HICC: Human health tier II assessment

26 October 2018

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
3-Cyclohexene-1-carboxaldehyde, 4-(4-hydroxy-4-methylpentyl)-	31906-04-4
3-Cyclohexene-1-carboxaldehyde, 3-(4-hydroxy-4-methylpentyl)-	51414-25-6

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

Commercial hydroxyisohexyl 3-cyclohexene carboxaldehyde (HICC) is a synthetic blend of two isomers: CAS No. 31906-04-4 (major isomer, 70 %) and CAS No. 51414-25-6 (minor isomer, 30 %). The CAS No. 31906-04-4 is often used to refer to the multi-constituent form as well as the major isomer. HICC is used as a synthetic fragrance ingredient and masking agent in a wide range of cosmetic and domestic products, under the common trade names such as lyral or Kovanol (CLH, 2013).

HICC is a common contact allergen. Due to its strong skin sensitising properties, the chemical was included in the European baseline series (Fragrance Mix II) for diagnostic patch testing of perfume allergy at concentrations up to 2.5 %. It is also tested individually at concentrations up to 5 % in petrolatum (Johansen et. al., 2011).

Import, Manufacture and Use

Australian

The chemical, 3-cyclohexene-1-carboxaldehyde, 4-(4-hydroxy-4-methylpentyl)-, has reported use in industrial and/or consumer cleaning products.

International

The following international uses have been identified through Galleria Chemica; the Substances and Preparations in Nordic countries (SPIN) database; the European Commission Cosmetic Ingredients and Substances (CosIng) database; the United States (US) Personal Care Products Council International Nomenclature of Cosmetic Ingredients (INCI) Dictionary, the US Household Products Database (HPD) and the International Fragrance Association (IFRA) Transparency List.

HICC has reported cosmetic and domestic use as a fragrance ingredient in perfumes (at a maximum concentration of 0.2 %) and in a wide range of personal care products (0.02–0.2 %) (SCCS, 2012). It is reported to be used as a substitute for another

fragrance allergen, hydroxycitronellal. Prior to restriction by the fragrance industry, it was reported to be used in concentrations of 3 % or more in fine fragrances as well as in many deodorants (Johansen et. al., 2011).

CAS No. 31906-04-4 is reported to be used in domestic products at concentrations up to 5 % (HPD).

Restrictions

Australian

No known restrictions have been identified.

International

HICC (CAS Nos 31906-04-4 and 51414-25-6) is listed on the following (Galleria Chemica):

- EU Cosmetics Regulation 2017/1410 Annex II—List of substances prohibited in cosmetic products; and
- Association of South East Asian Nations (ASEAN) Cosmetic Directive Annex II—List of substances which must not form part of the composition of cosmetic products

'From 23 August 2019 cosmetic products containing one or more of the substances prohibited by this Regulation shall not be placed on the Union market. From 23 August 2021 cosmetic products containing one or more of the substances prohibited by this Regulation shall be not be made available on the Union market' (European Parliament and Council, 2017).

Existing Worker Health and Safety Controls

Hazard Classification

The chemicals are not listed on the Hazardous Chemical Information System (HCIS) (Safe Work Australia).

Exposure Standards

Australian

No specific exposure standards are available.

International

No specific exposure standards are available.

Health Hazard Information

Data are available for the blend or for the major isomer (CAS No. 31906-04-4), and the test material often is not specified. Therefore unless otherwise indicated, the chemicals in this group will be referred to as ‘HICC’.

Toxicokinetics

No in vivo toxicokinetic studies are available. HICC is a lipophilic terpene-based aldehyde, synthesised from myrcenol and acrolein. The lipophilicity of HICC enables it to easily penetrate the skin and; therefore, dermal absorption is expected to be high (CLH, 2013; RAC, 2014). Due to having similar functional groups, HICC may have similar toxicological properties to cinnamaldehyde and benzaldehyde.

The chemicals have an electrophilic carbonyl group which is expected to bind to the nucleophilic amino groups of lysine residues on proteins via Schiff base formation. This reaction is independent of the position of the aldehyde group. The tertiary hydroxyl group of HICC is susceptible to acid-catalysed dehydration in vivo, forming an unsaturated bond with skin proteins giving a further mechanism for triggering allergic reactions (see **Skin sensitisation** section) (CLH, 2013).

In several in vitro studies, HICC has been found to cause photosensitisation via an oxygen-dependent mechanism. Following formation of a hapten-protein conjugate, re-exposure to HICC through the dermal route will elicit an inflammatory response. This mode of action indicates that it is unlikely that HICC will be available for circulation and will not be eliminated from the system. Repeated exposure to HICC also enables the build-up of reactive oxygen species (ROS) which may lead to depletion of Phase II detoxification enzymes (CLH, 2013).

In an in vitro human dermal absorption study, the overall dermal absorption values for HICC at 1.5 % in ethanol/water were 14.3 % (non-occluded) and 36.4 % (occluded) of the applied dose. As the values in this study were considered high for a hydroalcoholic formulation, absorption is assumed to be higher from its use in other cosmetic formulations (SCCS, 2011).

Acute Toxicity

Oral

HICC has low acute toxicity based on results from animal tests following oral exposure.

The reported median lethal dose (LD50) in rats is >5000 mg/kg bw. Observed sub-lethal effects included decreased activity, abnormal stance, prostration, piloerection, ptosis, flaccid body tone and vasodilatation (SCCS, 2011).

Dermal

HICC has low acute toxicity in animal tests following dermal exposure.

The reported dermal LD50 was >5000 mg/kg bw in rabbits. Skin irritation was observed in all treated rabbits (SCCS, 2011).

Inhalation

No data are available.

Corrosion / Irritation

Skin Irritation

HICC is a mild to moderate skin irritant in animal studies. Mild transient irritation was reported in humans. The effects are not sufficient to warrant hazard classification.

Data are available from six skin irritation tests in rabbits. Little to no irritation was reported in three primary irritation tests (duration not specified) and in one 24-hour open application test. In one primary irritation test, the undiluted HICC caused slight to moderate erythema and oedema in all treated animals, and skin cracking in 5/8 rabbits at 72 hours. In an acute dermal study, the undiluted HICC at 5000 mg/kg bw caused erythema ranging from slight (5/10 rabbits), moderate (4/10 rabbits) to severe (1/10 rabbits). Slight to moderate oedema was also reported in this study. No other information is available (SCCS, 2011).

HICC was evaluated in several pre-screening studies for the guinea pig maximisation test (GPMT). In some studies, irritation was observed at >0.5 % HICC in dodecylbenzene sulfonate(DOBS)/saline, and very slight irritation observed at ≥5 % in ethanol. No irritation was observed at 25 % and 50 % in an acetone/PEG/saline solution. When evaluated as part of a phototoxicity test, no irritation was observed up to 50 % HICC (SCCS, 2011).

Eye Irritation

Limited information is available. Reporting of the data is not sufficient to determine whether the chemicals warrant hazard classification. HICC is an eye irritant in rabbits at concentrations >0.4 %. The Scientific Committee on Consumer Safety (SCCS) concluded that despite being an eye irritant under the conditions of these studies in animals, HICC is not expected to be an irritant under anticipated exposure conditions in humans (SCCS, 2011).

In several eye irritation studies, effects including corneal opacity and swelling, conjunctival irritation with chemosis, discharge and iritis were observed when HICC was instilled into the eyes of rabbits at concentrations of 2 %, 5 %, 10 % or undiluted. No reactions were observed at a concentration of 0.4 %. No other details are available (SCCS, 2011).

Observation in humans

HICC was not irritating in several human patch test studies (24 and 48-hour exposures) in the majority of tested subjects at concentrations up to 20 %. In four 24-hour human repeated insult patch tests (HRIPT), mild and transient irritation was observed following exposure to fragrances that contained concentrations of HICC at >5 % (SCCS, 2011).

Sensitisation

Skin Sensitisation

Based on the high prevalence of allergic dermatitis in humans, hazard classification for skin sensitisation (Category 1A) is recommended. Animal data showed scattered incidences of sensitisation. However, there are many reported cases of skin allergy in humans due to widespread use of HICC in consumer products (see **Observation in humans** section).

Data are available for 3 guinea pig studies (2 maximisation tests and 1 intradermal test), and 1 mouse local lymph node study (LLNA) (SCCS, 2011).

In the LLNA, HICC was applied on the dorsal surface of the ears of female CBA mice (n=4/dose) at concentrations of 1 %, 2.5 %, 5 %, 10 % or 25 % in acetone/olive oil on 3 consecutive days. Sensitisation was observed. The stimulation index (SI) was reported to be 4.9 % for the highest concentration. The EC3 (effective concentration needed to produce a three-fold increase in lymphocyte proliferation) value was 17.1 %, indicative of a moderate sensitiser.

In a GPMT, albino Dunkin-Hartley guinea pigs (n = 10) were intradermally induced with 0.1 mL of a solution of 0.5 % HICC in Dobs/saline, followed by topical induction at 100 % concentration, a week after the injections. After a 2-week non-treatment period, the animals were challenged with occlusive patches of 100 % HICC for a 24-hour period. Observations were made at 1 and 2 days following patch removal. The animals were further challenged with 2 more applications at weekly intervals on alternate flanks. The second challenge application was at 100 % HICC, and the third challenge application was made with both undiluted and 10 % HICC in saline. No dermal reactions were observed at 10 % HICC, and 9/30 reactions were observed at 100 % HICC.

In another GPMT, female Dunkin-Hartley guinea pigs (n=5) were intradermally induced with 10 % HICC, followed by topical induction to 10 % HICC. The challenge concentrations were 5 %, 10 %, 20 % or 40 % HICC in a propylene glycol/acetone mixture. Reactions to HICC were observed in 4/5 guinea pigs at every challenge concentration.

In a guinea pig intradermal study (non-guideline), eight male guinea pigs were induced with a total of 10 injections of 0.1 % HICC in saline daily, and challenged at the same concentration. No reactions were observed at challenge.

Observation in humans

There are a large number of cases of skin sensitisation reported in humans, with more than 1500 cases reported in Europe from late 1990 to 2012 (SCCS, 2012). Many studies on HICC were conducted to investigate its role in induction and elicitation of contact dermatitis in humans.

Restrictions of the concentration of HICC to 200 ppm in finished consumer products was recommended by both the Scientific Committee on Cosmetic Products and Non-Food Products intended for Consumers (SCCNFP, 2003) and IFRA. A reduction in HICC allergy was not observed in Europe following implementation of these restrictions (Johansen, Frosch & Lepoittevin, 2011; CLH, 2013). Therefore, the SCCS concluded that HICC is an established contact allergen in humans and that repeated exposure to HICC is not safe, even at concentrations as low as 200 ppm. This is based on the exceptionally high number of reported cases of HICC allergy over a decade. The Committee proposed that it should not be used in all consumer products (SCCS, 2012).

Many case studies following exposure to HICC are available. Effects were reported at relatively low concentrations of HICC (100–6300 ppm, equivalent to 0.01–0.63 %) in consumer products. Consumers were repeatedly exposed to HICC due to the widespread use in consumer products (especially cosmetic products such as deodorants and creams) (CLH, 2013; RAC, 2014).

It was reported that HICC caused a high prevalence of allergic contact dermatitis as seen in diagnostic patch testing in several thousands of patients in different clinics. The average incidence of HICC sensitisation varied between 2– 3 % in dermatitis patients, with an average of 2.7 % in Europe (Johansen, Frosch & Lepoittevin, 2011; CLH, 2013). In many European diagnostic patch test studies for fragrance allergy, HICC (in the baseline series) has been tested at concentrations up to 5 % in petrolatum in several thousands of eczema or dermatitis patients. Among the fragrance ingredients tested, HICC showed the highest frequency of positive results in >2 % of the patients. Furthermore, it was observed that >70 % of these cases were of clinical relevance (CLH, 2013).

Repeated open application tests (ROAT) were conducted to confirm results of the patch test studies. Patients positive to 5 % HICC in petrolatum were patch tested with 0.0006–6 % HICC in ethanol. They were further subjected to use tests with cosmetic products containing 200, 600 or 1800 ppm HICC. In the patch tests, elicitation thresholds of 25 ppm and 610 ppm were identified on 10 % and 50 % of patients sensitised to HICC, respectively. In the use tests, around 64 % of the patients reacted to deodorants containing 200 ppm HICC. Therefore, it was concluded that the restricted level of HICC in consumer products at 200 ppm was not safe for patients who are allergic to HICC (CLH, 2013).

Repeated Dose Toxicity

Oral

Based on the available data, HICC is not considered to cause serious damage to health following repeated oral exposure.

In a 28-day repeat dose oral toxicity study (OECD TG 407), HICC was administered (gavage) to Sprague Dawley (SD) rats (n = 5/sex/dose) at doses of 0, 15, 150 or 1000 mg/kg bw/day in peanut oil. At the highest dose, both sexes showed respiratory symptoms, hunched posture, changes in haematological parameters, increased liver and kidney weights (absolute and relative), and histopathological changes in the liver (centrilobular inflammation and necrosis and hepatocyte enlargement). Additional effects were observed in male rats, including scattered incidences of staining and scab formation around the mouth, decreased body weight gain and food consumption, and histopathological changes in the kidney (increased density of the proximal tubular epithelium). At 150 mg/kg bw/day, changes in liver and kidney weights and haematological parameters were also observed but were considered by the authors as adaptive metabolic responses and of no toxicological relevance. The no observed adverse effect level (NOAEL) was determined as 150 mg/kg bw/day (SCCS, 2011).

In a preliminary range-finding toxicity study, HICC was administered (gavage) to SD rats (n = 3/sex/dose) at doses of 0, 500 or 1000 mg/kg bw/day in peanut oil. At the highest dose, minor effects such as decreased body weight gain was observed on day 4 only. No clinical signs, and changes in weight or histopathological parameters were observed at 500 mg/kg bw/day (SCCS, 2011). Based on the reported observations, the NOAEL is >1000 mg/kg bw/day in this study (SCCS, 2011).

In a one-generation reproductive toxicity study (see **Reproductive and developmental toxicity** section), SD rats (n = 24/sex/dose) were administered HICC orally at doses of 0, 25, 100 or 500 mg/kg bw/day in peanut oil. At the highest dose, mortality occurred in both sexes. Hunched postures, piloerection and tiptoe walking were observed in females at the last week of gestation. Reduced body weights were reported in males, and reduced food consumption observed in females. The NOAEL was determined as 100 mg/kg bw/day (SCCS, 2011).

Dermal

No data are available.

Inhalation

No data are available.

Genotoxicity

Based on the available data, HICC is not considered to be genotoxic.

The following results were reported in in vitro assays (SCCS, 2011):

- negative results in bacterial reverse mutation assays (OECD 471) with strains of *Salmonella typhimurium* (TA1535, TA1537, TA98, TA100 and TA1538) and *Escherichia coli* WP2 *uvrA* up to 5000 µg/plate, with and without metabolic activation; and
- HICC induced chromosomal aberrations in Chinese hamster ovary (CHO) cells up to 900 µg/mL, with metabolic activation.

HICC was not genotoxic in an in vivo mammalian erythrocytes micronucleus test (OECD TG 474) in ICR mice. The animals were orally administered HICC at 0, 225, 450 or 900 mg/kg bw. Erythrocytes were collected at 24 hours or 48 hours for both controls and the highest dose. A dose dependent decrease in the polychromatic and total erythrocytes (PCE/TE) ratio was observed, indicating bioavailability of HICC to the bone marrow cells. No increase in the number of micronucleated PCE was observed compared with controls (SCCS, 2011).

Carcinogenicity

No data are available.

Reproductive and Developmental Toxicity

Based on the available reproductive toxicity studies, there is evidence that HICC may cause adverse effects via lactation at high doses and therefore, hazard classification is warranted (see **Recommendation** section).

In a one-generation reproductive toxicity study (OECD TG 415), SD rats (n = 24/sex/dose) were administered HICC orally at doses of 0, 25, 100 or 500 mg/kg bw/day in peanut oil. At the highest dose, litter loss between birth and postnatal day (PND) 1 occurred in six females. Clinical toxicity effects were observed (see **Repeated dose toxicity** section). At ≥100 mg/kg bw/day, increased duration of gestation was observed. There were no effects on female oestrus cycles, mating or fertility, gestation or parturition indices. For the offspring, reduced body weights and retardation in ossification in the high dose group were observed. At ≥100 mg/kg bw/day, skin sloughing, ridges along the tail, swollen ears, premature opening of eyes and sparse fur coverage were observed. Skin effects including acanthosis and hyperkeratosis were also observed in litters at ≥100 mg/kg bw/day several days after birth, but these effects were reversible after skin shedding. The NOAEL for maternal and developmental toxicity was considered to be 25 mg/kg bw/day (SCCS, 2011).

A subsequent study was conducted for further evaluation of HICC potentially affecting dermal development, due to the observed skin effects in the offspring. Groups of SD rats were administered the chemical at 0 or 500 mg/kg bw/day during gestation or

throughout lactation. The dose of 500 mg/kg bw/day was confirmed to be toxic to both dams and pups, causing effects such as dystocia (obstructed labour), haematological parameter changes, perinatal mortality in pups, reduced live litter size and transient skin flaking. Skin effects were observed to be progressively severe and were irreversible by the end of the treatment period. The authors suggested that the observed skin effects in pups from dams treated at 500 mg/kg bw/day are postnatal effects, and are probably due to residual HICC in maternal milk (SCCS, 2011).

In another follow-up study, female SD rats were orally administered HICC at 10, 25 or 500 mg/kg bw/day from day 1 to day 21 of lactation. There were no adverse effects in the dams, except for a transient decrease in maternal body weight gain and feed consumption. For the F1 generation, postweaning deaths and skin peeling were observed at the highest dose and considered due to maternal treatment with HICC. HICC was detected in the milk of dams treated at 500 mg/kg bw/day at an average concentration of 73.5 ng/mL and 59.85 ng/mL on day 14 and day 21 postpartum, respectively. HICC was not identified in the milk of dams at lower doses (SCCS, 2011).

These studies have shown that HICC has potential to cause adverse effects on the offspring via lactation.

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include local effects (skin sensitisation).

HICC may cause adverse effects to the offspring via lactation at very high doses (500 mg/kg bw/day). However, oral exposure of humans to the chemical at this dose is not expected.

Public Risk Characterisation

Although use in cosmetic and domestic products in Australia is not known, HICC is reported to be used in cosmetic products overseas at concentrations up to 0.2 %, and in domestic products up to 5 % .

In Australia, the chemical, 3-cyclohexene-1-carboxaldehyde, 4-(4-hydroxy-4-methylpentyl)- is reported to be used in industrial and/or consumer cleaning products. Currently, there are no restrictions in Australia on using HICC in cosmetics or domestic products. The European Union and ASEAN have restricted the use of HICC in cosmetics (see **Restrictions: International** section).

Considering the range of domestic, cosmetic and personal care products that may contain HICC, the main route of public exposure is expected to be through dermal exposure. In the absence of further regulatory controls, the characterised critical health effect (skin sensitisation) has the potential to pose an unreasonable risk under the identified uses.

Occupational Risk Characterisation

During product formulation, dermal 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 local health effects, the chemicals could pose an unreasonable risk to workers unless adequate control measures to minimise dermal 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.

The data available support an amendment to the hazard classification in the HCIS (Safe Work Australia) (see **Recommendation** section).

NICNAS Recommendation

Further risk management is required. Sufficient information is available to recommend that risks to public health and safety from the potential use of HICC in cosmetics and/or domestic products be managed through changes to poisons scheduling, and risks for workplace health and safety be managed through changes to classification and labelling.

Assessment of HICC is considered to be sufficient provided that risk management recommendations are implemented and all requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Regulatory Control

Public Health

Due to the toxicity profile at concentrations reported to be potentially in use, HICC is recommended to be included in the *Poisons Standard*—the *Standard for the Uniform Scheduling of Medicines and Poisons* (SUSMP) to preclude the sale, supply and use in cosmetic products. Matters to be taken into consideration include:

- the use of HICC as a fragrance ingredient in a wide range of cosmetic and domestic products, although there is no information to confirm that HICC is currently used in cosmetic products in Australia;
- HICC is an established skin sensitiser and common contact allergen in humans;
- the SCCS concluded that HICC is an established contact allergen in humans and that repeated exposure to HICC is not safe even at concentrations as low as 200 ppm, based on the exceptionally high number of reported cases of HICC allergy over a decade; and
- HICC is prohibited for cosmetic use overseas. The restrictions on the use of HICC in cosmetic products in the EU and ASEAN (see **Restrictions: International** section) are considered appropriate, for Australia, to mitigate the potential risks associated with the use of HICC in cosmetics.

Work Health and Safety

The chemicals are recommended for classification and labelling aligned with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) as below. This does not consider classification of physical hazards and environmental hazards.

From 1 January 2017, under the model Work Health and Safety Regulations, chemicals are no longer to be classified under the Approved Criteria for Classifying Hazardous Substances system.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Sensitisation	Not Applicable	May cause an allergic skin reaction - Cat. 1A (H317)
Reproductive and Developmental Toxicity	Not Applicable	May cause harm to breast-fed children (H362)

[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 HICC should be used according to the instructions on the label.

Advice for industry

Control measures

Control measures to minimise the risk from dermal 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 that could minimise the risk include, but are not limited to:

- health monitoring for any worker who is at risk of exposure to the chemical, 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 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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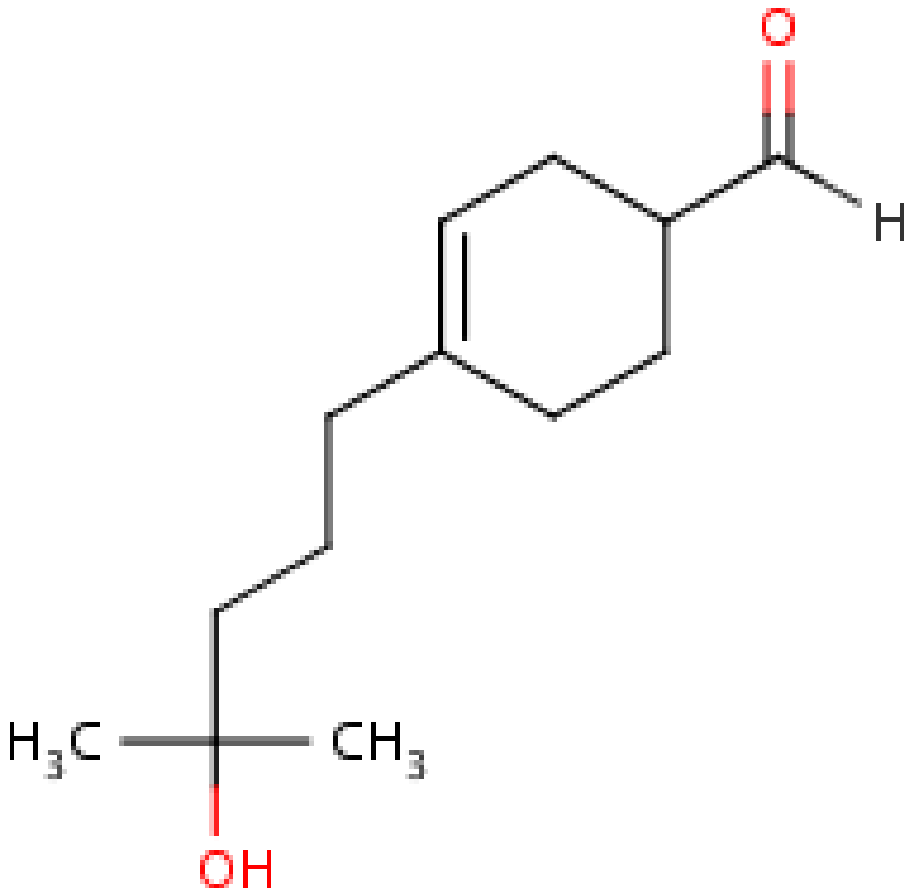
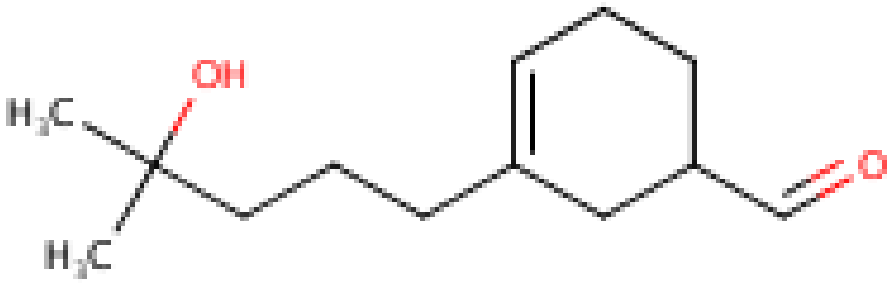
Last Update 26 October 2018

Chemical Identities

Chemical Name in the Inventory and Synonyms	**3-Cyclohexene-1-carboxaldehyde, 4-(4-hydroxy-4-methylpentyl)-** lyral liral 4-(4-hydroxy-4-methylpentyl)-3-cyclohexene-1-carboxaldehyde HICC
CAS Number	31906-04-4
Structural Formula	

	
Molecular Formula	C13H22O2
Molecular Weight	210.32

Chemical Name in the Inventory and Synonyms	**3-Cyclohexene-1-carboxaldehyde, 3-(4-hydroxy-4-methylpentyl)-** 3-(4-hydroxy-4-methylpentyl)cyclohex-3-ene-1-carbaldehyde HICC
CAS Number	51414-25-6
Structural Formula	

	
Molecular Formula	C13H22O2
Molecular Weight	210.32

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