Phenol and cresol epoxy novolacs: Human health tier II assessment

03 July 2015

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Oxirane, 2,2'-[1,3-phenylenebis(oxymethylene)]bis-	101-90-6
Oxirane, [(2-methylphenoxy)methyl]-	2210-79-9
Oxirane, 2,2',2'',2'''-[1,2-ethanediylidenetetrakis(4,1-phenyleneoxymethylene)]tetrakis-	7328-97-4
Oxirane, [(methylphenoxy)methyl]-	26447-14-3
Formaldehyde, polymer with (chloromethyl)oxirane and methylphenol	37382-79-9
Oxirane, 2,2'-[methylenebis(2,1-phenyleneoxymethylene)]bis-	54208-63-8

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**

ACRONYMS & ABBREVIATIONS

Grouping Rationale

The chemicals in this group are epoxy resin substances, known as aromatic glycidyl ethers, resulting from phenols, including cresols and resorcinol, reacting with formaldehyde and subsequent glycidylation with epichlorohydrin. The chemicals are described as epoxidised novolacs, such as epoxy phenol novolacs (EPN) and epoxy cresol novolacs (ECN). Highly cross-linked polymer networks result from higher epoxy functionalities (mean epoxy functionality of around 2–6 units) whereby specific mechanical properties can be manufactured. These properties include high viscosity (for EPN), solid at room temperature (for ECN), high temperature and chemical resistance and low flexibility (ASM International, 2001).

The following chemicals in this group are considered to be ECNs:

- glycidyl o-methylphenyl ether (GMPE) (CAS No. 2210-79-9);
- 1,1,2,2-tetrakis(p-glycidyloxyphenyl)ethane (TGOPE) (CAS No. 7328-97-4);
- cresol glycidyl ether (CGE) (CAS No. 26447-14-3);
- cresol, formaldehyde, epichlorohydrin polymer (CFEP) (CAS No. 37382-79-9); and
- methylenebis[o-phenol (MP) (CAS No. 54208-63-8).

Diglycidyl resorcinol ether (DGRE) (CAS No. 101-90-6) is an EPN and also known as resorcinol diglycidyl ether.

The carcinogenicity and mutagenicity of TGOPE and DGRE are related to the crosslinking potential from multiple epoxy rings, as each alkylating epoxy ring can bind covalently with deoxyribonucleic acid (DNA) (Government of Canada, 2010).

The structurally-related chemical oxirane, (phenoxymethyl)- (CAS No. 122-60-1), also known as phenyl glycidyl ether (PGE) is considered an appropriate analogue for all endpoints of the chemicals in this group (Government of Canada, 2010; NICNAS).

Import, Manufacture and Use

Australian

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

International

The following international uses have been identified through:

- Galleria Chemica;
- the Substances and Preparations in Nordic countries (SPIN) database;
- the United States National Library of Medicine's Hazardous Substances Data Bank (US HSDB);
- the US Department of Health and Human Services, Household Products Database; and
- various international assessments (Government of Canada, 2010).

The chemicals in this group identified by the CAS Nos. 2210-79-9 (GMPE), 7328-97-4 (TGOPE), 26447-14-3 (CGE) and 54208-63-8 (MP) have one or more of the following reported domestic uses, including in:

- adhesives (binding agents) (TGOPE is available at concentrations of 10–30 % in an epoxy-patch adhesive resin product);

- surface treatments (GMPE is available at 5 % concentration in liquid products);
- cleaning/washing agents;
- odour agents;
- paints, lacquers and varnishes; and
- fillers.

The chemicals GMPE, CGE and MP have one or more of the following reported commercial uses, including:

- as solvents;
- as absorbents and adsorbents;
- as process regulators;
- as viscosity adjustors;
- in construction materials; and
- as reactants in producing industrial-grade epoxy resins.

The chemicals GMPE, TGOPE, CGE and DGRE have one or more of the following reported site-limited uses, including:

- as intermediates;
- in synthetic polymers; and
- as liquid epoxy resins and as reactive diluents in producing other industrial-grade epoxy resins.

Restrictions

Australian

These chemicals are listed in the *Poisons Standard—the Standard for the Uniform Scheduling of Medicines and Poisons* (SUSMP) in Schedule 5 (SUSMP, 2015) under '*Epoxy resins, liquid*'.

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

International

The chemicals GMPE (CAS No. 2210-79-9), DGRE (CAS No. 101-90-60) and CGE (CAS No. 26447-14-3) are listed on the European Union (EU) Cosmetics Regulation 1223/2009 Annex II— List of substances prohibited in cosmetic products (CosIng; Galleria Chemica).

These chemicals are also listed on:

- ASEAN Cosmetic Directive Annex II Part 1: List of substances which must not form part of the composition of cosmetic products;
- China List of Banned substances for use in cosmetics; and
- New Zealand Cosmetic Products Group Standard—Schedule 4: Components cosmetic products must not contain (Galleria Chemica).

Existing Worker Health and Safety Controls

Hazard Classification

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

GMPE (CAS No. 2210-79-9) and CGE (CAS No. 26447-14-3):

- Muta. Cat. 3; R68 (Possible risk of irreversible effects)
- Xi; R38 (Irritating to skin)
- Xi; R43 (May cause sensitisation by skin contact)

DGRE (CAS No. 101-90-6):

- Carc. Cat. 3; R40 (Limited evidence of a carcinogenic effect)
- Muta. Cat. 3; R68 (Possible risk of irreversible effects)
- Xn; R21/22 (Harmful in contact with skin and if swallowed)
- Xi; R36/38 (Irritating to eyes and skin)
- Xi; R43 (May cause sensitisation by skin contact)

Exposure Standards

Australian

No specific exposure standards are available.

International

No specific exposure standards are available for most of the chemicals in this group except for CGE (CAS No. 26447-14-3). A time weighted average (TWA) exposure limit of 70 mg/m^3 (10 ppm) in different countries such as Denmark and Iceland was identified for the chemical (Galleria Chemica).

Health Hazard Information

Toxicokinetics

There are limited data available for the chemicals in this group.

The glycidyl ether groups of TGOPE were reported to be rapidly metabolised by epoxide hydrolase to form a less reactive bis-diol. Dermal penetration of TGOPE is expected to be very low (likely to be <1 %) and involve extensive metabolism in the skin (Government of Canada, 2010).

Percutaneous absorption rates for the chemical PGE were reported as 13.5 mg/cm^2/hour in rats and 4.2 mg/cm^2/hour for rabbits. Acute dermal treatment of rats and rabbits with PGE showed that the substance is well absorbed through the skin (NICNAS).

Acute Toxicity

Oral

There are limited data available for the chemicals in this group. The chemical DGRE is classified as hazardous with the risk phrase 'Harmful if swallowed' (Xn; R22) in the HSIS (Safe Work Australia). There are insufficient data available to assess this classification for the chemical.

Based on the available animal test data for TGOPE and CGE, these chemicals are considered to have low acute toxicity following oral exposure. In three acute studies, TGOPE, epon resin 1031-B-80 (containing 80 % TGOPE and 20 % methyl ethyl ketone), and CGE were reported to have low acute oral toxicity in rats, with acute oral median lethal dose (LD50) values of >2000 mg/kg bw, >5 mL/kg bw and 5140 mg/kg bw, respectively. No further study details were available (Government of Canada, 2010; Galleria Chemica; HSDB).

The analogue chemical PGE is reported to have low acute oral toxicity (LD50 value of 3850 mg/kg bw in rats) (NICNAS).

Dermal

There are limited data available for the chemicals in this group. The chemical DGRE is classified as hazardous with the risk phrase 'Harmful in contact with skin' (Xn; R21) in the HSIS (Safe Work Australia). There are insufficient data available to assess this classification for the chemical.

Based on the available animal test data for TGOPE and CGE, these chemicals are considered to have low acute toxicity following dermal exposure. In three acute studies, two for TGOPE (in rabbits) and one for CGE (in rats) the chemicals were found to have low acute dermal toxicity, with LD50 values of >2000 mg/kg bw, >2 mL/kg bw and >2150 mg/kg bw, respectively. No further study details were available (Government of Canada, 2010; Galleria Chemica; HSDB).

The analogue chemical PGE is reported to have low acute dermal toxicity (LD50 value of 2100 mg/kg bw in rats) (NICNAS).

Inhalation

There are limited data available for the chemicals in this group. Based on the available animal test data for the chemical CGE, the chemicals in this group are considered to have low acute toxicity following inhalation exposure.

In two acute studies, CGE was reported to have low acute inhalation toxicity in rats, with acute inhalation median lethal concentration (LC50) values of >1220 mg/kg bw and 4.8–8.5 mg/L. No adverse effects were reported (Galleria Chemica; HSDB).

The analogue chemical PGE is reported to have low acute inhalation toxicity (LC50 values of >100 ppm/four hours in rats and mice) (NICNAS).

Corrosion / Irritation

Respiratory Irritation

No data are available for the chemicals in this group

The analogue chemical PGE is reported to be respiratory irritant upon single or repeated inhalation exposure (NICNAS).

Skin Irritation

There are limited data available for the chemicals in this group. The chemicals DGRE, GMPE and CGE are classified as hazardous with the risk phrase 'Irritating to skin' (Xi; R38) in the HSIS (Safe Work Australia). There are limited data available to assess this classification for the chemicals.

Epon resin 1031-B-80 (containing 80 % TGOPE and 20 % methyl ethyl ketone) was reported to be minimally irritating to both intact and abraded skin of New Zealand White rabbits (three/sex/group), following an unspecified application. No further study details were available (Government of Canada, 2010).

In another skin irritation study, no dermal irritation was reported in intact skin of rabbits (five; strain and sex not specified) exposed to an unspecified application of epon resin 1031-B-80. No further study details were available (Government of Canada, 2010).

The chemical CGE is reported to be a moderate to severe skin irritant. Undiluted CGE is reported to cause severe skin irritation when observed 24 hours after application, which progressed to necrosis by 14 days after application. In another study, the chemical was reported to cause slight skin irritation that was reversible within seven days following a four-hour semi-occluded exposure (HSDB).

The analogue chemical PGE is reported to be a skin irritant (NICNAS).

Eye Irritation

There are limited data available for the chemicals in this group. The chemical DGRE is classified as hazardous with the risk phrase 'Irritating to eyes' (Xi; R36) in the HSIS (Safe Work Australia). There are insufficient data available to amend this classification for the chemical.

Epon resin 1031-B-80 (containing 80 % TGOPE and 20 % methyl ethyl ketone) was reported to be mildly irritating to non-washed and washed eyes of male New Zealand White rabbits, following an unspecified application. No further study details were available (Government of Canada, 2010).

In another eye irritation study, no eye irritation was reported in rabbits (five; strain and sex not specified) exposed to powder at an unspecified application of TGOPE (CAS No. 7328-97-4). Minor eye irritation was reported in rabbits exposed to 20 % TGOPE in PEG 400 (polyethylene glycol 400). No further study details were available (Government of Canada, 2010).

The chemical CGE is reported to be moderate to slightly irritating to the eye (HSDB).

The analogue chemical PGE is reported to be an eye irritant (NICNAS).

Sensitisation

Respiratory Sensitisation

No data are available for the chemicals in this group.

Skin Sensitisation

There are limited data available for the chemicals in this group. The chemicals DGRE, GMPE and CGE are classified as hazardous with the risk phrase 'May cause sensitisation by skin contact' (Xi; R43) in the HSIS (Safe Work Australia). There are sufficient data available to support this classification for all members in the group (refer to **Skin sensitisation: Observation in humans** section).

Epon resin 1031-B-80 (containing 80 % TGOPE and 20 % methyl ethyl ketone) was reported to not be a skin sensitiser in Dunkin-Hartley albino guinea pigs (five/sex/group), following an unspecified application. No further study details were available (Government of Canada, 2010).

The analogue chemical PGE is reported to be a skin sensitiser (NICNAS).

All the chemicals in this group have functional groups that present alerts for skin sensitisation based on their molecular structures as profiled by the OECD Quantitative Structure–Activity Relationship (QSAR) Toolbox v3.2.

Observation in humans

The chemical CGE is reported to be potent skin sensitiser (HSDB). In humans, some cases of sensitisation from topical contact with the analogue chemical PGE have been reported (HSDB).

Two case studies identifying positive allergic reactions to PGE patch tests were documented, indicating that the patients were sensitised to this compound (NICNAS).

Twenty workers in an Italian aircraft factory suffered from an outbreak of contact dermatitis. Symptoms ranged from slight erythema to strong oedematous-vesicular lesions on the upper extremities and face, but rarely on the genitalia and thighs. Patch testing was positive to the epoxy-resin material in 13/20 workers. Thin-layer chromatography identified PGE as one of the agents responsible for this outbreak of contact dermatitis (NICNAS)

In another case report, 5/40 workers with dermatitis and occupationally exposed to epoxy resins, but not to PGE, showed positive skin sensitivity reactions to PGE. With long-term exposure, cross sensitisation with other glycidyl ethers can also occur. Among 58 dermatitis patients who had been exposed occupationally to PGE, nine primarily responded to PGE (NICNAS).

Additionally it has been reported that epoxy resin systems (ERSs), including CGE and PGE, are a frequent cause of occupational allergic contact dermatitis and sensitisation. Cross sensitivity between different epoxy resins, including PGE, has been documented (HSDB).

Based on the above information the chemicals in this group are considered skin sensitisers in humans. Classification is considered warranted for all members of this group (refer to **Recommendation** section). If data become available for the individual group members, they should be used to determine individual classifications.

Repeated Dose Toxicity

Oral

No data are available for the chemicals in this group.

Dermal

No data are available for the chemicals in this group.

Inhalation

No data are available for the chemicals in this group.

Genotoxicity

There are limited data are available for the chemicals in this group. The chemicals DGRE, GMPE and CGE are classified as hazardous (Category 3 mutagenic substances) with the risk phrase ‘Possible risk of irreversible effects’ (Xn; R68) in the HSIS (Safe Work Australia). There are sufficient data available to support this classification for all members in the group.

Several in vitro assays for epon resin 1031-B-80 (containing 80 % TGOPE and 20 % methyl ethyl ketone) and DGRE gave largely positive results (Government of Canada, 2010) in the following studies:

- mostly positive results in bacterial mutation assays (various *Salmonella typhimurium* strains) with and without metabolic activation at doses between 0–5000 µg/mL);
- positive results for chromosomal aberrations in Chinese hamster ovary (CHO) cells with and without metabolic activation (doses between 0–300 µg/mL);
- both positive and negative results for gene mutation assays in mouse lymphoma cells with and without metabolic activation (doses between 0–1000 µg/mL); and
- a positive result for sister chromatid exchange assays for CHO cells (doses up to 1.6 µg/mL) without and without metabolic activation.

DGRE gave largely positive results in several in vivo genotoxicity assays including:

- both negative and positive results for micronuclei induction in B6C3F1 and ICR mice (doses up to 600 mg/kg);
- a positive result in a reciprocal translocation test in *Drosophila melanogaster* (doses up to 50000 ppm); and
- a positive result in a sex-linked recessive lethal test in *D. melanogaster* (doses up to 50000 ppm).

All the chemicals in this group have functional groups that present alerts for mutagenicity based on their molecular structures as profiled by the OECD QSAR Toolbox v3.2.

The analogue chemical PGE is reported to be a Category 3 mutagenic substances with the risk phrase ‘Possible risk of irreversible effects’ (Xn; R68) in the HSIS (NICNAS).

Classification is considered warranted for all members of this group (refer to **Recommendation** section). If data become available for the individual group members, they should be used to determine individual classifications.

Carcinogenicity

There are limited data available for the chemicals in this group. The chemical DGRE is classified as hazardous (Category 3 carcinogenic substance), with the risk phrase 'May cause cancer' (Xn; R40) in the HSIS (Safe Work Australia). There are sufficient data available to support this classification for the chemical, but there are insufficient data to support this classification for all other members in the group.

Two oral studies reported the carcinogenic potential of DGRE (approximately 88 % purity with 30 unspecified impurities, including 1.9 % 3-methylbenzoic acid ethyl ester, 1.6 % 3-chloropropoxy-benzene, 2.8 % dihydroxypropoxybenzene) in animals (Government of Canada, 2010). The chemical was administered to Fischer 344 (F344) rats (50/sex/dose) and B6C3F1 mice (50/sex/dose) by oral gavage at concentrations of 0, 12, 25 or 50 mg/kg bw and 0, 50 or 100 mg/kg bw, respectively five times/week for 103 weeks. Increased incidence of hyperkeratosis, hyperplasia, papillomas and squamous-cell carcinomas of the forestomach in rats and mice were reported in both studies. Increased incidence of hepatocellular carcinomas in mice was also reported (Government of Canada, 2010).

Studies in ICR/Ha Swiss-Webster mice exposed dermally to 1 % solution of DGRE

(purity not specified) in benzene (approximately 100 mg/application) thrice weekly for life, reported no treatment-related effects in the incidence of systemic or dermal tumours (Government of Canada, 2010).

The analogue chemical PGE is reported to be a Category 2 carcinogenic substance, with the risk phrase 'May cause cancer' (T; R45) in the HSIS (NICNAS).

The carcinogenic potential of the other members of the group cannot be ruled out, given the central role that the epoxy group is anticipated to play in carcinogenic activity. If data become available for the individual group members, they should be used to determine individual classifications.

Reproductive and Developmental Toxicity

No data are available for the chemicals in this group.

The analogue chemical PGE is reported to have no specific reproductive or developmental toxicity (NICNAS).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include systemic long-term effects (potential carcinogenicity and mutagenicity) and local effects (skin sensitisation). Components with crosslinking epoxy rings (the chemicals DGRE and TGOPE) will be of particular concern for carcinogenicity (refer to **Grouping rationale** section). Local irritant properties also cannot be excluded.

Public Risk Characterisation

Although the public could be exposed to the chemicals through potential domestic and commerical uses at low concentrations and in products where the chemicals are not readily bioavailable (refer to **Import, manufacture & use** section), the exposure is considered to be low as use of epoxy resins is expected to be sporadic and the chemicals can be managed through appropriate labelling. Thus, the chemicals are not considered to pose an unreasonable risk to public health.

Occupational Risk Characterisation

During product formulation, oral, dermal and ocular exposure of workers to the chemicals might occur, particularly where manual or open processes are used. These can include transfer and blending activities, quality control analysis, and cleaning and maintaining equipment. Worker exposure to the chemicals at lower concentrations can 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 systemic long-term health effects, the chemicals may pose an unreasonable risk to workers unless adequate control measures to minimise inhalation exposure to the chemicals 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 appropriate controls.

The data available support an amendment to the hazard classification in HSIS (refer to **Recommendation** section).

NICNAS Recommendation

Assessment of these chemicals is considered to be sufficient, provided that the recommended amendments to the classification are adopted, and labelling and all other requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Regulatory Control

Public Health

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

Work Health and Safety

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

The classifications proposed below are based on analogues (refer to section on **Grouping rationale**). It should be used as a default for all members of the group. If empirical data become available for any member of the group indicating that a lower (or higher) classification is appropriate for the specific chemical, these may be used to amend the default classification for that chemical.

Note 1: The acute oral, acute dermal, eye irritation and carcinogenicity classifications apply to only DGRE (CAS No. 101-90-6).

Note 2: The skin irritation classifications apply to DGRE, GMPE (CAS No. 2210-79-9) and CGE (CAS No. 26447-14-3).

Note 3: The skin sensitisation and genotoxicity classifications applies to all members of this group. If data become available for the individual group members, they should be used to determine individual classifications.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Acute Toxicity	Harmful if swallowed (Xn; R22)* Harmful in contact with skin (Xn; R21)*	Harmful if swallowed - Cat. 4 (H302) Harmful in contact with skin - Cat. 4 (H312)
Irritation / Corrosivity	Irritating to eyes (Xi; R36)* Irritating to skin (Xi; R38)*	Causes serious eye irritation - Cat. 2A (H319) Causes skin irritation - Cat. 2 (H315)
Sensitisation	May cause sensitisation by skin contact (Xi; R43)	May cause an allergic skin reaction - Cat. 1 (H317)
Genotoxicity	Muta. Cat 3 - Possible risk of irreversible effects (Xn; R68)	Suspected of causing genetic defects - Cat. 2 (H341)
Carcinogenicity	Carc. Cat 3 - Limited evidence of a carcinogenic effect (Xn; R40)*	Suspected of causing cancer - Cat. 2 (H351)

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

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

[*] Existing Hazard Classification. No change recommended to this classification

Advice for consumers

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

Advice for industry

Control measures

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

- health monitoring for any worker who is at risk of exposure to the chemicals, if valid techniques are available to monitor the effect on the worker's health;
- minimising manual processes and work tasks through automating processes;
- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemicals.

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

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

Obligations under workplace health and safety legislation

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

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

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

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

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

References

ASM International (2001). ASM handbook. Volume 21, Epoxy Resins. Materials Park, OH, ASM International. **http://app.knovel.com/hotlink/toc/id:kpASMHVC13/asm-handbook-volume**.

Chemical Abstracts Service (SciFinder) a division of the American Chemical Sociey. Accessed March 2015 at **http://www.cas.org/products/scifinder**

ChemIDPlus Advanced. Accessed April 2015 at **http://chem.sis.nlm.nih.gov/chemidplus/**

Cosmetic Ingredients and Substances (CosIng). Accessed April 2015 at **http://ec.europa.eu/consumers/cosmetics/cosing/**

Galleria Chemica. Accessed April 2015 at **http://jr.chemwatch.net/galeria/**

Globally Harmonised System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third edition. Accessed at **http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html**

Government of Canada (2010). Final Screening Assessment on Oxirane, 2,2',2",2"'-[1,2-ethanediylidenetetrakis(4,1-phenyleneoxymethylene)]tetrakis- (CAS No. 7328-97-4). Accessed May 2015 at **https://www.ec.gc.ca/ese-ees/34C616CE-D397-44C9-8851-694DE31A29F0/batch9_7328-97-4_en.pdf**.

Hazardous Substances Data Bank (HSDB). National Library of Medicine. Accessed April 2015 at **http://toxnet.nlm.nih.gov**

National Industrial Chemical Notification and Assessment Scheme (NICNASa). Tier II human health assessment for Oxirane, (phenoxymethyl)- (CAS No. 122-60-1). Australian Government Department of Health. Accessed at **http://www.nicnas.gov.au/chemical-information/imap-assessments/imap-assessment-details?assessment_id=18**

OECD QSAR Toolbox version 3.2. **http://www.oecd.org/chemicalsafety/assessmentofchemicals/theoecdqsartoolbox.htm**

Safe Work Australia (SWA). Approved Criteria for Classifying Hazardous Substances, 3rd Edition [NOHSC: 1008 (2004)]. Accesssd Mar 2015 at **http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/258/ApprovedCriteria_Classifying_Hazardous_Substances_NOHSC1008-2004_PDF.pdf**

Safe Work Australia (SWA). Hazardous Substances Information System (HSIS). Accessed April 2015 at **http://hsis.safeworkaustralia.gov.au/HazardousSubstance**.

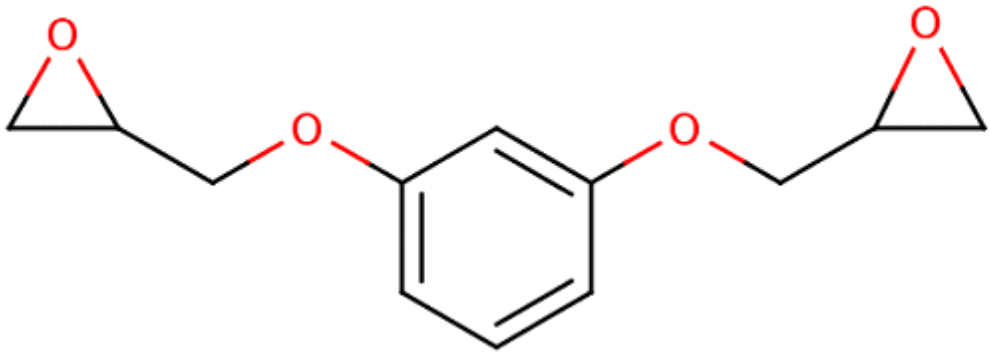
Substances in Preparations in Nordic Countries (SPIN). Accessed January 2015 at **http://188.183.47.4/dotnetnuke/Home/tabid/58/Default.aspx**

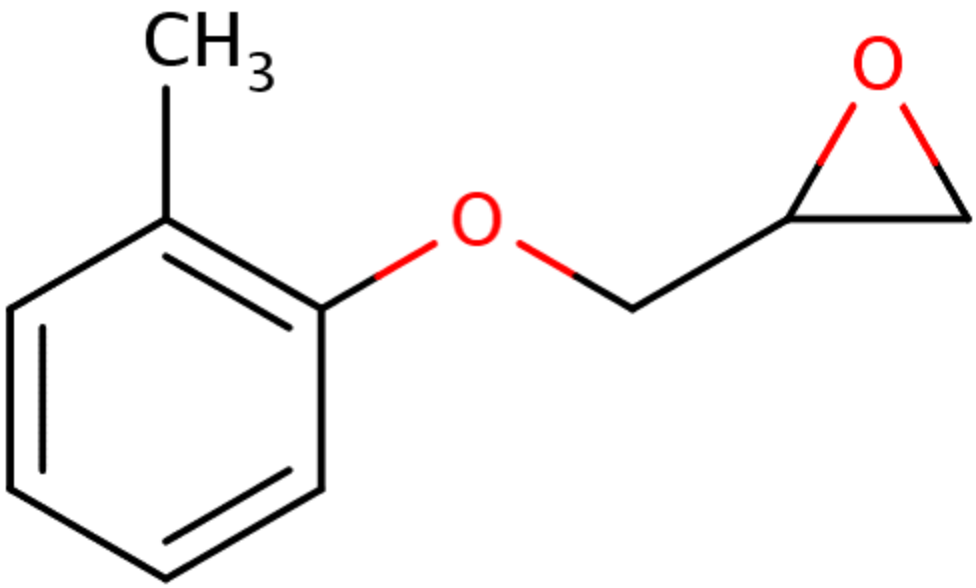
US Department of Health and Human Services, Household Products Database, Health and safety information on household products. Accessed May 2015 at **http://householdproducts.nlm.nih.gov/**

Last Update 03 July 2015

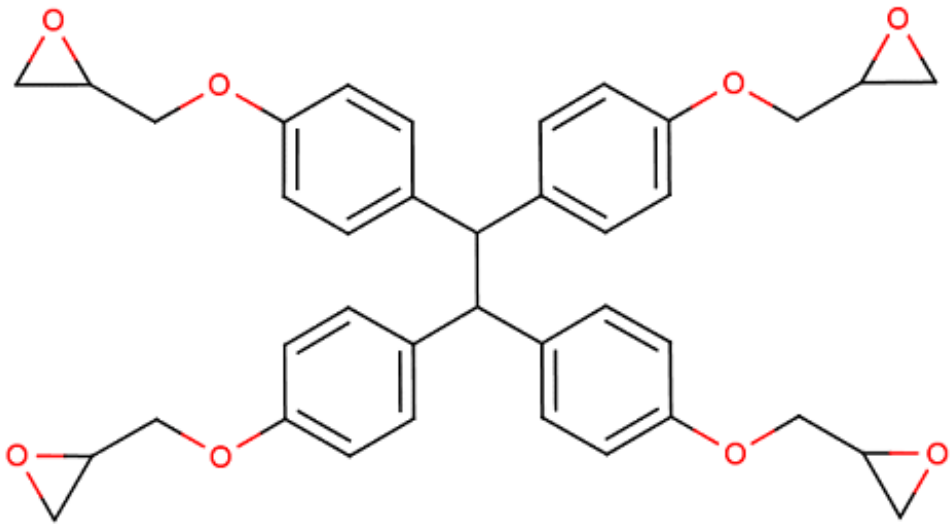
Chemical Identities

Chemical Name in the Inventory and Synonyms	**Oxirane, 2,2'-[1,3-phenylenebis(oxymethylene)]bis-** diglycidyl resorcinol ether (DGRE) resorcinol diglycidyl ether m-bis(glycidyloxy)benzene resorcinol bis(2,3-epoxypropyl) ether 1,3-diglycidyloxybenzene

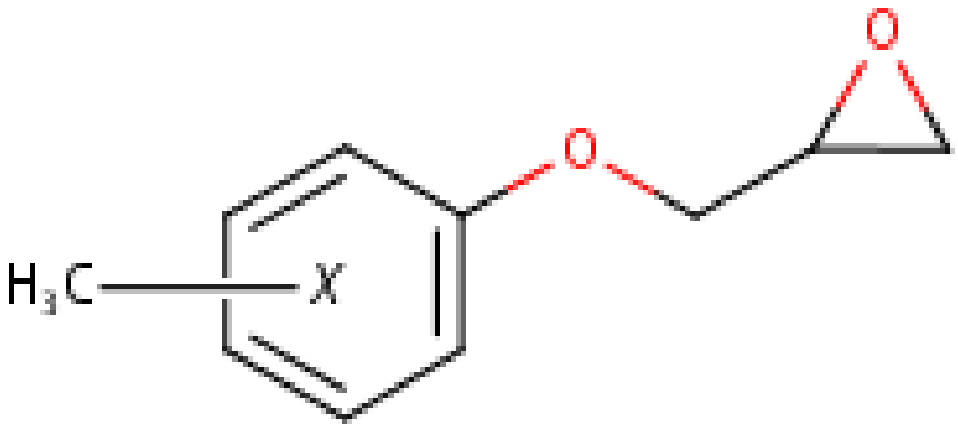
CAS Number	101-90-6
Structural Formula	
Molecular Formula	C12H14O4
Molecular Weight	222.24

Chemical Name in the Inventory and Synonyms	**Oxirane, [(2-methylphenoxy)methyl]-** glycidyl o-methylphenyl ether (GMPE) o-cresol, glycidyl ether 2,3-epoxypropyl o-tolyl ether 2-methylphenyl glycidyl ether 1,2-epoxy-3-(o-tolyloxy)propane
CAS Number	2210-79-9
Structural Formula	
Molecular Formula	C10H12O2
Molecular Weight	164.20

Chemical Name in the Inventory and Synonyms	**Oxirane, 2,2',2'',2'''-[1,2-ethanediylidenetetrakis(4,1-phenyleneoxymethylene)]tetrakis-** 1,1,2,2-tetrakis(p-glycidyloxyphenyl)ethane (TGOPE)

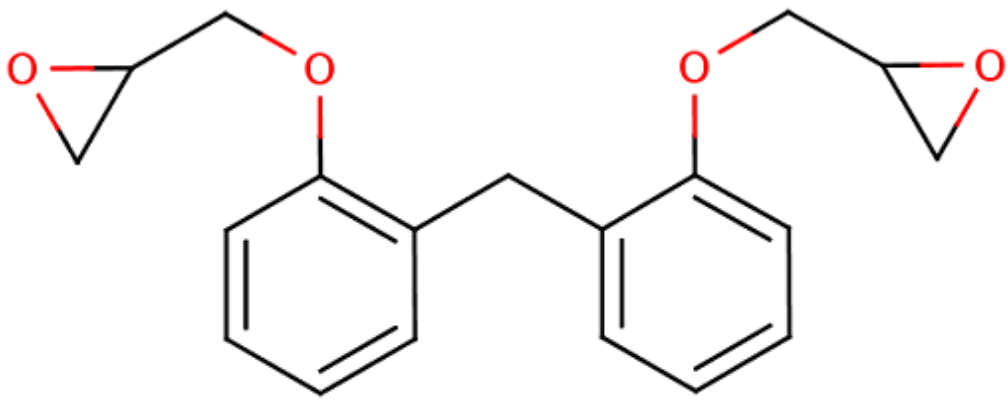
	tetraphenylolethane, epichlorohydrin epoxy resin ethane, 1,1,2,2-tetrakis(p-(2,3-epoxypropoxy)phenyl)- 2,2',2'',2'''-(ethane-1,2-diylidenetetrakis(p-phenyleneoxymethylene))tetraoxirane epon resin 1031
CAS Number	7328-97-4
Structural Formula	
Molecular Formula	C38H38O8
Molecular Weight	622.71

Chemical Name in the Inventory and Synonyms	**Oxirane, [(methylphenoxy)methyl]-** cresyl glycidyl ether (CGE) (tolyloxy)methyl]oxirane ((methylphenoxy)methyl)oxirane glycidyl methylphenyl ether 1,2-epoxy-3-(tolyloxy)propane
CAS Number	26447-14-3
Structural Formula	

	
Molecular Formula	C10H12O2
Molecular Weight	165.21

Chemical Name in the Inventory and Synonyms	**Formaldehyde, polymer with (chloromethyl)oxirane and methylphenol** cresol, formaldehyde, epichlorohydrin polymer (CFEP) formaldehyde, cresol, epichlorohydrin polymer formaldehyde, polymer with 2-(chloromethyl)oxirane and methylphenol epichlorohydrin, cresol, formaldehyde polymer formaldehyde, polymer with (chloromethyl)oxirane and methylphenol
CAS Number	37382-79-9
Structural Formula	**No Structural Diagram Available**

Molecular Formula	(C7H8O.C3H5ClO.CH2O)x
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Oxirane, 2,2'-[methylenebis(2,1-phenyleneoxymethylene)]bis-** methylenebis[o-phenol (MP) methylenebis(2-gylcidyloxyphenyl) methylenebis(o-phenol), 3-propylene oxide ether 2,2'-(methylenebis(o-phenyleneoxymethylene))bisoxirane oxirane, 2,2'-(methylenebis(2,1-phenyleneoxymethylene))bis-
CAS Number	54208-63-8
Structural Formula	
Molecular Formula	C19H20O4
Molecular Weight	312.36

Share this page