



Phosphonic acid: Human health tier II assessment

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Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Phosphorous acid	10294-56-1
Phosphonic acid	13598-36-2

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit: www.nicnas.gov.au

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ACRONYMS & ABBREVIATIONS

Grouping Rationale

The chemicals in this group are constitutional isomers existing in two interconvertible, tautomeric forms, representing the same chemical compound with the structural formula H_3PO_3 . At equilibrium, the phosphonic acid form is effectively the only tautomer present. Organic derivatives in the form of both phosphorous acid esters $\text{P}(\text{OR})_3$ and phosphonic acid esters $\text{RPO}(\text{OR})_2$ can be made (Holleman et al., 2001).

Import, Manufacture and Use

Australian

The chemicals in this group were reported under previous mandatory and/or voluntary calls for information. However, the specific uses of the chemicals were not identified.

International

The following international uses have been identified through:

- the European Union (EU) Registration, Evaluation and Authorization of Chemicals (REACH) dossiers;
- Galleria Chemica;
- the Substances and Preparations in Nordic countries (SPIN) database; and
- the United States (US) Department of Health and Human Services, Household Products Database (HPD).

The chemicals have reported domestic uses, including in:

- paints, lacquers and varnishes;
- cleaning/washing agents;
- surface treatments (the chemicals are available at an unspecified concentration in a liquid home maintenance product and a personal care liquid cleaning and disinfecting product (as a stabiliser));
- corrosion inhibitors; and
- odour agents.

The chemicals have reported commercial uses, including:

- as anti-set-off and anti-adhesive agents;
- in hydraulic fluids and additives;
- in lubricants and additives; and
- as pH-regulation agents.

The chemicals have reported site-limited uses, including as:

- stabilisers;
- reducing agents;
- complexing and flocculating agents; and
- reagents in the preparation of inorganic phosphites, phosphite salts, organic phosphonates and mercury.

The chemicals have reported non-industrial uses, including in non-agricultural pesticides and preservatives.

Restrictions

Australian

Phosphonic acid is listed in the *Poisons Standard—the Standard for the Uniform Scheduling of Medicines and Poisons* (SUSMP) in Schedule 5, 'except in preparations containing 10 per cent or less of phosphonic acid (H₃PO₃)' (SUSMP, 2015) under '*Phosphonic acid (excluding salts and derivatives)*'.

Schedule 5 chemicals are described as 'Substances with a low potential for causing harm, the extent of which can be reduced through the use of appropriate packaging with simple warnings and safety directions on the label.' Schedule 5 chemicals are labelled with 'Caution' (SUSMP, 2015).

International

No known restrictions have been identified.

Existing Worker Health and Safety Controls

Hazard Classification

The chemicals are classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia):

- Xn; R22 (Harmful if swallowed)
- C; R35 (Corrosivity/causes severe burns)

Exposure Standards

Australian

No specific exposure standards are available.

International

No specific exposure standards are available.

Health Hazard Information

Phosphonic acid is a strong diprotic acid that dissociates into the hydrogenphosphite ion (HP(O)₂(OH))⁻ and hydrogen ion (H⁺). The dissociation of the chemical in the body is expected to lead to local effects such as corrosion. The hydrogenphosphite ion is also a moderately strong acid.

Phosphorous acid is considered identical to phosphonic acid due to the tautomeric equilibrium (refer to **Grouping Rationale** section).

Acute Toxicity

Oral

The chemicals are classified as hazardous with the risk phrase 'Harmful if swallowed' (Xn; R22) in the HSIS (Safe Work Australia). The available data support this classification.

Phosphonic acid (as 10 % phosphonic acid (w/w) in water) has moderate acute toxicity based on results from an animal study conducted according to the Organisation for Economic Co-operation and Development Test Guideline (OECD TG) 401 in male and female rats following oral exposure. The median lethal doses (LD50s) in Charles River CD rats were reported as 1580 and 1560 mg/kg bw for male and female rats, respectively (REACH).

Observed sub-lethal effects reported include lethargy and piloerection at all dose levels. Red nasal encrustation, loose faeces and ataxia were reported at doses ≥1700 mg/kg, brown staining around the mouth at doses ≥2390 mg/kg, while prostration and convulsion were reported only at the 3000 mg/kg dose. Haemorrhaging of the stomach and gastro-intestinal tract, and abdominal organs (stomach, pancreas, spleen, liver and small intestine) was reported following administration of both lethal and sub-lethal doses (REACH).

The observations are consistent with local corrosive effects on the gastrointestinal tract.

Dermal

No data are available.

Inhalation

No data are available.

Corrosion / Irritation

Corrosivity

The chemicals are classified as hazardous with the risk phrase 'Causes severe burns' (Xn; R35) in the HSIS (Safe Work Australia). The available data support this classification.

In a skin irritation/corrosion study, three male and three female New Zealand White rabbits were exposed to phosphonic acid (as 80 % phosphonic acid), under occlusive conditions on shaved skin for up to four hours, and observed over 48 hours (at 3 minutes, 1, 4, 24, and 48 hour intervals) after the patch was removed. Visible necrosis was observed in two animals after contact for 3–60 minutes. The remaining four animals showed necrosis after contact of more than one hour and up to four hours. Mean erythema scores (0, 0.83, 2) and oedema scores (0.25, 2, 6) for the three-minute to four-hour observation period were reported. By the 24-hour interval, the remaining animals exhibited dark red–brown coloured skin or a complete breakdown of skin with bleeding, and with blackening at 48 hours post-exposure. The study noted that as the chemical was determined as corrosive, the animals were euthanised before the standard 72-hour study duration (REACH).

Sensitisation

Skin Sensitisation

No data are available.

Repeated Dose Toxicity

Oral

Based on the data available, repeated oral exposure to the chemicals are associated with short-term local effects.

In a combined repeated dose reproductive developmental toxicity screening test (OECD TG 422), male and female Wistar rats were daily administered phosphonic acid, by oral gavage concentrations of 0, 80, 250 and 750 mg/kg bw/day. Males were treated over 29 days (starting two weeks before mating) and female treatment started two weeks before mating, then through mating until being euthanised (after at least four days of lactation). During the first four days, the 750 mg/kg dose group exhibited severe toxicity, and the dose concentration was decreased to 500 mg/kg from day five onwards.

At the 500 mg/kg bw/day dose, the effects observed included mortality, severe localised stomach effects, reduced body weights and reduced food consumption. The effects on clinical biochemistry parameters, macroscopic and microscopic findings of the stomach indicated severe irritation and corrosion. In females rats, weight changes and microscopic findings were observed in the spleen (REACH).

Dermal

No data are available.

Inhalation

No data are available.

Genotoxicity

Based on the available in vitro data, the chemicals are not considered to have genotoxic potential. No in vivo studies were available.

Several in vitro assays using phosphonic acid gave negative results (REACH) in the following studies:

- bacterial mutation assays (various *Salmonella typhimurium* strains and the *Escherichia coli* WP2 uvrA strain) with and without metabolic activation at doses of 3–5000 µg/mL);
- a micronucleus test in human peripheral blood lymphocytes (doses up to 820 µg/mL) with and without metabolic activation; and
- a gene mutation assay in mouse lymphoma L5178Y cells with and without metabolic activation (doses up to 820 µg/mL).

Carcinogenicity

No data are available.

Reproductive and Developmental Toxicity

Based on the available data, the chemicals are not reproductive or developmental toxicants.

In a combined repeated dose reproductive developmental toxicity screening test previously described (refer to the **Repeated dose toxicity: Oral** section), short-term local effects were observed from the oral administration of phosphonic acid (REACH).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include local effects (corrosive effects on the skin, eyes and gastrointestinal tract).

Public Risk Characterisation

The chemicals have uses in domestic products where they are normally part of surface treatment formulations, and as cleaning and washing agents. However, they are expected to be present at low concentrations and largely neutralised (refer to **Import, manufacture and use** section) in domestic products. According to the US Department of Health and Human Services, Household Products Database, the chemicals are reported under phosphonic acid (CAS No. 13598-36-2) and are available at unspecified concentrations in domestic products. The main route of public exposure is expected to be skin and eye contact. Labelling for phosphonic acid formulations is controlled by the *Poisons Standard* (SUSMP, 2015). As formulations sometimes report the presence of phosphorous acid rather than phosphonic acid, the entry should also cover phosphorous acid (CAS No. 10294-56-1) as an equivalent, tautomeric form under the existing listing (refer to **Restrictions: Australian** section) to resolve ambiguity. Provided that the appropriate precautions are taken to avoid skin and eye contact, the risk from the use of domestic products is not considered to be unreasonable.

Occupational Risk Characterisation

During product formulation, oral, dermal and ocular exposure might occur, particularly where manual or open processes are used. These could include transfer and blending activities, quality control analysis, and cleaning and maintaining equipment. Worker exposure to the chemicals at lower concentrations could also occur while using formulated products containing the chemicals. The level and route of exposure will vary depending on the method of application and work practices employed.

Given the critical health effects, the chemicals could pose an unreasonable risk to workers unless adequate control measures to minimise oral, dermal and ocular exposure are implemented. The chemicals should be appropriately classified and labelled to ensure that a person conducting a business or undertaking (PCBU) at a workplace (such as an employer) has adequate information to determine the appropriate controls.

Based on the available data, the hazard classification in HSIS are considered appropriate for the chemicals.

NICNAS Recommendation

Current risk management measures are considered adequate to protect public and workers' health and safety, provided that all requirements are met under workplace health and safety, and poisons legislation as adopted by the relevant state or territory. No further assessment is required.

Regulatory Control

Public Health

Products containing the chemicals should be labelled in accordance with state and territory legislation (SUSMP, 2015).

Work Health and Safety

The chemicals are recommended for classification and labelling under the current approved criteria and adopted GHS as below. This assessment does not consider classification of physical and environmental hazards.

Hazard	Approved Criteria (HSIS) ^a	GHS Classification (HCIS) ^b
Acute Toxicity	Harmful if swallowed (Xn; R22)*	Harmful if swallowed - Cat. 4 (H302)
Irritation / Corrosivity	Causes severe burns (C; R35)*	Causes severe skin burns and eye damage - Cat. 1A (H314)

^a Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)].

^b Globally Harmonized System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third Edition.

* Existing Hazard Classification. No change recommended to this classification

Advice for consumers

Products containing the chemicals should be used according to the instructions on the label.

Advice for industry

Control measures

Control measures to minimise the risk from oral, dermal and ocular exposure to the chemicals should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate, or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemical is used. Examples of control measures which could minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- using local exhaust ventilation to prevent the chemical from entering the breathing zone of any worker;
- air monitoring to ensure control measures in place are working effectively and continue to do so;
- minimising manual processes and work tasks through automating processes;
- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemical.

Guidance on managing risks from hazardous chemicals are provided in the *Managing risks of hazardous chemicals in the workplace—Code of practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to help meet obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((M)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemical are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (M)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of safety data sheets for hazardous chemicals—Code of practice* and *Labelling of workplace hazardous chemicals—Code of practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of the chemical has not been undertaken as part of this assessment.

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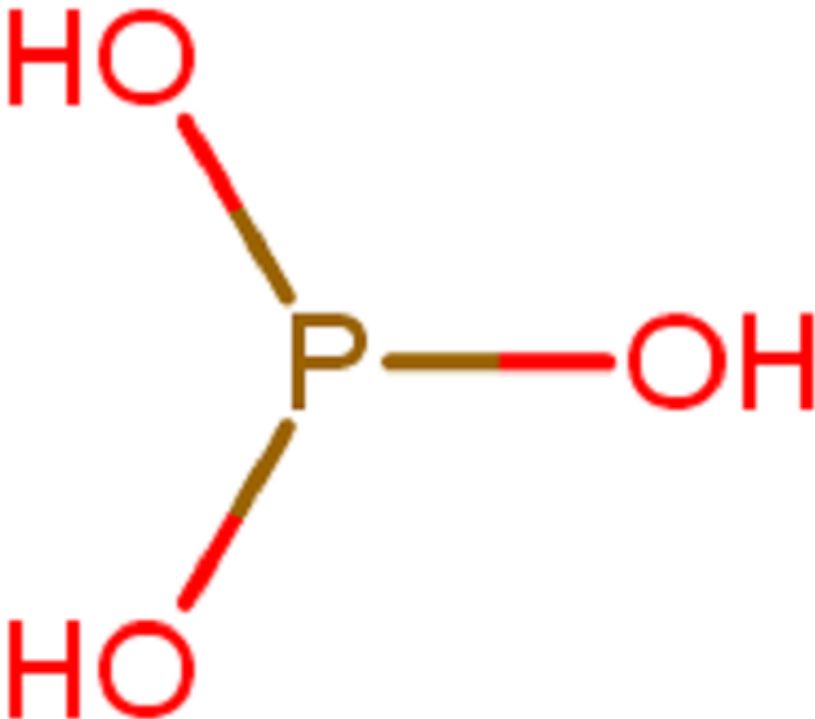
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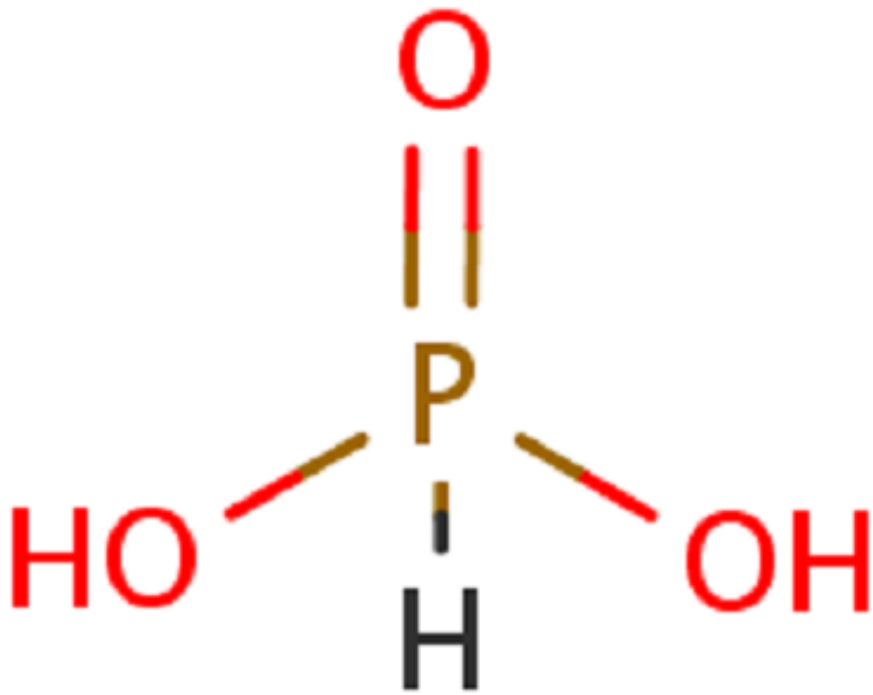
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Chemical Identities

Chemical Name in the Inventory and Synonyms	Phosphorous acid
CAS Number	10294-56-1
Structural Formula	
Molecular Formula	H3O3P
Molecular Weight	81.99

Chemical Name in the Inventory and Synonyms	Phosphonic acid dihydroxyphosphine oxide orthophosphorus acid phosphorus trihydroxide trihydroxyphosphine
CAS Number	13598-36-2

Structural Formula	
Molecular Formula	H3O3P
Molecular Weight	81.99

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