressure breathing air may be ensured by the use of high pressure standard cylinders, with demand type valve and face piece.

6.3.3 Industrial canister type gas masks

This apparatus equipped with full face pieces with the proper canister for absorbing vapour. These will afford protection against concentrations not exceeding 2 percent by volume when used in accordance with manufacturer's instructions. The oxygen content, of the air shall not be less than 16 percent by volume. The masks should be used for relatively short exposure periods only. They may not be suitable for use in an emergency since, at that time, the actual vapour concentration is unknown and an oxygen deficiency may exist. The wearer shall be warned to leave the contaminated area immediately on detecting the odour of a harmful vapour. This may indicate that the mask is not functioning properly, that the vapour concentration is too high, that the canister is exhausted, or that the mask is not properly fitted.

7 STORAGE, HANDLING, LABELLING AND TRANSPORT

7.1 General

7.1.1 All preventive measures given under clause 7 shall be taken while storing, handling and transporting phosphoric acid in various containers.

7.1.2 Usual shifting containers are boxed carboys, fibre drums for liquids, metal drums of stainless steel or rubber lined carbon steel. Tank cars or tank trucks are also fabricated from stainless steel or rubber lined carbon steel.

7.1.3 The hazards of the phosphoric acid may be avoided by effective employee education, proper safety instructions, intelligent supervision and use of safety equipment.

7.1.4 Working places where phosphoric acid mist and fluorine vapours are expected to be present should be kept well-ventilated by mechanical drafts.

7.1.5 In places where phosphoric acid is heated either for concentration or for processing, workers should be provided with gas masks.

7.1.6 Rags, clothing, etc, soaked in acid should be washed clean in water before using again.

7.1.7 The containers should be properly labelled and tightly closed.

7.1.8 As phosphoric acid is highly corrosive to many metals and alloys, the proper designing and selection of handling, storage and process equipment should be done by chemical and safety engineers, skilled in the handling of acid.

7.1.9 Care shall also be taken that phosphoric acid is not left in unvented pipelines, as a measure of safety against pressure rupture.

7.1.10 Electrical fixtures where the acid is handled shall be as vapour-tight as possible to protect against the corrosive action of vapour. All wiring should be in tight, rigid conduits.

7.1.11 Employee education in respect of safety in phosphoric acid is an essential feature for a safe working condition. The employees should be educated, regarding the use of protective equipments, and the actions to be taken in an emergency. The employees should also be trained to report to the proper authorities in case of failures of equipment and machinery or at the time of emergency.

7.1.12 The protective equipments include chemical safety goggles, face-shields, respiratory equipments, skull guards, PVC or rubber gumboots, safety gloves, chemical-resistant aprons, etc. These equipments shall be kept

well clean and at easily accessible areas. After use, these equipments shall be cleaned in water using soap or soda ash.

7.1.13 Air Analysis

For safe working in phosphoric acid, a knowledge of concentration of fluorine vapours and phosphoric acid in the atmosphere is essential.

7.2 Storage

7.2.1 General Precautions

7.2.1.1 Phosphoric acid attacks many metals, but it can be stored satisfactorily in rubber lined steel or stainless steel tanks designed and fabricated for the purpose, or in the drums in which it is received. The corrosive properties vary with the concentration.

7.2.1.2 Drums should be stored with the plugs up and the storage period kept to a minimum.

7.2.1.3 To release pressure which may build up, loosen plugs of stored drums weekly and more frequently in hot weather.

7.2.1.4 Carboys

Filled boxed carboys of phosphoric acid should not be tiered more than two carboys high. Empty boxed carboys should be stored on their flat side, not over four tiers high, in such a manner that the necks will not protrude into aisles or passageways.

7.2.2 Indoor Storage

The indoor storage area should be cool, dry, well-ventilated, out of direct sunlight and away from heat and ignition sources, separate from incompatible materials.

7.2.3 Outdoor Storage

The store drums should be kept away from heat and direct sunlight.

7.3 Handling

7.3.1 Tank cleaning and repairs

7.3.1.1 Preparation of tanks and equipment

7.3.1.1.1 Tank and equipment cleaning should be done under the direction of trained personnel familiar with the hazards and the necessary safeguards.

7.3.1.1.2 Tanks and equipment, pumps, lines and valves should always be drained and thoroughly flushed with water before being repaired. Workmen should never be allowed to attempt to repair equipment while it is in operation and the lines full.

7.3.1.1.3 All pipelines to the tank should be disconnected, and all connecting lines should be blanked off.

7.3.1.1.4 The agitators, if any, should be disconnected or locked off and tag system should be applied.

7.3.1.1.5 If pipe sections are to be removed and flanges opened, the lower bolts should be loosened first and although the lines have been flushed, care should be taken to avoid personal contact with the liquid draining or dripping from the equipment. All spillage from the lines or equipment should be removed immediately by flushing to the drain with large quantities of water.

7.3.1.1.6 Due to its ready dilution by water and its low vapour pressure, tanks or equipment should be so cleaned of phosphoric acid that there is little chance of exposure to hazardous vapours. Despite this, however, consideration should be given to the instructions laid down in **7.3.1.2**, **7.3.1.3** and **7.3.1.4** as a guide to have safe tank and equipment cleaning and repairs.

7.3.1.2 Entering tank

7.3.1.2.1 No one should enter a tank or confined space until a work-permit (*see* IS 17893) has been signed by an authorized person indicating that the area has been tested and found to be safe. The persons entering inside the tank must be well-trained on confined space activities. Furthermore, no workman should enter a tank or vessel that does not have a manhole opening large enough to admit a person wearing a safety harness, life line, and emergency respiratory equipment. It should be ascertained that the tank or vessel can be left by the original entrance.

7.3.1.2.2 One personnel should be placed outside of the tank to keep the personnel in the tank under observation and another personnel should be available nearby to aid in rescue if any of the personnels in the tank are overcome.

7.3.1.2.3 A supplied-air respirator or self-contained breathing apparatus, together with rescue harness and life line, should always be located outside the tank entrance for rescue purposes, regardless of the type of respiratory equipment or air supply which is provided for employees inside the tank.

7.3.1.2.4 Special ventilation is recommended during the entire period, the men are engaged in cleaning, repairing, or inspecting the tank. Ventilation can be accomplished by exhausting or removing vapours from the bottom of the tank either through its bottom openings, or by exhausting the vapours from the tank bottom by means of a large flexible duct where tanks have a top opening only. As a precaution against the ignition of existing hydrogen, the blowers or air movers used for ventilation of oxygen should be cleaned frequently so that moving parts will not set up friction heat. If electrical exhaust blowers are used, its motor must have flame proof fittings. In tanks having only a top opening, care shall be exercised to ensure complete removal of vapours from the entire tank. Care shall also be taken to avoid having exhaust gases recycled into the tank.

7.3.1.2.5 In all cases, if repair work is interrupted, the tank atmosphere should be checked thoroughly and a new work-permit issued before resumption of work.

7.3.1.3 *Emergency rescue*

Under no circumstance should a rescuer enter a tank to remove a victim of overexposure without proper respiratory protection, a safety harness and an attached life line. The free end of the life line should be manned by an attendant standing outside the tank. Another attendant should be immediately available to assist in the rescue, if needed. The rescuer should have a view of the outside attendant at all times or in constant communication with him.

7.3.1.4 *Exterior repair work*

7.3.1.4.1 Exterior tank repairs, including repairs of steam coils, cutting, riveting and welding, should be permitted only after thorough cleaning and testing of the tank to make sure it is free from vapours and after a work-permit has been issued by an authorized person. Repeated tests with an approved combustible gas indicator should be made to fully protect workmen.

7.3.1.4.2 All outside welding or burning on tanks or equipment, which have contained phosphoric acid, should be done only after such containers have been completely purged with steam. Purging should be continued while the repair work is in progress. Filling clean, empty tanks with inert gas is another method which may be used in outside welding or burning.

7.3.1.4.3 In all cases, if repair work is interrupted, the tank atmosphere should be checked thoroughly and a new work-permit issued before resumption of work.

7.3.1.4.4 If the tank is rubber lined, care should be taken to avoid any unwanted are inside the tank due to presence of rubber lining, when welding work is done outside the tank.

7.4 **Labelling**

7.4.1 Each container (including tankers) shall carry an identifying label or stencil as specified in Label model No. 8 of Annex B of IS 18149. 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.

7.4.2 Lower half of the label shall have the following text.

PHOSPHORIC ACID

CAUTION: CAUSES SKIN IRRITATION. AVOID CONTACT WITH SKIN AND EYES. IN CASE OF CONTACT FLUSH SKIN OR EYES WITH PLENTY OF WATER FOR AT LEAST 15 MIN — GET MEDICAL ATTENTION.

7.5 Transport

As per hazardous materials transportation guidelines. Containers generally used for transport of phosphoric acid or tankers and drums.

7.5.1 Precautions during Transportation

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.

7.5.2 Unloading drums

Manual unloading to be prevented.

7.5.3 Driver

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

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 firefighting equipment while handling phosphoric acid.

8.2 Spillage

8.2.1 General Information

While handling with spillage of phosphoric acid always proceed with caution. The access to contaminated area should be restricted. The unprotected personnel should always be away and upwind of spill area. The contact with spilled product should be avoided without wearing necessary protective gears. Protect sewers and waterways from contaminated runoff. Notify proper authorities. Plan response such that all physical contact with Phosphoric acid should be avoided.

8.2.1.1 Small Spill

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary, neutralize the residue with a dilute solution of sodium carbonate.

8.2.1.2 Large Spill

As phosphoric acid is a corrosive and poisonous liquid, it is necessary to stop leakage without taking any risk. Absorb with DRY earth, sand or other non-combustible material. Avoid taking water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapours. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above threshold limit value (TLV). Check TLV on the material safety data sheet (MSDS) and with local authorities.

8.2.2 Land Spill (Spill on land)

8.2.2.1 Containment

Phosphoric acid can be contained by building dikes or barrier using earth, and or similar materials, and then covered with water, wet sand. The contained product should be removed as soon as possible to prevent spread of contamination. Keep product wet before and after removal.

8.2.2.2 Consequence

Properly ventilate the area of spill. Phosphoric acid spills may be handled by flushing with plenty of water. Care must be taken to protect against prolonged contact with skin. Non-impervious clothing must not be re-worn till Phosphoric acid is completely removed.

8.2.2.3 Mitigation

Area cleared of spilled phosphoric acid may remain contaminated.

8.2.3 Water Spill (Spill in Water)

8.2.3.1 Containment

Stop use of water from water resources nearby by the phosphoric acid contamination sites. The local, state and central authorities should be notified to stop water intake or to monitor water for contamination. Spilled product will dissolve in water.

8.2.3.2 Mitigation

8.3 Leakages

Leakages whether large or small, a leak from a drum or tank containing phosphoric acid is most effectively controlled by spraying water on the leaking phosphoric acid.

8.4 Waste Disposal

8.4.1 Disposal of waste phosphoric acid as per hazardous waste management and handling rules 2016.

8.4.2 Water in contact with phosphoric acid should be treated suitably.

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 phosphoric acid have been removed.

9 FIRE PREVENTION AND FIRE FIGHTING

9.1 General

In case of fire fighting in phosphoric acid vicinity due to liberated hydrogen or otherwise, care must be taken to avoid exposure to fumes and vapours. Firemen should wear all-purpose canister type respirators. Where heavy concentrations over 2 percent by volume in air are suspected, self-contained breathing apparatus shall be worn.

10 TRAINING

10.1 Employee Education and Training

10.1.1 Safety in handling phosphoric acid depends, to a great extent, upon the effectiveness of employee education, proper safety instructions, intelligent supervision and the use of safe equipment.

10.1.2 The education and training of employees to work safely and to use the personal protective equipment or other safeguards provided for them is the responsibility of supervision. Workers should be thoroughly informed of the hazards that may result from improper handling of phosphoric acid. Each employees should be fully informed as what to do in an emergency.

10.1.3 Employee education and training should include the following:

- a) Instruction and periodic drill or quiz regarding the locations, purpose and use of respiratory protective devices and other personal protective equipment and action to be taken during emergency.
- b) Instruction and periodic drill or quiz regarding the locations of safety showers, eye baths, bubbler drenching fountains, or the closest source of water for use in emergencies.
- c) Instructions to avoid all unnecessary inhalation of vapours of phosphoric acid and all direct contact with the liquid.

d) Instruction and periodic drill or quiz regarding the location, purpose and the use of emergency fire-fighting equipment. Instruction to strictly prohibit smoking in storage area.

e) Instructions to report to the proper authority all equipment failures and any unusual odour of phosphoric acid.

11 HEALTH MANAGEMENT, FIRST-AID AND MEDICAL TREATMENT

11.1 Health Monitoring

All workmen, working on phosphoric acid should be regularly subjected to medical check-up by competent physician acquainted with occupational diseases. The workmen who have developed symptoms of poisoning by fluorine should be removed from the work spot and proper medical attention given.

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 phosphoric acid is being handled.

11.1.2 Physical Examination

11.1.2.1 Pre-placement physical examinations

Pre-placement medical examination should be directed toward eliminating from exposure to phosphoric acid. Those workers with any evidence of history of liver disease and those workers with any of the following dental defects: gingivitis, pyorrhoea, carious teeth, exposed sockets and dental cysts. Absence of all natural teeth is no contraindication.

11.1.2.2 Periodic examination

The extent of medical or dental control depends upon the amount of exposure to phosphoric acid. Where there is a prolonged exposure to open phosphoric acid, the necessary recommended procedures shall be followed.

11.1.2.3 Medical examination

An annual medical examination should be conducted for each employee who is constantly exposed to phosphoric acid. They 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.

11.1.2.4 Dental examination

Periodical dental examinations may be conducted.

11.2 First Aid

11.2.1 Contact with Skin

In case of contact, it is advisable to immediately flush skin with plenty of water for at least 15 min while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately. Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

In case the skin and mucous membrane are affected, remove contact and wash the affected portion with plenty of water.

11.2.2 Contact with Eyes

In the case of eye exposure, treatment should be begun immediately after flushing the eyes at least for 15 min with cold water by lifting the lower and upper lids occasionally. An eye irrigation fountain is very effective. Contact lenses should not be worn, if worn should be removed immediately. Get the medical attention immediately.

11.2.3 Ingestion

In case of swallowing, administer plenty of water to reduce concentration of acid. Vomiting may be induced by having the patient stick his finger down his throat.

11.2.4 Inhalation

If a workman inhales large quantity of fumes or vapours, remove him to fresh air and, if necessary, artificial respiration should be administered. Administer oxygen whenever necessary.

11.3 Medical Treatment

In case of inhalation, swallowing or acute contact, administer calcium gluconate. In case of severe doses, an intravenous injection may be necessary.

NOTES

- 1 As soon as first aid is given the attention of a physician is imperative.
- 2 Never administer anything orally when the patient is unconscious.

ANNEX A

(Clause 2)

LIST OF REFERRED STANDARDS

| <i>IS No.</i> | <i>Title</i> |
|----------------|--|
| IS 2925 : 1984 | Specification for industrial safety helmets (<i>second revision</i>) |

| | |
|-------------------------------------|--|
| IS 4155 : 2023 | Glossary of terms relating to chemical and radiation hazards and hazardous chemicals (<i>first revision</i>) |
| IS 4167 : 2020 | Glossary of terms relating to air pollution (<i>second revision</i>) |
| IS 8519 : 2024 | Guide for selection of occupational protective clothing — Body protection (selection, care , and maintenance) (<i>first revision</i>) |
| IS 8520 : 2023/ ISO 19734 : 2021 | Eye and face protection — Guidance on selection, use, and maintenance (<i>first revision</i>) |
| IS 10245 (Part 1) : 1996 | Breathing apparatus Part 1 Closed circuit breathing apparatus (compressed oxygen cylinder) — Specification (<i>first revision</i>) |
| IS 10592 : 2018 | Industrial emergency showers, eye and face fountains and combination units — Specification (<i>first revision</i>) |
| IS 10667 : 1983 | Guide for selection of industrial safety equipment for protection of foot and leg |
| IS 15298 (Part 2) : 2024 | Personal Protective Equipment Part 2 Safety Footwear (<i>third revision</i>) |
| IS 15803 : 2008 | Respiratory protective devices — Self-contained closed circuit breathing apparatus chemical oxygen (KO ₂) type, self-generating, self-rescuers — Specification |
| IS 17893: 2023 | Work permit system — Code of practice |
| IS 18149: 2023 | Transportation of dangerous goods – Guidelines |