Hexahydrophthalic anhydride: Human health tier II assessment

21 April 2016

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
1,3-Isobenzofurandione, hexahydro-	85-42-7
1,3-Isobenzofurandione, hexahydro-, (3aR,7aS)-rel-	13149-00-3

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**

Disclaimer

ACRONYMS & ABBREVIATIONS

Grouping Rationale

The chemical (CAS No. 85-42-7) is a mixture containing both the cis- and trans- stereoisomer forms of the chemical. The cis-isomer of the chemical (CAS No. 13149-00-3) is listed separately on the Australian Inventory of Chemical Substances (AICS) and has been included in this assessment.

The uses of the chemicals and their hazardous properties are expected to be dominated by the acid anhydride functional group. As the cis isomer is also a constituent of the mixed isomers, these chemicals are assessed together.

Import, Manufacture and Use

Australian

The total volume introduced into Australia, reported under previous mandatory and/or voluntary calls for information, was <100 tonnes.

The isomer mixture (CAS No. 85-42-7) has reported site-limited use as an intermediate in the manufacture of other chemicals.

International

The following international uses have been identified through the EU REACH dossiers; Galleria Chemica; the Substances and Preparations in Nordic countries (SPIN) database; the US Environmental Protection Agency's Aggregated Computer Toxicology Resource (ACToR); and the US National Library of Medicine's Hazardous Substances Data Bank (HSDB).

The isomer mixture (CAS No. 85-42-7) has reported domestic uses including in:

- paints, lacquers and varnish (including thinner); and
- cleaning agents.

The domestic use as a cleaning agent was only listed in the SPIN database. However, it should be noted that SPIN does not distinguish between direct use of the chemical, or use of the materials that are produced from chemical reactions involving the chemical.

The isomer mixture (CAS No. 85-42-7) has reported commercial uses including:

- in adhesives, binding agents;
- in viscosity adjusters (lubricants);
- as a process regulator;
- as a fixing agent;
- in heat transferring agents;
- in insulating materials;
- as a plastic hardener (such as food packaging, storage, toys, mobiles); and
- in colouring agents (dyes).

The isomer mixture (CAS No. 85-42-7) has reported site-limited use as an intermediate for alkyds, plasticisers and rust inhibitors.

The cis isomer (CAS No. 13149-00-3) has reported commercial and site limited industrial uses as a hardener for epoxy resins and as a chemical intermediate (Galleria).

Restrictions

Australian

There are no specific entries in the *Poisons Standard—the Standard for the Uniform Scheduling of Medicines and Poisons* (SUSMP) for either of the chemicals.

There is a general entry for 'ANHYDRIDES, ORGANIC ACID for use as curing agents for epoxy resins **except** when separately specified in these Schedules' in the SUSMP in Schedule 5 (SUSMP, 2016). This entry covers both chemicals when used as curing agents for epoxy resins.

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, 2016).

International

The chemicals are listed on the candidate list of substances of very high concern (SVHC) for eventual inclusion in Annex XIV (ECHA). In the European Union (EU), companies could have legal obligations if the chemical that they produce, supply, or use is included on the candidate list whether on its own, in mixtures, or present in articles.

The Netherlands has submitted an Annex XV report proposing to restrict manufacturing and using the isomer mixture (ECHA). The recommendation is based on the respiratory sensitisation hazard as an "equivalent level of concern".

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):

- Xi; R41 (eye irritation);
- Xn; R42 (respiratory sensitisation); and
- Xi; R43 (skin sensitisation).

Exposure Standards

Australian

No specific exposure standards are available.

International

A short-term exposure limit (STEL) of 0.005 mg/m^3 was identified in Spain (Galleria Chemica).

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) of 0.005 mg/m^3 time weighted average (TWA).

Health Hazard Information

The information presented in this section is based on the reported hazards of the isomeric mixture (referred to as 'the chemical'), which contains both the cis- and trans- isomeric forms.

Toxicokinetics

Acid anhydrides hydrolyse rapidly and the chemical is expected to be present as the diacid hydrolysis product when present in the systemic circulation. The chemical is absorbed quickly following respiratory exposure and can be found in the plasma following absorption. The chemical is excreted via urine (ACGIH, 2004; HSDB).

In human volunteers exposed to the vapour of the chemical at 10, 40 or 80 µg/m^3 for 8 hours, absorption was essentially complete—it is likely that hydrolysis of the chemical on mucous membranes resulted in absorption as the corresponding diacid. Levels in the plasma increased rapidly, and a steady state was not reached during the exposure period. The chemical was excreted via the kidneys (urine) (HSDB).

The biological half life of the chemical in plasma was reported as approximately two hours in humans (HSDB).

Guinea pigs and rats were exposed to radiolabelled chemical as an aerosol for three or eight hours. Radioactivity was primarily found in the nasal mucosa (not the lung) in animals. It was considered likely that this finding reflected rapid hydrolysis in the mucosa to the parent diacid. Radioactivity was also found in the mucosa of the conjunctivae, oral cavity, oesophagus and gastrointestinal tract, as well as in the kidneys. Analysis of the plasma from both species indicates that the chemical was bound to serum albumin and haemoglobin. The plasma half life decayed in a similar manner to a two stage model (ACGIH, 2004).

In a worker exposure study, it was observed that the post-shift increase in urinary excretion of the chemical was proportional with the Time Weighted Average (TWA) exposure during the shift. A subsequent study showed a correlation between the eight hour TWA and excretion rate (total excretion of hexahydrophthalic (HHP) acid in urine collected during the last 4 hours, and total excretion in urine). The authors determined the biological half life of the chemical to be five hours (ACGIH, 2004).

Acute Toxicity

Oral

Based on the available data, the chemicals have low acute oral toxicity in rats.

The median lethal dose (LD50) in rats is 2700 mg/kg bw. Observed sublethal effects included decreased activity and/or urinary incontinence (RTECS; US HPVIS).

Dermal

Based on the available data, the chemicals have low acute dermal toxicity in rabbits.

The median lethal dose (LD50) was >2000 mg/kg bw in rabbits (RTECS, US HPVIS). There were no deaths and no clinical signs of toxicity. Minimal irritant effects were observed on day two (US HPVIS).

Inhalation

Based on the available data, the chemicals have low acute inhalation toxicity in rats .

The median lethal concentration (LC50) was > 1100 mg/m^3 in rats with no deaths during the study period following four hours of exposure (RTECS, US HPVIS). Clinical symptoms of exposure to the chemical included decreased activity. The dose used was considered to be a maximum attainable concentration (US HPVIS).

Corrosion / Irritation

Skin Irritation

Based on the limited available data, the chemicals are considered to be slightly irritating to skin at 50 % concentration.

Rabbits were exposed to the chemical at concentrations of 6.25, 12.5, 25 and 50 % in mineral oil for 24 hours. The chemical was reported to be a slight irritant to the skin at all doses (HSDB, US HPVIS).

When tested at a concentration of 50 % in polyethylene glycol, the chemical caused oedema in 3/6 rabbits with intact skin after a 24 hour exposure period. Signs of skin irritation were absent at 72 hours after exposure (REACH).

Eye Irritation

The chemicals are classified as hazardous with the risk phrase 'Risk of serious damage to eyes' (Xi; R41) in the HSIS (Safe Work Australia). The available data support this classification. The chemicals may cause irreversible effects to the eyes.

In an eye irritation study in New Zealand White (NZW) rabbits, the chemical was administered to six rabbits without washing the eyes, while three rabbits had eyes washed after four seconds and three rabbits had eyes washed after 30 seconds. Irritation effects were not reversible by day 21 in unwashed eyes and eyes washed after 30 seconds and the responses were reported to

be corrosive and severely irritating, respectively. Irritation was reversible in the remaining group (eyes washed after four seconds), 19 days after exposure to the chemical (US HPVIS). Irritation scores were not available.

In an eye irritation study in rabbits, the chemical was administered to six rabbits (three without washing the eyes and the other three had eyes washed after 30 seconds). Observations were scored according to the Draize scale. All animals from the unwashed group showed conjunctival (mean scores (24, 48 and 72 hours) for each animal: chemosis 2, 3, and 2.3; redness 3, 3, and 3), iridial (mean score of 1 for all animals) and corneal (mean score of 1, 1 and 1.3) effects. Effects to the conjunctivae, iris and cornea were still present at the 6-day observation (last observation recorded). Animals with eyes washed after 30 seconds also showed conjuctival effects (mean scores (24, 48 and 72 hours) for each animal: chemosis 2.3, 2.3 and 1.7; redness 3, 3, and 3) and corneal effects (mean score of 1 for all animals). One of the three animals showed iridial effects (mean score = 0.7). Conjunctival and corneal effects were present in washed eyes 14 days after initial exposure. The chemical was determined to be highly irritating to eyes (REACH).

Observation in humans

In a case study of three workers with nasal and/or skin complaints that had been exposed to the chemical and a related chemical methylhexahydrophthalic anhydride (MHHPA), symptoms in one worker (nasal pain and rhinorrhoea) were determined to be due to an irritant reaction (Yokota et al, 2001).

Sensitisation

Respiratory Sensitisation

The chemicals are classified as hazardous with the risk phrase ‘May cause sensitisation by inhalation’ (R42) in the HSIS (Safe Work Australia). The available animal and human (see **Observations in humans** below) data support this classification.

Guinea pigs were intradermally exposed to the chemical (concentration not specified). Four weeks later, animals were challenged via inhalational exposure with the chemical conjugated with guinea pig serum albumin. The symptoms produced, such as bronchial obstruction/spasm, secretion and oedema, were consistent with respiratory allergy. Recovery from respiratory symptoms was observed within 30 minutes (ACGIH, 2004).

Guinea pigs with induced respiratory allergy (measured by lung resistance and extravasation) to the chemical showed dose-dependent specific IgG responses. Following intratracheal instillation, effects on the airways were immediate and lasted up to 6 minutes (ACGIH, 2004).

Mice (strain not specified) topically exposed to the chemical for three days showed a T cell response (type 2, T-helper, cytokine secretion) that was consistent with the ability to produce a respiratory allergy (ACGIH, 2004).

Skin Sensitisation

The chemicals are classified as hazardous with the risk phrase ‘May cause sensitisation by skin contact' (R43) in the HSIS (Safe Work Australia). The available animal and human (see **Observations in humans** below) data support this classification.

In a guinea pig maximisation test (GPMT), 17/20 (85 %) guinea pigs gave a positive response confirming the chemical as a skin sensitiser (US HPVIS). There were few details regarding the conduct of the experiment (such as concentration of chemical used for testing).

Hartley guinea pigs intradermally exposed to a single dose (0.3 m solution) of organic acid anhydrides (including the chemical) developed both specific IgG and IgE antibodies to the chemical (ACGIH 2004).

Observation in humans

The chemicals can cause respiratory sensitisation and/or skin sensitisation in humans. There are a number of documented case studies of workers exposed to the chemical and immunological investigations available in scientific literature.

In one dermal study using a 5 % solution of the chemical in mineral oil, 4/53 patients showed low grade sensitivity and 1/53 patients showed a marked reaction to the chemical. Therefore, the chemical is considered to be a skin sensitiser (US HPVIS).

In a study designed to determine the efficacy of workplace hygiene measures, workers exposed to the chemical and a related chemical, MTHPA were examined for sensitisation reactions. In the initial assessment, 20/110 workers examined prior to workplace initiatives to reduce exposure were determined as sensitised to the chemicals (either specific IgE for MTHPA and/or the chemical or positive skin prick testing). In a follow up examination, sensitisation to MTHPA was confirmed in all workers who initially tested positive (specific IgE levels for 'the chemical' were not reported). An additional group that initially tested negative for skin sensitisation, but had worked at the plant prior to the workplace initiatives to reduce exposure, also tested positive for sensitisation to MTHPA. None of the workers examined who began their employment after the workplace initiatives to reduce exposure were positive for sensitisation to MTHPA in the follow up study (Drexler et al, 1999).

In a case study of three workers with nasal and/or skin complaints who had been exposed to the chemical and a related chemical, MHHPA, the symptoms in one worker (nasal pain and rhinorrhoea) were determined to be due to an irritant reaction. A second worker with similar levels of exposure displayed symptoms of severe rhinitis and cough, although symptoms resolved when removed from the exposure source. Despite negative determinations of specific IgE and patch tests, this worker was assumed to be sensitised to MHHPA according to the study methodology. The third worker displayed symptoms of rhinitis and urticaria and tested positive for specific IgE for phthalic anhydride and the chemical and patch testing to MHHPA (Yokota et al, 2001).

In a study designed to investigate the exposure relationships of the chemical and MHHPA for sensitsation and effects to the airway, a close association between test results for MHHPA and the chemical was observed. This was reported as likely to be attributable to cross-sensitivity (Nielsen et al, 2001).

In an investigation of workers exposed to the chemical, nasal challenge tests determined that 11 subjects with work-related nasal symptoms were sensitised to the chemical, based on positive skin prick test and positive radioallergosorbent test (RAST) (which screens for IgE mediated allergy). Workers also had decreased nasal inspiratory peak flow and increased levels of symptoms following challenge. Out of 20 unsensitised workers (11 without symptoms and 9 with work related nasal symptoms), there were no significant changes to any of the tested parameters (HSDB).

A worker with a history of childhood asthma and atopy experienced respiratory symptoms (chest tightness, cough and wheezing) after 4-5 minutes of exposure to the chemical fumes. Another worker exposed to airborne MHHPA and the chemical was diagnosed with occupational contact urticaria, rhinitis and conjunctivitis (HSDB).

Repeated Dose Toxicity

Oral

Based on the available 28-day study, the chemicals are not considered to cause severe systemic toxicity following repeated oral exposure up to 300 mg/kg bw/day. The majority of treatment-related effects observed were consistent with the irritant effects of the chemical (see **Irritation** section).

In an oral gavage study (conducted according to the Organisation for Economic Cooperation and Development (OECD) Test Guideline (TG) 407), CD-1 rats (5/sex/dose) were administered the chemical at doses of 0, 100, 300 or 1000 mg/kg bw/day for 28 days. Treatment-related signs of toxicity (mortality, chin rubbing, salivation and respiratory impairment associated with inflammatory cells in the epithelium of nasal turbinates) were observed at the highest dose. Other treatment-related effects included effects on serum biochemistry (increased sodium, calcium, alkaline phosphatase, urea, creatinine and cholesterol in males, decreased potassium and gamma glutamyl transferase in males, increased sodium and chloride in females), urinalysis (high urine volume in both sexes after 4 weeks) and haematology parameters (high white blood cell count, neutrophil, eosinophil, monocyte and large unstained cell concentrations in males) in the high dose group, microscopic changes to the kidneys (cortical tubular basophilia and/or cortical tubular dilation) in the high dose group and macroscopic (and microscopic) changes to the stomach at doses of 300 mg/kg bw/d and above (including epithelial hyperplasia in the foveolar region, submucosal inflammation of the glandular region, hyperkeratosis, epithelial hyperplasia, vacuolation, mucosal and submucosal

inflammation and erosion of the non glandular region). After a two week recovery period, only changes to some biochemistry parameters (high potassium and low calcium in males at 1000 mg/kg bw/d), microscopic stomach changes (reduced incidence and severity) and kidney effects (unilateral tubular basophilia in one male) remained in the high dose group (REACH). A No Observed Adverse Effect Level (NOAEL) of 100 mg/kg bw/day based on local effects (stomach changes and respiratory impairment) and a NOAEL of 300 mg/kg bw/day based on systemic effects (toxic effects at highest dose) could be applied to the chemical.

Dermal

No data are available.

Inhalation

No data are available.

Genotoxicity

Based on the available negative in vitro genotoxicity data, the chemicals are not expected to be genotoxic. The chemical tested negative for mutagenicity in vitro, both in bacterial and mammalian cells, with or without metabolic activation (ACGIH, 2004; REACH). No in vivo genotoxicity data are available. The rapid hydrolysis of the chemical may indicate that it is unlikely to interact with genetic material.

The chemical tested negative for mutagenicity in an in vitro bacterial reverse mutation assay, both with or without metabolic activation in strains of *Salmonella typhimurium* (ACGIH, 2004). No study details were available.

The chemical tested negative for mutagenicity, with or without metabolic activation in all of the following in vitro assays (REACH):

- a bacterial reverse mutation assay (OECD TG 471) in *S.typhimurium* strains TA 98, 100, 1535 and 1537 and *Escherichia coli* strain WP2 uvr A pKM 101, at concentrations up to 5000 µg/plate of the chemical in dimethyl sulfoxide (DMSO) vehicle using both the plate incorporation and pre-incubation methods with a 72 hour incubation period;
- a mammalian cell gene mutation test (OECD TG 476) in mouse lymphoma cells in the presence of concentrations up to 770.9 µg/mL of the chemical in DMSO, with incubation periods of 1-3 hours and 2-24 hours); and
- a mammalian chromosome aberration test (OECD TG 473) in human lymphocytes with concentrations up to 555 µg/mL in DMSO, for a 3-hour exposure period.

Carcinogenicity

No data are available.

Reproductive and Developmental Toxicity

Based on the available data, the chemicals are not expected to cause specific reproductive or developmental toxicity effects.

In a reproduction and developmental toxicity screening test (OECD TG 421) in Sprague Dawley (SD) rats (n = 10/sex/dose), the chemical was administered via oral gavage doses of 0, 100, 300 or 1000 mg/kg bw/day, from 15 days prior to mating. Males were dosed for a total of approximately 48 days (includes dosing prior to mating) and females were dosed prior to mating, throughout the gestation period and until lactation day (LD) 7. Clinical signs of toxicity were observed in parental animals at doses ≥300 mg/kg bw/day. Body weight and food consumption were reduced in the high dose groups as compared to controls. Increased mean absolute spleen weights (in males and females) and mean absolute ovary weights (statistically significant) were observed in the 1000 mg/kg bw/day dose groups. Macroscopic changes in the stomach were observed in parental animals at

doses of 300 mg/kg bw/day and above; these findings were similar to those observed in the 28-day repeat dose study, likely due to irritant effects of the chemical. There were no changes to reproductive organs that were considered to affect fertility. No treatment related effects were reported in offspring. The NOAELs for foetal toxicity and toxicity to fertility were reported as 1000 mg/kg bw/day (REACH).

Risk Characterisation

Critical Health Effects

The critical health effect for risk characterisation is respiratory sensitisation. The chemical is also a skin sensitiser and severely irritating to the eyes.

Public Risk Characterisation

The Australian use for the chemicals indicated site-limited use only. However, the international uses indicated some potential domestic uses (in paints, lacquers and cleaning products). It is unclear as to the relevance of the potential domestic uses as the chemicals are expected to be used in manufacture of other chemicals for these uses.

The chemicals are covered by the Schedule 5 general group entry for 'ANHYDRIDES, ORGANIC ACID' in the SUSMP for use as curing agents for epoxy resins (SUSMP, 2016). The chemicals may also be present in reacted form in consumer items manufactured from plastics (such as food packaging, storage, mobile phones, toys etc.), but the chemicals are not expected to be regenerated from manufactured articles to pose an unreasonable health risk to the general public.

Given the Australian use identified for these chemicals, it is unlikely that the public will be exposed, except at very low levels for uses covered by the existing Schedule 5 entry. Hence, the public risk from these chemicals is not considered to be unreasonable. If information becomes available to indicate the chemicals are used in domestic products in Australia (to have public exposure), further regulatory controls may need to be implemented to protect the general public from the identified health hazards.

Occupational Risk Characterisation

Given the critical health effects, the chemicals could pose an unreasonable risk to workers unless adequate control measures to minimise dermal and inhalational exposure are implemented. The chemicals should be appropriately 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.

There is no current Australian exposure standard that applies to the chemicals. Based on the available information regarding the health risk to exposed workers, respiratory allergy is a major concern arising from the industrial use of the chemicals, and there may be no level of exposure that does not result in an increased risk of developing respiratory allergy (ECHA). However, the chemicals are appropriately classified to implement control measures to prevent worker inhalation and dermal exposure.

Based on the available data, the hazard classification in the HSIS (Safe Work Australia) is considered appropriate for both 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

Work Health and Safety

The chemicals are currently classified as hazardous 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]
Irritation / Corrosivity	Risk of serious eye damage (Xi; R41)*	Causes serious eye damage - Cat. 1 (H318)
Sensitisation	May cause sensitisation by inhalation (Xn, R42)* May cause sensitisation by skin contact (Xi; R43)*	May cause allergy or asthma symptoms or breathing difficulties if inhaled - Cat. 1 (H334) May cause an allergic skin reaction - Cat. 1 (H317)

[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 industry

Control measures

Control measures to minimise the risk from dermal and inhalational 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 chemicals are used. Examples of control measures that could minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- using local exhaust ventilation to prevent the chemicals from entering the breathing zone of any worker;
- health monitoring for any worker who is at risk of exposure to the chemicals, if valid techniques are available to monitor the effect on the worker's health;
- 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 chemicals.

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 chemicals 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 these chemicals has not been undertaken as part of this assessment.

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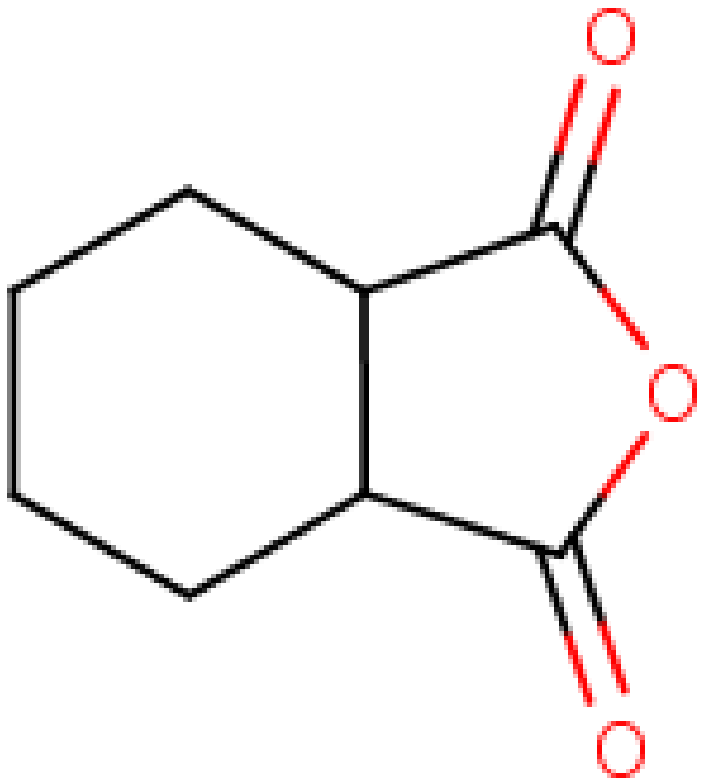
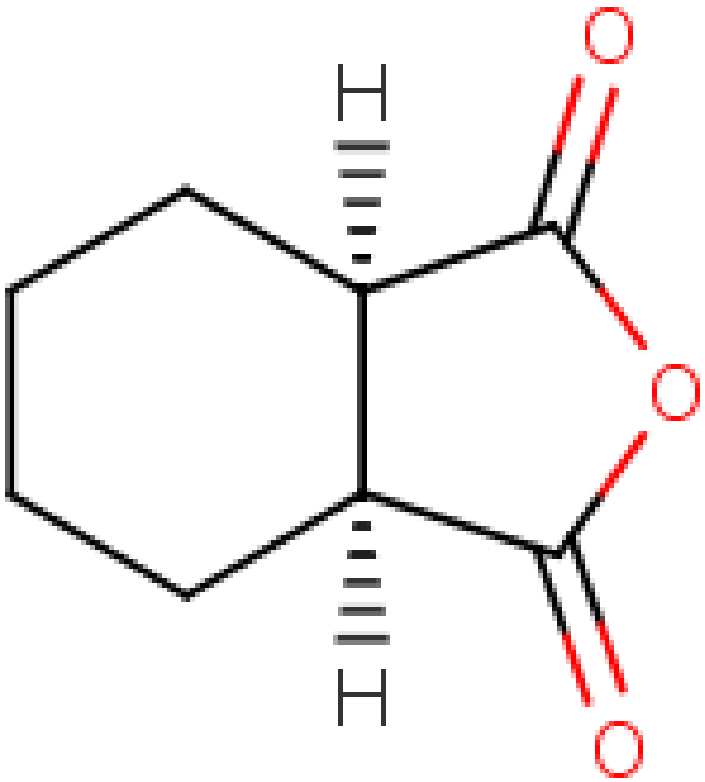
Last Update 21 April 2016

Chemical Identities

Chemical Name in the Inventory and Synonyms	**1,3-Isobenzofurandione, hexahydro-** hexahydrophthalic anhydride (HHPA) 1,2-cyclohexanedicarboxylic anhydride 1,2-cyclohexanedicarboxylic acid anhydride cyclohexane-1,2-dicarboxylic anhydride hexahydro-2-benzofuran-1,3-dione
CAS Number	85-42-7
Structural Formula	
Molecular Formula	C8H10O3
Molecular Weight	154.16

Chemical Name in the Inventory and Synonyms	**1,3-Isobenzofurandione, hexahydro-, (3aR,7aS)-rel-** cis-hexahydroisobenzofuran-1,3-dione

	cis-hexahydrophthalic anhydride (3aR, 7aS)-hexahydro-2-benzofuran-1,3-dione
CAS Number	13149-00-3
Structural Formula	
Molecular Formula	C8H10O3
Molecular Weight	154.16

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