Ethoxylates of aliphatic alcohols (>C6): Human health tier II assessment

12 December 2019

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Ethanol, 2-[2-(hexyloxy)ethoxy]-	112-59-4
Ethanol, 2-[2-(dodecyloxy)ethoxy]-	3055-93-4
Ethanol, 2-[2-[2-(dodecyloxy)ethoxy]ethoxy]-	3055-94-5
3,6,9,12,15-Pentaoxaheptacosan-1-ol	3055-95-6
3,6,9,12,15,18,21-Heptaoxatritriacontan-1-ol	3055-97-8
Ethanol, 2-(dodecyloxy)-	4536-30-5
3,6,9,12-Tetraoxatetracosan-1-ol	5274-68-0
Poly(oxy-1,2-ethanediyl), .alpha.-9-octadecenyl-.omega.-hydroxy-	25190-05-0
Poly(oxy-1,2-ethanediyl), .alpha.-hexadecyl-.omega.-hydroxy-, mixture with .alpha.-octadecyl-.omega.-hydroxypoly(oxy-1,2-ethanediyl)	8065-80-3

Chemical Name in the Inventory	CAS Number
Poly(oxy-1,2-ethanediyl), .alpha.-hexadecyl-.omega.-hydroxy-, mixture with (Z)-.alpha.-9-octadecenyl-.omega.-hydroxypoly(oxy-1,2-ethanediyl)	8065-81-4
Poly(oxy-1,2-ethanediyl), .alpha.-dodecyl-.omega.-hydroxy-	9002-92-0
Poly(oxy-1,2-ethanediyl), .alpha.-hexadecyl-.omega.-hydroxy-	9004-95-9
Poly(oxy-1,2-ethanediyl), .alpha.-(9Z)-9-octadecen-1-yl-.omega.-hydroxy-	9004-98-2
Poly(oxy-1,2-ethanediyl), .alpha.-octadecyl-.omega.-hydroxy-	9005-00-9
Poly(oxy-1,2-ethanediyl), .alpha.-isotridecyl-.omega.-hydroxy-	9043-30-5
Poly(oxy-1,2-ethanediyl), .alpha.-hexyl-.omega.-hydroxy-	31726-34-8
Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-	24938-91-8
Poly(oxy-1,2-ethanediyl), .alpha.-decyl-.omega.-hydroxy-	26183-52-8
Poly(oxy-1,2-ethanediyl), .alpha.-(2-ethylhexyl)-.omega.-hydroxy-	26468-86-0
Poly(oxy-1,2-ethanediyl), .alpha.-octyl-.omega.-hydroxy-	27252-75-1
Poly(oxy-1,2-ethanediyl), .alpha.-tetradecyl-.omega.-hydroxy-	27306-79-2
1-Octadecanol, polymer with ethylene oxide	31943-12-1
Poly(oxy-1,2-ethanediyl), alpha-(2-octyldodecyl)-omega-hydroxy-	32128-65-7
Alcohol, straight chain, modified polyethoxylate	37281-47-3
9-Octadecen-1-ol, (Z)-, polymer with oxirane	37702-39-9

Chemical Name in the Inventory	CAS Number
Poly(oxy-1,2-ethanediyl), .alpha.-nonyl-.omega.-hydroxy-	39587-22-9
Poly(oxy-1,2-ethanediyl), .alpha.-isooctadecyl-.omega.-hydroxy-	52292-17-8
Poly(oxy-1,2-ethanediyl), .alpha.-isooctyl-.omega.-hydroxy-	61723-78-2
Alcohols, C6-12, ethoxylated	68439-45-2
Alcohols, C9-11, ethoxylated	68439-46-3
Alcohols, C16-18, ethoxylated	68439-49-6
Alcohols, C12-14, ethoxylated	68439-50-9
Alcohols, C11-13-branched, ethoxylated	68439-54-3
Alcohols, coco, ethoxylated	61791-13-7
Alcohols, tallow, ethoxylated	61791-28-4
Poly(oxy-1,2-ethanediyl), .alpha.-isodecyl-.omega.-hydroxy-	61827-42-7
Alcohols, C13-15, ethoxylated	64425-86-1
Alcohols, C12-13, ethoxylated	66455-14-9
Alcohols, C10-14, ethoxylated	66455-15-0
Alcohols, C16-22, ethoxylated	69227-20-9
Alcohols, C10-12, ethoxylated	67254-71-1
Alcohols, C10-16, ethoxylated	68002-97-1
Alcohols, C12-15, ethoxylated	68131-39-5
Alcohols, C11-15-secondary, ethoxylated	68131-40-8
Alcohols, C16 and C18-unsaturated, ethoxylated	68155-01-1

Chemical Name in the Inventory	CAS Number
Alcohols, C12-18, ethoxylated	68213-23-0
Alcohols, C12-20, ethoxylated	68526-94-3
Alcohols, C12-16, ethoxylated	68551-12-2
Alcohols, C>30, ethoxylated	97953-22-5
Alcohols, C16-18 and C18-unsaturated, ethoxylated	68920-66-1
Alcohols, C7-21, ethoxylated	68991-48-0
Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-, branched	69011-36-5
Alcohols, C8-22, ethoxylated	69013-19-0
Alcohols, C6-10, ethoxylated	70879-83-3
Alcohols, C8-10, ethoxylated	71060-57-6
Alcohols, C8-16, ethoxylated	71243-46-4
Alcohols, C9-11-iso-, C10 rich, ethoxylated	78330-20-8
Alcohols, C11-14-iso-, C13 rich, ethoxylated	78330-21-9
Alcohols, C12-C14-secondary, ethoxylated	84133-50-6
Alcohols, C10-18, ethoxylated	85422-93-1
Alcohols, C12-20 and C12-20-unsaturated, ethoxylated	106232-81-9
Alcohols, C16-20, ethoxylated	106232-82-0
Alcohols, C12-15-branched and linear, ethoxylated	106232-83-1
Alcohols, C18-22-alkyl, ethoxylated	116810-32-3
Alcohols, C14-15-branched and linear, ethoxylated	120944-68-5

Chemical Name in the Inventory	CAS Number
Alcohols, C10-12-secondary, ethoxylated	125736-52-9
Alcohols, C14-18 and C16-18-unsaturated, ethoxylated	126646-02-4
Poly(oxy-1,2-ethanediyl), .alpha.-undecyl-.omega.-hydroxy-,branched and linear	127036-24-2
Poly(oxy-1,2-ethanediyl), .alpha.-isohexadecyl-.omega.-hydroxy-	69364-63-2

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**

Disclaimer

NICNAS has made every effort to assure the quality of information available in this report. However, before relying on it for a specific purpose, users should obtain advice relevant to their particular circumstances. This report has been prepared by NICNAS using a range of sources, including information from databases maintained by third parties, which include data supplied by industry. NICNAS has not verified and cannot guarantee the correctness of all information obtained from those databases.

ACRONYMS & ABBREVIATIONS

Grouping Rationale

This assessment replaces previous assessments for ethoxylates of aliphatic alcohols (C =6) or alcohol ethoxylates (AEs). It is conducted in conjunction with the other IMAP Human Health Tier II assessments for mixed alkoxylates and propoxylates of aliphatic alcohols (C =6) (NICNASa; NICNASb). Three assessments in this series are based on the analogue and chain-length category approach (OECD, 2014), including structure-activity relationship (SAR) analyses of these chemicals and their physiochemical, toxicokinetic and toxicological profiles. The SAR information available for AEs is specified where applicable.

Although most AEs in this group are polymers according to the definition in the National Industrial Chemicals (Notification and Assessment) Act (1989), the individual members do not necessarily meet the criteria for polymers of low concern (please refer to NICNAS PLC criteria available at nicnas.gov.au), based on molecular weight (MW).

These AE polymers share similar uses as nonionic surfactants in cosmetic, domestic and commercial products, including in laundry detergents, household and industrial cleaners (see **Import, Manufacture & Use** section).

The AEs in this assessment are structurally related, where the hydrophilic ethylene oxide (EO) chain is attached via an ether linkage to the hydrophobic aliphatic alcohol chain (C =6). The alkyl chain can be linear, branched, saturated or unsaturated in the AE group. Ethoxylated shorter chain alcohols (C <6) do not show the same degree of surface activity compared with longer chains, and hence they are not included in this assessment.

A generic structural formula of the AE is shown below:

$H–(CH2)_{x–y}–(OCH_2CH_2)_n–OH$

where n = average number of ethylene oxide (EO) units

x–y = range of carbon units (C =6)

A simpler notation of '$C_{x–y}EO_n$' will be used to represent the corresponding AEs in this assessment.

Generally, increasing the carbon chain length increases lipophilicity, whereas increasing alkoxylation increases hydrophilicity of the chemical. These trends are consistent across the linear, branched, saturated or unsaturated AEs of varying alkyl chain lengths and ethoxylation degrees (Lindner, 2010). It was demonstrated that branching of the AEs had a relatively minor impact on calculated partition coefficients (K_{ow}), and hence their biological properties (Lindner, 2010). Further, for unsaturated AEs, as the point of unsaturation is generally remote from the carbon where the EO chain is attached, they are expected to have similar physiochemical properties to saturated AEs.

The AEs in this assessment have been shown to have similarities or trends in their toxicokinetic and toxicological profiles, although the alkyl chain length (whether linear, branched, saturated or unsaturated) and ethoxylation degree vary (see **Health Hazard Information** section). For this AE group, SARs were reported between the degree of ethoxylation and the acute toxicity (direct) and skin irritation (inverse).

On the basis of the analogue and chain-length category approach (i.e. by considering similarities and trends in molecular structure, physiochemical properties (K_{ow}), uses, and hazard profiles), the AEs in this assessment are qualified to be assessed as a group. Based on such trend analyses, the available datasets for AEs ranging from C6–C18 and EO3–EO12 were considered representative of the AE category for filling data gaps (HERA, 2009; Lindner, 2010). Available data for any AEs will be applicable to group members where data are incomplete or unavailable, such as for ethoxylates of coco, tallow, and C >20 alcohols.

Overall, AEs are not expected to be systemically toxic, although some short chain ethylene glycol ethers, e.g. methyl and ethyl homologues are of concern for a range of adverse health effects. They include skin and eye irritation, liver and kidney damage, bone marrow and central nervous system (CNS) depression, testicular atrophy, developmental toxicity, and immunotoxicity. For higher propyl and butyl homologues, the toxicity involves haemolysis (anaemia) with secondary effects relating to haemosiderin accumulation in the spleen, liver and kidney, and compensatory haematopoiesis in the bone marrow. Systemic toxicity was shown to decrease with increasing alkyl chain lengths and/or alkoxylation degrees (ECETOC, 2005; US EPA, 2010). The chemicals ethylene glycol hexyl ether (with a longer alkyl chain length, CAS No. 112-25-4) and diethylene glycol butyl ether (with a higher ethoxylation degree, CAS No. 112-34-5) have no evidence of systemic effects including haemolysis (ECETOC, 2005; NICNASc).

Commercially available AEs are mixtures of homologues of varying carbon chain lengths and it is possible that some of the chemicals with an average alkyl chain length C =6 may also contain shorter alkyl chains C <6. It is not practical to quantify the proportion of shorter C <6 chain lengths present in such chemicals, or these shorter chain lengths may not be present at all. The available data suggest a lack of systemic toxicity for the AE chemicals with potential short alkyl chain presence; therefore, the toxicity of the chemicals in this assessment is unlikely to be significantly affected by the presence of shorter chain alkyl groups.

Import, Manufacture and Use

Australian

The Australian industrial uses below were reported under previous mandatory and voluntary calls for information.

Polyethylene glycol (PEG) isocetyl ether (CAS No. 69364-63-2) has reported cosmetic uses in leave on and rinse off products.

The following chemicals have reported domestic uses as cleaning and washing agents, and additives:

- alcohols, C10-16, ethoxylated (CAS No. 68002-97-1)
- alcohols, C12-15, ethoxylated (CAS No. 68131-39-5)

The following chemicals have reported domestic and commercial uses:

Pigment dispersers or emulsifiers in paints (up to 0.2 %) and tinctures (up to 3 %)

- alcohols, C11-14-iso-, C13 rich, ethoxylated (CAS No. 78330-21-9)
- alcohols, C11-15-secondary, ethoxylated (CAS No. 68131-40-8)
- alcohols, C12-C14-secondary, ethoxylated (CAS No. 84133-50-6)
- dodecan-1-ol, ethoxylated (CAS No. 9002-92-0)
- isotridecanol, ethoxylated (CAS No. 69011-36-5)
- alcohols, C16-18, ethoxylated (CAS No. 68439-49-6)
- alcohols, C16-18 and C18-unsaturated, ethoxylated (CAS No. 68920-66-1)
- (Z)-9-octadecen-1-ol ethoxylated (CAS No. 9004-98-2).

Adhesives, sealants and cleaning products

- alcohols, C6-12, ethoxylated (CAS No. 68439-45-2)
- alcohols, C9-11, ethoxylated (CAS No. 68439-49-6)
- alcohols, C12-C14-secondary, ethoxylated (CAS No. 84133-50-6)
- alcohols, C12-18, ethoxylated (CAS No. 68213-23-0)

Coatings

- alcohols, C12-C14-secondary, ethoxylated (CAS No. 84133-50-6)
- octadecan-1-ol, ethoxylated (CAS No. 9005-00-9)

Automotive aftermarket products including waxes and rubbing compounds

- alcohols, C9-11-iso-, C10 rich, ethoxylated (CAS No. 78330-21-9)
- dodecan-1-ol, ethoxylated (CAS No. 9002-92-0)
- alcohols, C16-18, ethoxylated (CAS No. 68439-49-6)

The chemical PEG isodecyl ether (CAS No. 61827-42-7) has reported commercial use as a lubricant and additive.

No specific Australian use, import, or manufacturing information has been identified for other chemicals.

International

The following international uses have been identified through the European Union (EU) Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) dossiers; Galleria Chemica; the European Commission Cosmetic Ingredients and Substances (CosIng) database; Substances in Preparations in Nordic Countries (SPIN) database; the United States (US) National Library of Medicine Household Products Database; United States (US) Personal Care Products Council International Nomenclature Cosmetic Ingredients (INCI) dictionary; and other international assessments (HERA, 2009; CIR, 2012) .

The chemicals have reported use as nonionic surfactants. Generally, chemicals with fewer ethoxylate units function as emulsifying agents and, as the number of units increases, they function as solubilising or cleansing agents (CIR, 2012).

Some of the chemicals have additional functions as emulsion stabilisers, fragrance or skin-conditioning agents in cosmetic products.

Most AEs have reported cosmetic uses in:

- rinse off (=32 %) and leave on (=25 %) products
- odour agents

Some of the chemicals have reported cosmetic uses in baby products (CIR 2012). The concentration used in these products ranges from 0.03 to 4 %.

The chemicals have reported domestic uses in:

- cleaning and washing agents (up to 50 %)
- hard surface cleaners (up to 40 %)
- colouring agents
- paints, lacquers and varnishes
- preservatives
- softeners

The chemicals have reported commercial uses in:

- cutting fluids
- process regulators

The chemicals have reported site-limited uses as complexing and flocculating agents.

Some of the chemicals have reported non-industrial uses in:

- pesticides
- food additives
- pharmaceuticals

Restrictions

Australian

The chemicals in this group are synthesised through processes which may result in 1,4-dioxane as an impurity. This impurity (listed under dioxane) is controlled through the Poisons Standard (the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP)) in Schedule 6, with schedule labelling requirements applying above 100 ppm in Appendix G (SUSMP October 2019).

International

No known restrictions have been identified.

Existing Worker Health and Safety Controls

Hazard Classification

The following chemicals:

- alcohols, C6-12, ethoxylated (CAS No. 68439-45-2)
- poly(oxy-1,2-ethanediyl), .alpha.-isodecyl-.omega.-hydroxy- (CAS No. 61827-42-7)
- alcohols, C12-13, ethoxylated (CAS No. 66455-14-9)
- alcohols, C12-14, ethoxylated (CAS No. 68439-50-9)
- alcohols, C12-15, ethoxylated (CAS No. 68131-39-5)
- alcohols, C12-18, ethoxylated (CAS No. 68213-23-0)
- alcohols, C12-16, ethoxylated (CAS No. 68551-12-2)
- alcohols, C13-15, ethoxylated (CAS No. 64425-86-1)

are classified as hazardous on the Hazardous Chemicals Information System (HCIS), with the hazard categories and hazard statements for human health (Safe Work Australia):

- Acute Toxicity – Category 4; H302 (Harmful if swallowed)
- Skin Irritation – Category 2; H315 (Causes skin irritation)
- Eye Damage – Category 1; H318 (Causes serious eye damage)

The chemical ethanol, 2-[2-(hexyloxy)ethoxy]- (CAS No. 112-59-4) is listed on the HCIS with the following human health hazard categories and statements:

- Acute Toxicity – Category 4; H302 (Harmful if swallowed)
- Eye Damage – Category 1; H318 (Causes serious eye damage)

The chemical poly(oxy-1,2-ethanediyl), alpha-isohexadecyl-omega-hydroxy- (CAS No. 69364-63-2) is listed on the HCIS with the following human health hazard categories and statements:

- Skin Irritation – Category 2; H315 (Causes skin irritation)
- Eye Irritation – Category 2B; H320 (Causes eye irritation)

Exposure Standards

Australian

No specific exposure standards are available.

International

No specific exposure standards are available.

Health Hazard Information

The AEs in this group contain two defining substructures, the hydrophobic alcohol derived alkyl chain moiety and the hydrophilic ethoxylate chain moiety. Chemicals with the same generic CAS number may include a range of ethoxylation degrees and properties, which may affect the toxicological properties. Where the average number of EO units was stated in a study, this is noted.

Overall, AEs are not expected to be systemically toxic (refer to **Grouping Rationale** section). The available datasets for AEs ranging from C6–C18 and EO3–EO12 were considered representative of the AE category.

Toxicokinetics

Based on the animal and human data available for AEs with C12–C15 and EO3–EO10, the AEs in this assessment (whether linear, branched, saturated or unsaturated) are expected to be absorbed, metabolised and excreted in the urine, faeces and in expired air with minimal tissue distribution, following oral and parental exposure. Excretion following dermal absorption is primarily via the urine.

Oral absorption was rapid and extensive (>75 %) while dermal absorption was slow and incomplete with a lower penetration rate for human skin than for rat skin. The AEs with shorter alkyl and/or EO chains (or smaller MW) are expected to more readily absorbed (orally and dermally) than longer ones (or larger MW). Some AEs may enhance penetration of other ingredients through the skin due to their surfactant properties. The overall distribution and excretion were similar across AEs, regardless of their chain lengths. Metabolism is predicted to comprise hydrolysis of the ether linkage followed by oxidation of the alkyl chain to form lower molecular weight PEG-like compounds, and ultimately carbon dioxide (CO_2) and water, although no metabolic studies were available. Metabolism was found to correlate to the chemical chain lengths, resulting in a higher proportion excreted in expired air (with longer alkyl chains) and/or in the faeces (with longer ethoxylate chains) and less in the urine (SCCP, 2007; HERA, 2009; CIR, 2012; CIR, 2016).

In rats:

The chemicals $C_{12}EO_3$, $C_{12}EO_6$ and $C_{12}EO_{10}$ were completely absorbed (~100 %) and excreted (~95 %) with minimal tissue distribution (~5 %) 4 days after oral, intraperitoneal or subcutaneous exposure. Recovery of ^{14}C was largely in the urine as polar metabolites (no parent compound), with small proportions present in the faeces and in expired air ($^{14}CO_2$). An increased proportion of faecal ^{14}C for AEs with longer EO chains suggests biliary excretion. Dermal absorption of AEs occurred more readily with shorter EO chains than longer ones (SCCP, 2007; HERA, 2009).

Absorption, distribution, metabolism and excretion of $C_{13}EO_6$ (branched) and $C_{15}EO_7$ (branched) versus $C_{12}EO_6$ (linear) were comparable. Recovery was predominately in the urine (52–55 %) and smaller amounts in the faeces (23–27 %) and expired CO_2 (2–3 %) (SCCP, 2007; HERA, 2009).

For a longer AE $C_{14–18}EO_{10}$ (linear), excretion was almost equally split between the urine and faeces (~40–50 %) and similar to shorter AEs in the air (2 %), 72 hours after oral exposure, regardless of dose. Distribution to the liver and kidney was low (SCCP, 2007; HERA, 2009).

For $C_{12–15}EO_6$ and $C_{12–15}EO_7$, oral absorption was rapid and extensive (>75 %) while dermal absorption was slow and incomplete (~50 %) after 72 hours. Excretion and distribution were similar to the AEs above (SCCP, 2007; HERA, 2009).

In another study, dermal absorption of AEs with short chains (C8–C14 and EO3–EO7) was more rapid than with longer chains (>C14 and >EO7) (SCCP, 2007; HERA, 2009).

In humans:

The 2 chemicals, $C_{12}EO_6$ (linear) and $C_{13}EO_6$ (branched) were readily absorbed, metabolised and rapidly excreted in the urine (75 %), faeces (5 %) and expired air (4 %) within 24 hours of a single oral dosing. The chemicals were not bioaccumulative in the body with the blood levels of <1 % of the administered dose. This toxicokinetic profile is comparable with those of the rat, including the increasing metabolism into expired air with longer alkyl chain lengths (SCCP, 2007; HERA, 2009).

Absorption of $C_{12}EO_6$ through human skin occurred less readily than through rat skin. Distribution was barely detectable and excretion was mainly via the urine (1.82 % of the administered dose after 144 hours) (SCCP, 2007; HERA, 2009).

Acute Toxicity

Oral

Some of the AEs in this group are currently classified with hazard category ‘Acute Toxicity – Category 4’ and hazard statement ‘H302 Harmful if swallowed’ in the HCIS (refer to the **Existing Work Health and Safety Controls** section). Based on the available animal data and international reviews, the AEs in this group are expected to have low to moderate acute oral toxicity. The toxicity appears to correlate with the degree of ethoxylation (highest for EO5–EO14) and is unlikely to be greatly affected by the alkyl chain length (HERA, 2009; REACHa-h). Unless data for the specific chemical are available to indicate otherwise, moderate acute oral toxicity cannot be ruled out and hazard classification is recommended for the remaining chemicals in this group (refer to the **Recommendation** section).

The oral median lethal dose (LD50) values in rats ranged from 600 mg/kg bw ($C_{15–16}EO_{10}$, $C_{14–15}EO_{11}$) to 10000 mg/kg bw ($C_xEO_{1–3}$, $C_xEO_{>15}$). The discrepancy in study results was attributable to variations in EO chain lengths and study designs. No relationship between the alkyl chain length and acute oral toxicity was observed (HERA, 2009).

At necropsy, congestion of the lung, liver and kidney, haemorrhage of the gastric mucosa, and gastrointestinal irritation (e.g. stomach ulcerations) were observed, particularly after administration of a bolus dose or undiluted chemicals (HERA, 2009).

Dermal

Based on the available data, the AEs in this group are expected to have low acute dermal toxicity. No structural relationship was evident between the AEs and acute dermal toxicity.

In rabbits, the dermal LD50s were between 2000 to 5000 mg/kg bw. In rats, the dermal LD50 values ranged from >800 mg/kg bw ($C_{13–15}EO_{10}$, $C_{13–15}EO_{11}$) to >5000 mg/kg bw. At necropsy, haemorrhage of subcutaneous tissues and hyperaemia of the small intestine were observed (SCCP, 2007; HERA, 2009).

At high doses (>16000 mg/kg bw after a 24-hour dermal application), AEs caused severe skin irritation, ataxia and lung lesions in rabbits (HERA, 2009; CIR, 2012).

Inhalation

Based on the available data, the AEs in this group are expected to have low acute inhalation toxicity.

In a study compliant with OECD Test Guideline (TG) 403 (Acute Inhalation Toxicity), a single static 6-hour exposure to substantially saturated vapour (131.58 ppm) of C_6EO_2 (CAS No. 112-59-4) resulted in no mortality or other signs of toxicity in rats (REACHa).

In a non-guideline study, a median lethal concentration (LC50) of greater than 0.22 mg/L was reported for $C_{9–11}EO_5$ following 4-hour inhalation as a mist in rats. Other studies reported LC50 values from 1.5 to 20.7 mg/L, indicating that acute toxic thresholds were reached when rats were exposed to undiluted AEs in the form of respirable mists or aerosols, or at concentrations exceeding the saturated vapour pressure in air. At necropsy, corneal opacity, congestion and mottling of the lung, liver and kidney and adrenals were observed (HERA, 2009).

Corrosion / Irritation

Respiratory Irritation

Inhalation of droplets and/or particles (aerodynamic diameters <10 μm) released from the aerosolised products of these surfactant chemicals may cause respiratory irritation and consequent damage to the lung through prolonged or repeated exposure (NICNASa).

Skin Irritation

Some of the AEs in this group are currently classified with hazard category ‘Skin Irritation – Category 2’ and hazard statement ‘H315 Causes skin irritation’ in the HCIS (refer to the **Existing Work Health and Safety Controls** section). Based on the available data, this hazard classification is recommended for the remaining chemicals in the group (unless data for the specific chemical are available to indicate otherwise) (refer to the **Recommendation** section).

Overall, the degree of irritation was reported to be dependent on the type of patch (open vs vs semi-occluded vs occluded), exposure time (4 hours to 4 weeks), single vs repeated applications, and the concentration used. The chemicals were moderately to severely irritating at 100 %, slightly to moderately irritating at 10 %, mildly irritating at 1 %, and non-irritating at 0.1–0.5 %. The severity of irritation appears to inversely correlate with the degree of ethoxylation (i.e. more severe irritation for lower ethoxylation EO1–EO3) and is unlikely to be greatly affected by the alkyl chain length (HERA, 2009).

In a number of OECD TG 404 (Acute Dermal Irritation/Corrosion) compliant tests, AEs of varying chain lengths were applied undiluted to intact rabbit skin for 4 hours under fully occluded conditions. The chemicals ranged from slightly irritating ($C_{11}EO_9$, $C_{12–14}EO_{15}$, $C_{13}EO_{20}$), moderately irritating ($C_{12–14}EO_{10}$, $C_{13}EO_6$, $C_{13}EO_{5–6.5}$) to extremely irritating ($C_{12–14}EO_6$, $C_{12–14}EO_3$, $C_{13}EO_3$). The skin reactions from slightly irritating chemicals reversed by 6 days after exposure, and those from moderately to severely irritating chemicals persisted up to 14 days of the observation period. The data suggest a possible trend between

irritation and degree of ethoxylation, i.e. AEs with lower EO units are likely more irritating than those with higher number of EO units (HERA, 2009).

After 24-hour occlusive application, the following AEs (undiluted) were moderately to severely irritating. For the same C12–13 alkyl length, AEs with EO3 were severely irritating while those with EO7 were mildly to severely irritating. Dilutions of these AEs were slightly to moderately irritating at 10 %, slightly irritating at 1 %, and minimally to non-irritating at 0.1 % (CIR, 2012):

CAS No. 68439-46-3 ($C_{9–11}EO_{5–8}$)

CAS No. 66455-14-9 ($C_{12–13}EO_{7}$)

CAS No. 68131-39-5 ($C_{12–15}EO_{7–9}$)

CAS No. 68951-67-7 ($C_{14–15}EO_{7–13}$; not listed on the Inventory)

Dilutions (1–10 %) of $C_{9–11}EO_{8}$, $C_{12–15}EO_{7}$, and $C_{14–15}EO_{7–18}$ caused mild to severe irritation in guinea pigs and rabbits after repeated application (5 times a week) over 4 and a half weeks (HERA, 2009).

Eye Irritation

Some of the AEs in this group are currently classified with hazard category ‘Eye Damage – Category 1’ and hazard statement ‘H318 Causes serious eye damage’ in the HCIS (refer to the **Existing Work Health and Safety Controls** section). Based on the available data, this hazard classification is recommended for the remaining chemicals in the group (unless data are available for the specific chemical to indicate otherwise) (refer to the **Recommendation** section).

In summary, undiluted AEs caused moderate to severe eye irritation in rabbits. The chemicals were also reported to be slightly to moderately irritating at 1–10 % and non-irritating at 0.1 %. The severity of irritation was considered concentration-dependent and appears not to correlate with ethoxylation or alkyl chain length of the AEs. Rinsing the eye immediately after application of some AEs with tap water for 20–30 seconds reduced the severity of the effects.

In a number of OECD TG 405 and Good Laboratory Practice (GLP) compliant tests, the majority of undiluted AEs covering the range of C9–C19 and EO2.5–EO15 resulted in Draize eye irritation index (EII) scores of >25 to 50, and were considered moderately to severely irritating. Some chemicals caused irreversible damage to the eye, i.e. conjunctivitis and corneal opacity which persisted to the end of the observation period of 21 days. Vascularisation of the cornea was observed following exposure to undiluted AEs ($C_{7–9}EO_{6}$ and $C_{14–15}EO_{11}$; both not listed on the Inventory). Other AEs ($C_{12–13}EO_{2}$, $C_{7–9}EO_{12}$, and $C_{14–15}EO_{7}$) have reported EII scores between 0.5 and 15 (mildly irritating). Thus, there is no clear pattern between the eye irritant responses versus the alkyl or EO chain lengths. Other tests demonstrated that the irritancy of the chemicals (covering the range of C9–C18 and EO3–EO20) could be reduced by rinsing the eye immediately after instillation. Concentrations of 0.1 % were non-irritating and between 1–10 % were slightly to moderately irritating (HERA, 2009).

Similar results were reported from Draize tests in albino and New Zealand White rabbits, which covered the range of C9–C15 and EO1–EO18. These chemicals (CAS No. 68439-46-3, 66455-14-9, 68131-39-5 (group members) and 68951-67-7 (not on the Inventory) were severely to extremely irritating when tested undiluted and without rinsing, slightly to moderately irritating at 10 %, and non-irritating to mildly irritating at 0.1–1 % (CIR, 2012).

Observation in humans

Undiluted AEs (covering the range of C11–C18 and EO3–EO20) were reported to cause mild skin irritation in a number of standard human occlusive patch tests (4–24 hours). In some cases, mild erythema was observed and cleared within 72 hours (HERA, 2009; CIR, 2012).

In a human sensitisation test, the chemical $C_{12–13}EO_{6.5}$ showed an increased cumulative irritation response compared to AEs with a higher degree of ethoxylation, e.g. $C_{12–15}EO_{12}$ (HERA, 2009).

Sensitisation

Skin Sensitisation

Based on available data, the AEs in this group are not considered skin sensitisers.

Overall, AEs showed no evidence of skin sensitisation, based on 25 guinea pig maximisation tests (covering the range of C9 to C21 and EO2 to EO21), 13 non-adjuvant Buehler tests (covering the range of C9 to C15 and EO3 to EO13), and local lymph node assay (LLNA) (available for C_6EO_2, CAS No. 112-59-4). Most of the studies were scientifically well-conducted, and some were compliant with the OECD TG and GLP (HERA, 2009; REACHa; REACHb; REACHc; REACHe; REACHf; REACHg; REACHh).

Observation in humans

The chemicals were not skin sensitisers when tested under clinical settings.

A number of AEs of varying chain lengths, e.g. C12–C18 and EO2–EO23 (including $C_{12–13}EO_{6.5}$ (CAS No. 66455-14-9) and $C_{12–15}EO_{7–12}$ (CAS No. 68131-39-5), $C_{12}EO_9$ in aerosol cream and $C_{12}EO_2$), all tested negative in human repeated insult patch tests (HRIPTs). Induction concentrations were mostly between 1–25 %. In similar experiments, neither irritation nor sensitisation were reported for $C_{18}EO_2$, $C_{18}EO_{10}$ and $C_{18}EO_{20}$ at concentrations up to 60 % (HERA, 2009; CIR, 2012).

Repeated Dose Toxicity

Oral

Based on the available data, the chemicals in this group are not expected to cause serious damage to health from repeated oral exposure. No correlation with ethoxylation or alkyl chain length of the AEs was noted for repeated dose oral toxicity.

In several 90-day feeding studies in rats (similar to OECD TG 408), the reported NOAELs were between 50 and 700 mg/kg bw/day for group members (covering the range of C9–C18 and EO5–EO10). Effects observed at higher concentrations included reduced mean body weights and increases in relative liver, kidney and heart weights (SCCS, 2007; HERA 2009; CIR, 2012).

Similar effects were seen in longer-term 2-year feeding studies in rats. The NOAEL for the AEs CAS No. 66455-14-9 ($C_{12–13}EO_{6.5}$ group member) and CAS No. 68951-67-7 ($C_{14–15}EO_7$ not listed on the Inventory) were between 50 and 190 (females) mg/kg bw/day (HERA, 2009; CIR, 2012).

Repeated oral or inhalation exposure to certain short chain ethylene glycol ethers (EGEs), such as 2-butoxyethanol (ethylene glycol butyl ether, EGBE, CAS No. 111-76- 2) and its acetate (EGBEA, CAS No. 112-07-2), may cause haemolytic effects in rodents and effects on the liver, spleen and kidney. However, humans appear to be the least sensitive species for haemolytic effects (NICNAS, 1996; NICNASc; OECD, 2004; ECETOC, 2005). The AEs in this assessment are not expected to share these mechanisms of toxicity. Therefore, exposure to these AEs is not expected to cause haemolysis and associated organ toxicity in humans.

Dermal

Based on the available data, the chemicals in this group are not expected to cause serious damage to health (apart from local effects) from repeated dermal exposure. No correlation with ethoxylation or alkyl chain length of the AEs was found for repeated dose dermal toxicity.

In a well-reported OECD TG 411 (Subchronic 90-day Dermal Toxicity) study, Fischer rats were exposed to $C_{9–11}EO_6$ (CAS No. 68439-46-3) at 1, 10 or 25 % concentrations, 3 days/week. The application site was shaved and not covered. Dry, flaky skin and irritation (epidermal thickening with hyperkeratosis) were observed at >10 %. Relative kidney weights without histological lesions increased in both sexes at 25 %. The NOAEL was established at 10 %, equivalent to 80 mg/kg bw/day (HERA, 2009; CIR, 2012).

In an 18-month study, $C_{12–13}EO_{6.5}$ was applied to the back of Swiss mice 3 days/week. There were no treatment-related systemic lesions at up to 270 mg/kg bw/day. No further study information was available (HERA, 2009).

Inhalation

No data are available.

Genotoxicity

Based on the data available, the chemicals in this group are not considered mutagenic or genotoxic.

A broad spectrum of AEs (covering the range of C7–C22 and EO2–EO20) tested negative in multiple in vitro and in vivo tests (OECD and GLP compliant) for gene mutation and clastogenicity.

In vitro, negative results were reported in bacterial reverse mutation tests in *Salmonella typhimurium* (TA98, TA100, TA102, TA104, TA1535, TA1537 and TA1538) and *Escherichia coli* (strains WP2 and WP2 uvrA pKM101), with or without metabolic activation. Negative results were also reported in chromosomal aberration tests (Chinese hamster lung V79, Chinese hamster ovary, and rat liver cells) and gene mutation tests (mouse lymphoma cells) (SCCP, 2007; HERA, 2009; CIR, 2012).

In vivo, AEs (C12–C15 and EO3–EO9) did not induce chromosomal damage in Chinese hamster or Tunstall Wistar rat bone marrow cells after acute oral doses between 250 and 3400 mg/kg bw (SCCP, 2007; HERA, 2009).

Carcinogenicity

Based on the available data, chemicals in this group are not considered carcinogenic.

Two AEs, CAS No. 66455-14-9 ($C_{12–13}EO_{6.5}$, group chemical) and CAS No. 68951-67-7 ($C_{14–15}EO_7$, not listed on the Inventory), were administered at up to 1 % in the diet to rats for 1–2 years. No treatment-related histopathological effect or increased tumour incidence were observed (HERA, 2009; CIR, 2012).

There was no treatment-related lesions in mice, following 18-month dermal application of $C_{12–13}EO_{6.5}$ (HERA, 2009).

The AEs are synthesised through processes which may result in 1,4-dioxane as an impurity. This impurity is classified as a Carcinogen—Category 2 (H351 Suspected of causing cancer). There are restrictions on the levels of this chemical in preparations available to consumers in Australia (SUSMP).

Reproductive and Developmental Toxicity

Based on the data available, the chemicals of this group are not considered to cause reproductive or developmental toxicity. The oral NOAELs were determined at 250 mg/kg bw/day for reproductive toxicity, and >50 mg/kg bw/day for maternal and developmental toxicity.

In a 2-generation study, the chemical $C_{14–15}EO_7$ was administered in the diet of Charles River CD rats (25/sex/group, at doses of 0, 25, 50 or 250 mg/kg bw/day). The NOAEL for reproductive toxicity was established as 250 mg/kg bw/day (or 0.5 % in diet), given no treatment related effects on fertility, gestation or viability index at this highest tested dose. The NOAEL for maternal and

developmental toxicity was established as 50 mg/kg bw/day, based on reduced maternal and pup body weights and increased relative liver weights in both F1 (males and females) and F2 (males) generations at 250 mg/kg bw/day (HERA 2009; CIR, 2012).

In a 2-generation study protocol using a different AE ($C_{12}EO_6$), the NOAEL for reproductive toxicity was set at the highest tested dose of 250 mg/kg bw/day. The NOAELs for parental (F0) and developmental toxicity were also 50 mg/kg bw/day, based on reduced body weight gains in F0 and F1 generations at 250 mg/kg bw/day (HERA, 2009; CIR 2012).

In an oral developmental toxicity study, $C_{12}EO_6$ was administered in the diet of female rabbits at doses of 0, 50, 100 or 200 mg/kg bw/day from gestation days 2 to 16. Ataxia and a slight decrease in body weight were observed at =100 mg/kg bw/day. Nine rabbits in the control group and 31 in the treatment groups died during the study (details not available). There were no treatment related effects on corpora lutea, implantations, number of live foetuses and spontaneous abortions. No further information was available on live birth index, pup growth or developmental NOAEL. The NOAEL for maternal toxicity was reported at the lowest dose tested, i.e. 50 mg/kg bw/day (HERA, 2009; CIR, 2012).

In a dermal 2-generation study, $C_{9–11}EO_6$ (CAS No. 68439-46-3) was applied to Fischer 344 rats (30/sex/group, at doses of 0, 10, 100 or 250 mg/kg bw/day, 3 times/week except mating periods). No effects were reported on mating, fertility or mean gestational length in both generations. No treatment-related effects on testicular weights or sperm counts were observed. There were no effects on F1 and F2 litter size, number of live pups or sex ratio. The NOAEL for reproductive and developmental toxicity was established as 250 mg/kg bw/day (HERA 2009; CIR, 2012).

In 2 other dermal studies, the NOAEL values for developmental and teratogenicity of $C_{12}EO_4$ were reported at >240–300 mg/kg bw/day for rats and rabbits, respectively (HERA, 2009).

Although certain short chain EGEs such as 2-ethoxyethanol (ethylene glycol ethyl ether, EGEE, CAS No. 110-80-5) are known reproductive toxicants, the ability of these glycol ethers to cause testicular atrophy decreases with increasing alkyl chain length, with effects not observed with chain lengths =C3 (OECD, 2004; ECETOC, 2005). In addition, no effects on reproductive organs were observed in several repeated dose toxicity studies (refer to the **Repeated dose toxicity** section above).

Risk Characterisation

Critical Health Effects

The critical human health effects of the AEs for risk characterisation are acute oral toxicity and skin and eye irritation. The irritant effects are similar to those caused by other surfactants. The severity of irritation appears to increase directly with the chemical concentration. Skin irritation, but not eye irritation, generally decreases with an increasing degrees of ethoxylation.

Public Risk Characterisation

Although Australian use data are not available for all chemicals in the group, some have reported cosmetics and domestic uses in cleaning and washing products. International use data suggest widespread and repeated exposure of the public to these chemicals through the use of rinse-off and leave-on cosmetics and domestic products. Therefore, widespread public exposure is also expected in Australia, mainly involving exposure via the skin and eyes. Incidental inhalation (from aerosolised or powder products) and ingestion can also occur.

Considering the wide range of domestic products containing these chemicals, there is a possibility of public exposure to the chemicals through secondary exposure via the environment. However, this indirect human exposure is considered to be at very diluted concentrations; and hence, it not considered comparable to direct exposure.

A quantitative risk assessment of consumer cleaning products containing the chemicals concluded that these chemicals are not of any significant systemic human health concern (HERA, 2009). The margin of exposure calculated was based on the worst-case scenario and large enough to account for any uncertainties or inter- and intra-species extrapolation.

The CIR Expert Panel (CIR, 2016) indicated that up to 95–99 % of the droplets and/or particles (aerodynamic diameters >10 µm) released from cosmetic sprays containing these surfactant chemicals are not expected to be respirable into the gas

exchange region of the lung, but likely to deposit in the nasopharyngeal and bronchial regions and subsequently undergo elimination. Aerosol uses leading to inhalation of smaller droplets are not expected for the chemicals in this group.

The Panel (CIR, 2012) determined that cosmetic use concentrations of the alcohol ethoxylates are safe when formulated to be non-irritating. However, skin, eye and respiratory irritant effects on exposure could occur with some of the chemicals within the group at high concentrations and/or eye irritation from accidental eye contact cannot be ruled out for some known use concentrations.

Chemicals in this group are synthesised through processes that might result in 1,4-dioxane as a residual by-product. The concentration of 1,4-dioxane (listed under dioxane) is controlled through the Poisons Standard (Schedule 6), with schedule labelling requirements applying at above 100 ppm (Appendix G; SUSMP October 2019).

The available data for some of the chemicals can be extrapolated to support the safety of all the chemicals in this group. Taking into consideration the current use concentrations and existing restrictions described above, the chemicals are not considered to pose an unreasonable risk to public health when used at low concentrations or when formulated to be non-irritating.

The total surfactant concentration in the products should be considered when determining label instructions, especially where direct dermal and ocular exposures are likely to occur, or when packaging presents the possibility of incidental inhalation or ingestion. Any irritant effects can be mitigated by labelling (such as warning statement—If in eyes wash out immediately with water etc.) and concentration controls. Any controls for these chemicals should be considered as part of a broader review of the management of surfactants in the SUSMP.

Occupational Risk Characterisation

During product formulation, oral, dermal, ocular and inhalation exposure of workers to the chemicals may occur, particularly where manual or open processes are used. These may include transfer and blending activities, quality control analysis, and cleaning and maintenance of equipment. Worker exposure to the chemicals at higher concentrations is expected. The level and route of exposure will vary depending on the method of application and work practices employed.

Given the critical systemic acute and local health effects, the chemicals could pose an unreasonable risk to workers unless adequate control measures to minimise relevant exposure are implemented. Good hygiene practices to minimise oral exposure are expected to be in place.

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 appropriate controls.

The data available support an amendment to the hazard classification in the HCIS (Safe Work Australia) (refer to the **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 the chemicals in cosmetics and/or domestic products be managed through changes to the Poisons Standard in the broader context of total surfactants, and risks for workplace health and safety be managed through changes to classification and labelling under HCIS. It is recommended that the chemicals be considered as part of a broader review of the management of surfactants in the SUSMP.

The assessment of these chemicals 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

The public can be exposed to the chemicals through their presence in domestic (such as laundry and cleaning) or cosmetic products. However, the chemicals are not expected to be contact sensitisers or to be irritating at low concentrations. There is potential for dermal, ocular and respiratory irritation to occur from use of these chemicals at higher concentrations depending on the use pattern.

A different class of surfactant chemicals (such as sodium lauryl sulfate and its salts) are listed in Schedule 6 of the Poisons Standard.

No specific regulatory controls are recommended for the chemicals in this group as part of this assessment. NICNAS recommends that formulators of products containing these chemicals should take into account the total surfactant concentration in the products when determining label instructions, especially where direct dermal and ocular exposures are likely to occur, or when packaging presents the possibility of incidental inhalation or ingestion. Any irritant effects can be mitigated by labelling (such as warning statement—If in eyes wash out immediately with water etc.) and concentration controls. Any controls for these chemicals should be considered as part of a broader review of the management of surfactants in the SUSMP.

Work Health and Safety

Unless data for a specific chemical are available, the critical health effects cannot be ruled out for any chemical as they can be formulated with variable degree of ethoxylation and alkyl chain lengths. Chemicals with the same generic CAS number may include a range of ethoxylation degrees which may affect the toxicological properties.

The chemicals are recommended for classification and labelling aligned with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) as below, unless data for a specific chemical are available to indicate lower toxicity.

The recommended classification and labelling entry should have the following note appended for the majority of chemicals 'Note 10 (The chemical is a substance of unknown or variable composition, complex reaction product, or biological material (UVCB). The hazards of the chemical may depend on the composition. For more information refer to the assessment report published on the website of the National Industrial Chemical Notification and Assessment Scheme.)'

This assessment 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]
Acute Toxicity	Not Applicable	Harmful if swallowed - Cat. 4 (H302)
Irritation / Corrosivity	Not Applicable	Causes serious eye damage - Cat. 1 (H318) Causes skin irritation - Cat. 2 (H315)

[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 chemical should be used according to label instructions.

Advice for industry

Control measures

Control measures to minimise the risk from oral, dermal, ocular, and inhalation 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 may minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- 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 assist with meeting 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 12 December 2019

Chemical Identities

Chemical Name in the Inventory and Synonyms	**Ethanol, 2-[2-(hexyloxy)ethoxy]-** diethylene glycol hexyl ether n-hexyl carbitol
CAS Number	112-59-4
Structural Formula	
Molecular Formula	C10H22O3
Molecular Weight	190.3

Chemical Name in the Inventory and Synonyms	**Ethanol, 2-[2-(dodecyloxy)ethoxy]-** lauryl alcohol, mono(oxyethylene) ethanol laureth-2 diethylene glycol dodecyl ether
CAS Number	3055-93-4
Structural Formula	
Molecular Formula	C16H34O3
Molecular Weight	274.4

Chemical Name in the Inventory and Synonyms	**Ethanol, 2-[2-[2-(dodecyloxy)ethoxy]ethoxy]-** laureth-3 lauryl alcohol, di(oxyethylene) ethanol laureth-3 oxyethylene ether
CAS Number	3055-94-5
Structural Formula	

	
Molecular Formula	C18H38O4
Molecular Weight	318.5

Chemical Name in the Inventory and Synonyms	**3,6,9,12,15-Pentaoxaheptacosan-1-ol** lauryl alcohol, tetra(oxyethylene) ethanol pentaethylene glycol monododecyl ether
CAS Number	3055-95-6
Structural Formula	

	
Molecular Formula	C22H46O6
Molecular Weight	406.6

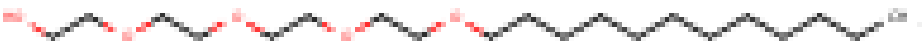
Chemical Name in the Inventory and Synonyms	**3,6,9,12,15,18,21-Heptaoxatritriacontan-1-ol** laureth-7 lauryl alcohol, hexa(oxyethylene) ethanol polyethylene glycol (7) lauryl ether
CAS Number	3055-97-8
Structural Formula	

	
Molecular Formula	C26H54O8
Molecular Weight	494.7

Chemical Name in the Inventory and Synonyms	**Ethanol, 2-(dodecyloxy)-** lauryl alcohol, oxyethanol PEG-1 lauryl ether
CAS Number	4536-30-5
Structural Formula	

	
Molecular Formula	C14H30O2
Molecular Weight	230.4

Chemical Name in the Inventory and Synonyms	**3,6,9,12-Tetraoxatetracosan-1-ol** polyoxyethylene(4) lauryl ether
CAS Number	5274-68-0
Structural Formula	

	
Molecular Formula	C20H42O5
Molecular Weight	362.5

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-9-octadecenyl-.omega.-hydroxy-** glycols, polyethylene, mono-9-octadecenyl ether oleth-16 polyoxyethylene (16) oleyl ether
CAS Number	25190-05-0
Structural Formula	

	
Molecular Formula	(C2H4O)nC18H36O
Molecular Weight	312.5

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-hexadecyl-.omega.-hydroxy-, mixture with .alpha.-octadecyl-.omega.-hydroxypoly(oxy-1,2-ethanediyl)** Poly(oxy-1,2-ethanediyl), .alpha.-octadecyl-.omega.-hydroxy-, mixture containing
CAS Number	8065-80-3
Structural Formula	

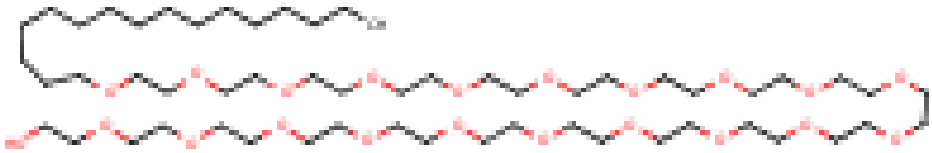
	
Molecular Formula	(C2H4O)nC18H38O.(C2H4O)nC16H34O
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-hexadecyl-.omega.-hydroxy-, mixture with (Z)-.alpha.-9-octadecenyl-.omega.-hydroxypoly(oxy-1,2-ethanediyl)** Oleyl alcohol, cetyl alcohol adduct with ethylene oxide
CAS Number	8065-81-4
Structural Formula	
Molecular Formula	(C2H4O)nC18H36O.(C2H4O)nC16H34O
Molecular Weight	

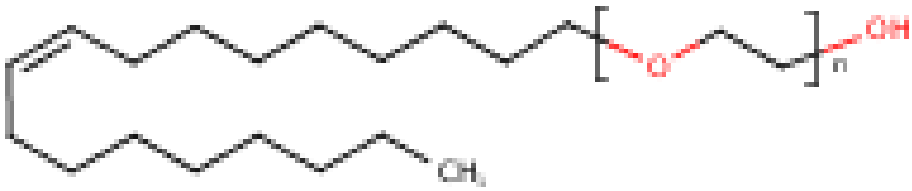
Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-dodecyl-.omega.-hydroxy-** dodecyl alcohol, monoether with polyethylene glycol ethoxylated lauryl alcohol glycols, polyethylene monododecyl ether

	laureth-11 laureth-13
CAS Number	9002-92-0
Structural Formula	
Molecular Formula	(C2H4O)nC12H26O
Molecular Weight	230.4

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-hexadecyl-.omega.-hydroxy-** 1-hexadecanol, compound with oxirane (1:1) 1-hexadecanol, ethylene oxide polymer 1-hexadecanol, polymer with oxirane cetyl alcohol, ethoxylated ethoxylated cetyl alcohol
CAS Number	9004-95-9
Structural Formula	

	
Molecular Formula	(C2H4O)nC16H34O
Molecular Weight	1123.5

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-(9Z)-9-octadecen-1-yl-.omega.-hydroxy-** 9-octadecen-1-ol, (Z)-, compound with oxirane (1:1) 9-octadecen-1-ol, monoether with polyethylene glycol, (Z)- glycols, polyethylene, mono-9-octadecenyl ether, (Z)- oleyl alcohol, ethoxylated polyoxyethylated oleyl alcohol
CAS Number	9004-98-2
Structural Formula	

	
Molecular Formula	(C2H4O)nC18H36O
Molecular Weight	312.5

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-octadecyl-.omega.-hydroxy-** 1-octadecanol, compound with oxirane (1:1) polyoxyethylated stearyl alcohol steareth-10 steareth-100 steareth-11
CAS Number	9005-00-9
Structural Formula	**No Structural Diagram Available**

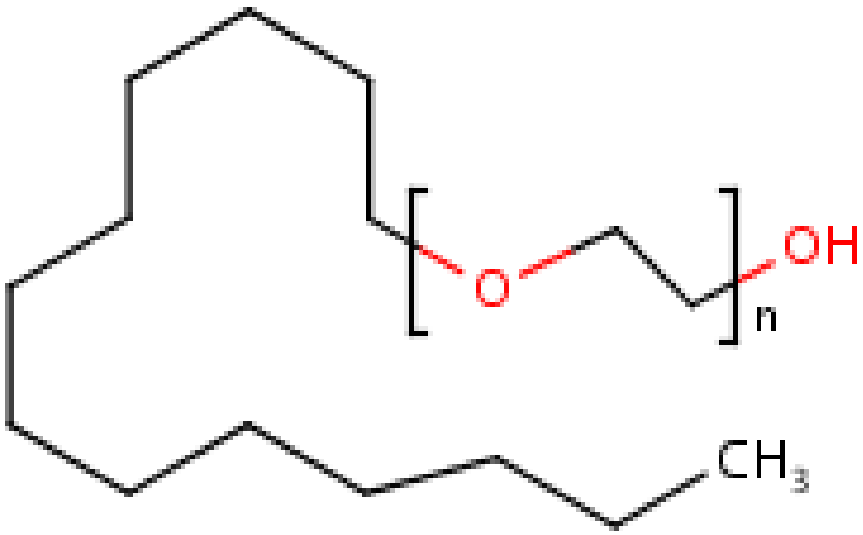
Molecular Formula	(C2H4O)nC18H38O
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-isotridecyl-.omega.-hydroxy-** polyethylene glycol, isotridecyl ether polyethylene glycol monoisotridecyl ether
CAS Number	9043-30-5
Structural Formula	**No Structural Diagram Available**
Molecular Formula	(C2H4O)nC13H28O
Molecular Weight	Unspecified

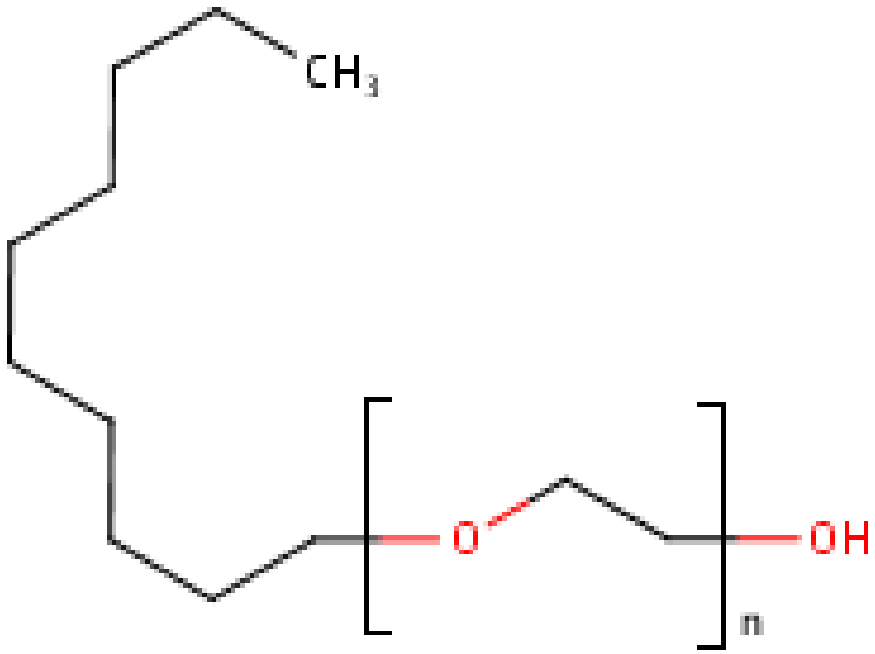
Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-hexyl-.omega.-hydroxy-** .alpha.-hexyl-.omega.-hydroxypoly(oxy-1,2-ethanediyl) hexyl poly(oxyethylene) ether hexyl alcohol, ethoxylated
CAS Number	31726-34-8
Structural Formula	

	
Molecular Formula	(C2H4O)nC6H14O
Molecular Weight	146.2

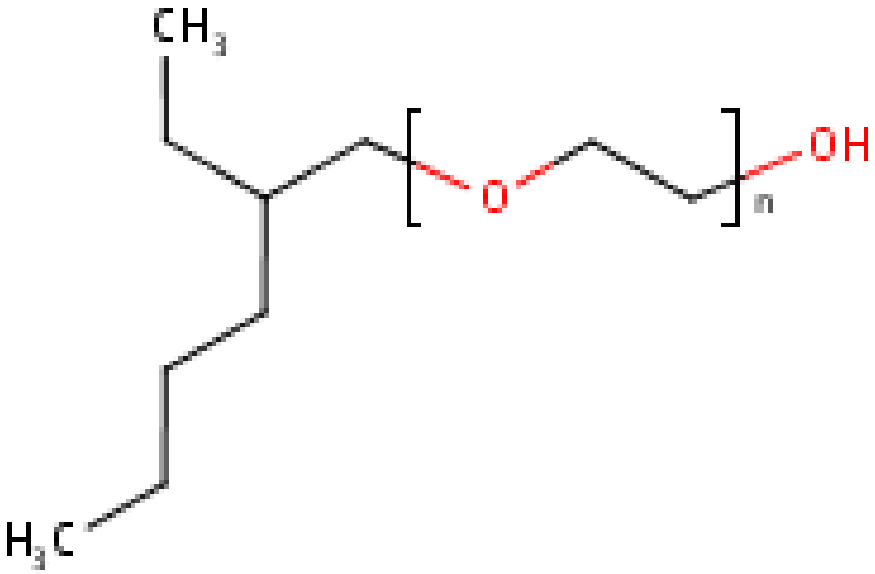
Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-** ethoxylated tridecyl alcohol trideceth-10 trideceth-11 trideceth-12 trideceth-15
CAS Number	24938-91-8
Structural Formula	

	
Molecular Formula	(C2H4O)nC13H28O
Molecular Weight	244.4

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-decyl-.omega.-hydroxy-** decyl alcohol, ethoxylated alpha-decyl-omega-hydroxypoly(oxy-1,2-ethanediyl)
CAS Number	26183-52-8
Structural Formula	

	
Molecular Formula	(C2H4O)nC10H22O
Molecular Weight	202.3

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-(2-ethylhexyl)-.omega.-hydroxy-** polyethylene glycol, mono(2-ethylhexyl) ether
CAS Number	26468-86-0
Structural Formula	

	
Molecular Formula	(C2H4O)nC8H18O
Molecular Weight	174.3

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-octyl-.omega.-hydroxy-** octyl alcohol, ethoxylated polyethylene glycol monooctyl ether
CAS Number	27252-75-1
Structural Formula	

	
Molecular Formula	(C2H4O)nC8H18O
Molecular Weight	174.3

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-tetradecyl-.omega.-hydroxy-** ethoxylated tetradecyl alcohol myristyl alcohol, ethoxylated
CAS Number	27306-79-2
Structural Formula	

	
Molecular Formula	(C2H4O)nC14H30O
Molecular Weight	258.4

Chemical Name in the Inventory and Synonyms	**1-Octadecanol, polymer with ethylene oxide**
CAS Number	31943-12-1
Structural Formula	**No Structural Diagram Available**

Molecular Formula	(C18H38O.C2H4O)x
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), alpha-(2-octyldodecyl)-omega-hydroxy-** octyldodeceth-10 polyethylene glycol (10) octyldodecyl ether
CAS Number	32128-65-7
Structural Formula	**No Structural Diagram Available**
Molecular Formula	(C2H4O)n C20H42O
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohol, straight chain, modified polyethoxylate** triton DF 12
CAS Number	37281-47-3
Structural Formula	

	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**9-Octadecen-1-ol, (Z)-, polymer with oxirane** oleyl alcohol, ethylene oxide condensation products
CAS Number	37702-39-9
Structural Formula	
Molecular Formula	(C18H36O.C2H4O)x
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-nonyl-.omega.-hydroxy-** nonyl alcohol, ethoxylated noneth-3

CAS Number	39587-22-9
Structural Formula	
Molecular Formula	(C2H4O)nC9H20O
Molecular Weight	188.3

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-isooctadecyl-.omega.-hydroxy-** PEG-10 isostearyl ether alpha-isooctadecyl-omega-hydroxypoly(oxy-1,2-ethanediyl) arosurf
CAS Number	52292-17-8
Structural Formula	

	
Molecular Formula	(C2H4O)nC18H38O
Molecular Weight	358.6

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-isooctyl-.omega.-hydroxy-** polyethylene glycol monoisooctyl ether
CAS Number	61723-78-2
Structural Formula	
Molecular Formula	(C2H4O)nC8H18O
Molecular Weight	Unspecified

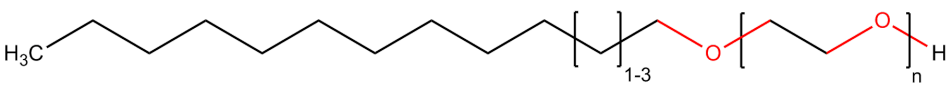
Chemical Name in the Inventory and Synonyms	**Alcohols, C6-12, ethoxylated** (C6-12) alkylcarboxylic acid, ethoxylated

CAS Number	68439-45-2
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

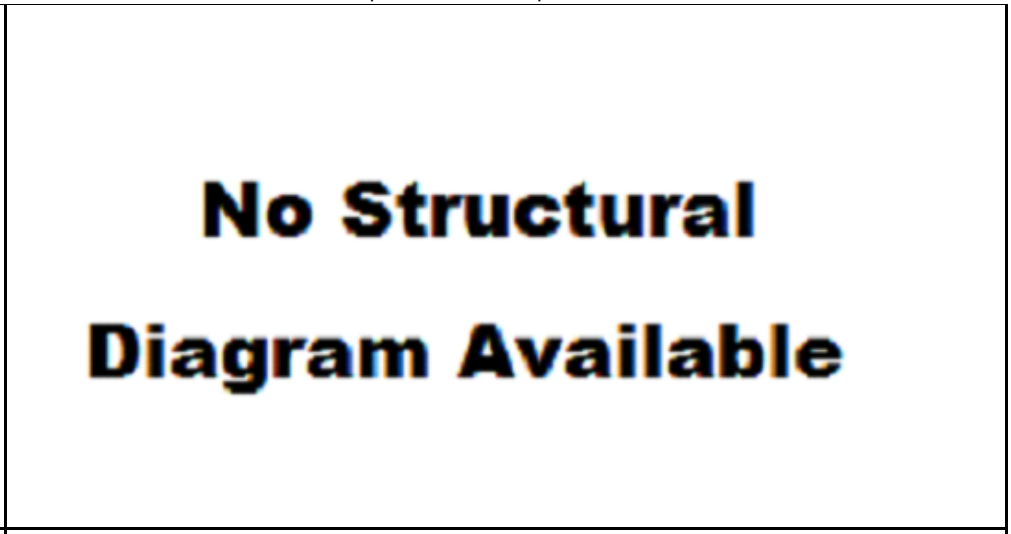
Chemical Name in the Inventory and Synonyms	**Alcohols, C9-11, ethoxylated** (C9-11) alkyl alcohol, ethoxylate
CAS Number	68439-46-3
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

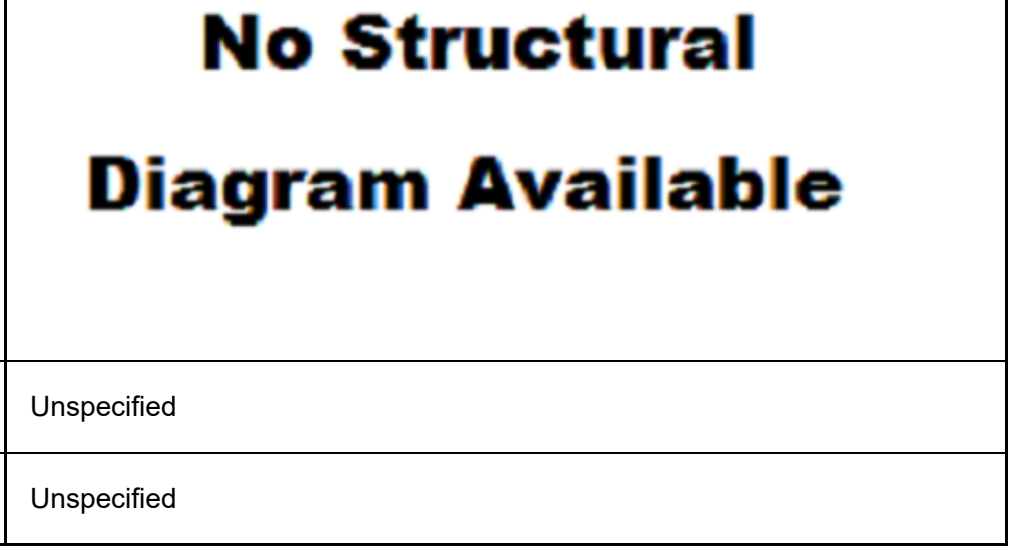
Chemical Name in the	**Alcohols, C16-18, ethoxylated**

Inventory and Synonyms	(C16-18) liphatic alcohol, ethoxylated (C16-18) fatty alcohol, ethylene oxide reaction products ceteareth cetostearyl alcohol, ethoxylated
CAS Number	68439-49-6
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C12-14, ethoxylated** Linear C12- and C14-alkyl alcohols, ethoxylated
CAS Number	68439-50-9
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

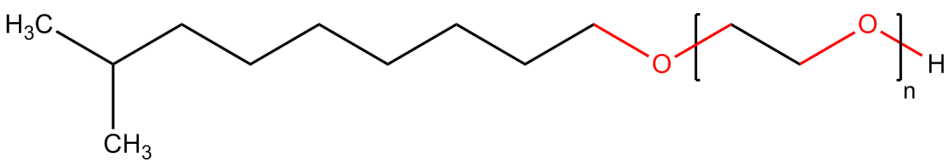
Chemical Name in the Inventory and Synonyms	**Alcohols, C11-13-branched, ethoxylated** (C11-13) branched alkyl alcohol, ethoxylate
CAS Number	68439-54-3

Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

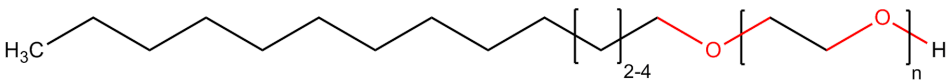
Chemical Name in the Inventory and Synonyms	**Alcohols, coco, ethoxylated** coconut oil alcohol, ethoxylated
CAS Number	61791-13-7
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

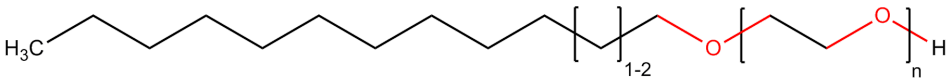
Chemical Name in the Inventory and Synonyms	**Alcohols, tallow, ethoxylated** tallow alcohols, ethoxylated

CAS Number	61791-28-4
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-isodecyl-.omega.-hydroxy-** polyethylene glycol isodecyl ether polyoxyethylene, isodecyl ether a-isodecyl-?-hydroxypoly(oxy-1,2-ethanediyl) ethoxylated isodecyl alcohol isodecanol, ethoxylated
CAS Number	61827-42-7
Structural Formula	
Molecular Formula	(C2H4O)nC10H22O
Molecular Weight	202.34

Chemical Name in the Inventory and Synonyms	**Alcohols, C13-15, ethoxylated**

CAS Number	64425-86-1
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C12-13, ethoxylated** polyethylene glycol, C12-13-alkyl ether
CAS Number	66455-14-9
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C10-14, ethoxylated** (C10-14) alkyl alcohol, ethoxylated
CAS Number	66455-15-0
Structural Formula	**No Structural Diagram Available**

Molecular Formula	Unspecified
Molecular Weight	Unspecified

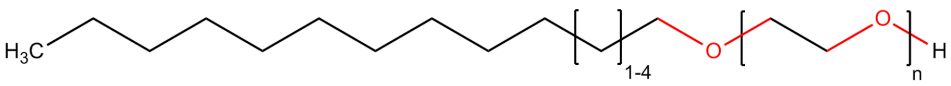
Chemical Name in the Inventory and Synonyms	**Alcohols, C16-22, ethoxylated** (C16-22) alkyl alcohol, ethoxylate
CAS Number	69227-20-9
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C10-12, ethoxylated** (C10-12) alkyl alcohol, saturated, linear, ethoxylated
CAS Number	67254-71-1
Structural Formula	

	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C10-16, ethoxylated** (C10-16) alkyl alcohol, ethoxylate
CAS Number	68002-97-1
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

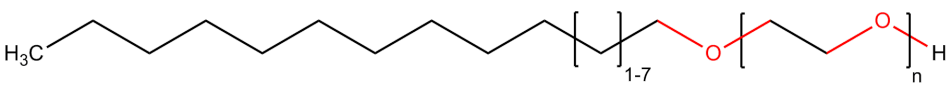
Chemical Name in the Inventory and Synonyms	**Alcohols, C12-15, ethoxylated** linear C12-15-primary alcohol, ethoxylate ethoxylated alcohols (C=12-15) oxoalcohol C12-15,ethoxylated

	alcohols, C12-15-alkyl, ethoxylated genapol OX
CAS Number	68131-39-5
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C11-15-secondary, ethoxylated** linear C11-15-secondary alcohol, ethoxylate
CAS Number	68131-40-8
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

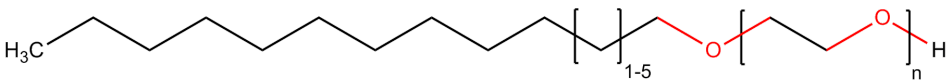
Chemical Name in the Inventory and Synonyms	**Alcohols, C16 and C18-unsaturated, ethoxylated** (C16-18-unsaturated) alkyl alcohol, ethoxylate
CAS Number	68155-01-1
Structural Formula	

	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C12-18, ethoxylated** ethoxylated alcohols (C=12-18) alcohols C12-18,ethoxylated alcohols, C12-18, ethoxylated, fatty poly(oxy-1,2-ethanediyl), a-(C12-C18) alkyl-?-hydroxy- C12-18 alkyl alcohol ethoxylate
CAS Number	68213-23-0
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C12-20, ethoxylated** polyethoxylated C12-20-alcohols
CAS Number	68526-94-3
Structural Formula	

	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C12-16, ethoxylated** polyethylene glycol, dodecyl, tetradecyl, hexadecyl ether
CAS Number	68551-12-2
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C>30, ethoxylated**
CAS Number	97953-22-5
Structural Formula	

	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C16-18 and C18-unsaturated, ethoxylated** C16-C18) and (C18) unsaturated alkylalcohol, ethoxylate
CAS Number	68920-66-1
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C7-21, ethoxylated** ethoxylated alcohols (C7-21)

CAS Number	68991-48-0
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-tridecyl-.omega.-hydroxy-, branched** branched tridecyl alcohol, ethoxylated
CAS Number	69011-36-5
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the	**Alcohols, C8-22, ethoxylated**

Inventory and Synonyms	linear C8-22-alkyl alcohol, ethoxylated
CAS Number	69013-19-0
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C6-10, ethoxylated**
CAS Number	70879-83-3
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C8-10, ethoxylated** (C8-10) alkyl alcohol, ethoxylated
CAS Number	71060-57-6
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C8-16, ethoxylated** (C8-16) alkyl alcohol, ethoxylated
CAS Number	71243-46-4
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C9-11-iso-, C10 rich, ethoxylated** ethoxylated branched C9-11, C10 rich alcohols
CAS Number	78330-20-8
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C11-14-iso-, C13 rich, ethoxylated** ethoxylated branched C11-14, C13 rich alcohols
CAS Number	78330-21-9
Structural Formula	**No Structural Diagram Available**

Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C12-C14-secondary, ethoxylated**
CAS Number	84133-50-6
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C10-18, ethoxylated**
CAS Number	85422-93-1
Structural Formula	

	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C12-20 and C12-20-unsaturated, ethoxylated**
CAS Number	106232-81-9
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C16-20, ethoxylated**

CAS Number	106232-82-0
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C12-15-branched and linear, ethoxylated**
CAS Number	106232-83-1
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the	**Alcohols, C18-22-alkyl, ethoxylated**

Inventory and Synonyms	
CAS Number	116810-32-3
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C14-15-branched and linear, ethoxylated**
CAS Number	120944-68-5
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C10-12-secondary, ethoxylated**
CAS Number	125736-52-9
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Alcohols, C14-18 and C16-18-unsaturated, ethoxylated**
CAS Number	126646-02-4
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-undecyl-.omega.-hydroxy-,branched and linear** alcohols, C11, branched and linear, ethoxylated
CAS Number	127036-24-2
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Poly(oxy-1,2-ethanediyl), .alpha.-isohexadecyl-.omega.-hydroxy-** Isoceteth-20
CAS Number	69364-63-2
Structural Formula	**No Structural Diagram Available**

Molecular Formula	(C2H4O)nC16H34O
Molecular Weight	

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